Arguing over Technology:
The Coproduction of Business Practices and International Maritime Environmental Regulation

D I S S E R T A T I O N
of the University of St.Gallen,
School of Management,
Economics, Law, Social Sciences,
International Affairs and Computer Science,
to obtain the title of
Doctor of Philosophy in International
Affairs and Political Economy

submitted by

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Dissertation no. 5049

Difo-Druck GmbH, Untersiemau 2021

The University of St.Gallen, School of Management, Economics, Law, Social Sciences, International Affairs and Computer Science hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St.Gallen, October 20, 2020

The President:

Prof. Dr. Bernhard Ehrenzeller

Acknowledgments

This dissertation has greatly benefitted from the help and support provided by many persons. For their great inspiration and very constructive feedback throughout this project, I wish to express my sincere gratitude to the three members of my PhD committee: James W. Davis and Klaus Dingwerth at the University of St.Gallen, and Jon Birger Skjærseth at the Fridtjof Nansen Institute in Norway. Special thanks go to the Institute of Political Science at the University of St.Gallen for the generous funding of my field research and of several conference participations.

The empirical research I conducted would not have been possible without the opportunity to attend and observe several committee meetings of the International Maritime Organization (IMO). I thank the Swiss Maritime Navigation Office very much for taking me on board the Swiss delegation to the Marine Environment Protection Committee. I also thank all those IMO delegates and maritime professionals who gave me insights into regulatory processes.

The quality of my dissertation has benefitted from multiple exchanges within the Department of Political Science at the University of St.Gallen and at academic conferences. I wish to thank the colleagues from our department as well as the numerous conference participants who raised helpful questions and critique on different parts of my dissertation. I am grateful for two conference travel grants provided by the Swiss Academy of Humanities and Social Sciences (SAGW).

Finally, I would like to wholeheartedly thank my wife Elisa, my family, and my friends. Your strong and continued support throughout the past five years made this dissertation possible.

St.Gallen, October 2020 Benjamin Hofmann

Contents

Figures and Tables

Acronyms and Abbreviations

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area
AECO	Association of Arctic Expedition Cruise Operators
ATS	Antarctic Treaty System
BIMCO	The Baltic and International Maritime Council
CAA	Clean Arctic Alliance
CCU	Circumpolar Conservation Union
CESA	Committee of EU Shipbuilders' Associations
CFCs	Chlorofluorocarbons
CLIA	Cruise Lines International Association
CSC	Clean Shipping Coalition
DNV	Det Norske Veritas (now DNV GL)
DE	Sub-Committee on Ship Design and Equipment of the IMO
ECC	European Cruise Council
EEDI	Energy Efficiency Design Index
EU	European Union
EUROMOT	European Association of Internal Combustion Engine Manufacturers
FOEI	Friends of the Earth International
HELCOM	Baltic Marine Environment Protection Commission (Helsinki Commission)
HFO	Heavy Fuel Oil
ICAO	International Civil Aviation Organization
ICCT	International Council on Clean Transportation
ICS	International Chamber of Shipping
IEA	International Energy Agency
IEADB	International Environmental Agreements Database
IFAW	International Fund for Animal Welfare
IMER	International Maritime Environmental Regulation Database, database developed for this dissertation
IMO	International Maritime Organization
INTERTANKO	International Association of Independent Tanker Owners
IOGP	International Association of Oil and Gas Producers

IPCC	Intergovernmental Panel on Climate Change
IRD	International Regimes Database
LNG	Liquefied Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environmental Protection Committee of the IMO
NGO	Nongovernmental organization
OCIMF	Oil Companies International Marine Forum
OECD	Organisation for Economic Co-operation and Development
OSCOM	Oslo Commission (established by Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft)
OSPAR	Mechanism for the protection of the marine environment of the North-East Atlantic (named after former Oslo and Paris Conventions/Commissions)
PAME	Protection of the Arctic Marine Environment Working Group of the Arctic Council
PARCOM	Paris Commission (established by Convention for the Prevention of Marine Pollution from Land-Based Sources)
POPs	Persistent organic pollutants
PPR	Sub-Committee on Pollution Prevention and Response of the IMO
ROPME	Regional Organization for the Protection of the Marine Environment (of the ROPME Sea area, covering the Gulfs area and parts of the Oman Sea)
SPREP	Secretariat of the Pacific Regional Environment Programme
UNCTAD	United Nations Conference on Trade and Development
UNECE LRTAP	United Nations Economic Commission for Europe Convention on Long-Range Transboundary Air Pollution
US EPA	United States Environmental Protection Agency
VTT	Technical Research Centre of Finland
WSC	World Shipping Council
WWF	World Wide Fund For Nature

Abstract

This dissertation explores the puzzle that international environmental regulations seem to develop dynamically despite the close involvement of business actors in their making. First, the dissertation asks to what extent international regulations are designed to really exert control over corporate environmental conduct. I conceptualize the notion of regulatory stringency, develop a novel stringency index, and use it to gather data on the regulation of environmental impacts of maritime shipping and offshore oil and gas production. The descriptive statistical data analysis finds that numerous regulations go beyond window-dressing as they require improvements in environmental performance and aim at eliciting compliance with these requirements. Among several patterns of regulatory variance, the analysis shows that international organizations with strong business participation produce relatively high shares of stringent regulation.

Second, the dissertation asks how and to what extent business and its environmental practices can influence or shape contentious decisions in international regulatory design. I develop the theory of argumentative coproduction which posits that corporate environmental practices can tip the scales when regulators argue over technology. Building on psychological assumptions about consistency-seeking decision-makers, I argue that progressive environmental practices of first-mover companies provide powerful evidence for the feasibility of more stringent regulation. My theory differs from models which highlight ideas of activists and scientists or interests and power resources of materially dominant corporations and states as drivers of regulation. The explanatory power of the different models is probed in two qualitative case studies of shipping regulation by the International Maritime Organization.

The case studies find that the empirical observations are most congruent with argumentative coproduction. In the regulation of nutrient inputs from passenger ships in the Baltic Sea, arguments for demanding standards prevailed thanks to the development and uptake of new sewage treatment technology by a few first-mover firms. In the regulation of fuel use in Arctic shipping, the voluntary transition to cleaner fuels by ever more companies facilitated the development of a ban of heavy fuel oil. The findings suggest that international environmental regulations develop dynamically not despite but because of business involvement in negotiations. The dissertation concludes that green first-mover businesses are constructive partners in international environmental politics and should therefore be involved more systematically into regulatory processes.

Zusammenfassung

Diese Dissertation untersucht das Rätsel, dass sich internationale Umweltregulierungen dynamisch zu entwickeln scheinen, obwohl Wirtschaftsakteure eng in deren Entstehung eingebunden sind. Erstens fragt die Arbeit, inwiefern internationale Regulierungen darauf ausgelegt sind, wirklich Kontrolle über das Umweltverhalten von Unternehmen auszuüben. Ich konzeptualisiere den Begriff der regulatorischen Strenge, entwickle einen neuen Strenge-Index, und nutze diesen für eine Datensammlung zur Regulierung von Umweltauswirkungen der Seeschifffahrt und Offshore Öl- und Gasproduktion. Die deskriptiv-statistische Datenanalyse zeigt, dass zahlreiche Regulierungen über Augenwischerei hinausgehen, indem sie Fortschritte in der Umweltperformanz vorschreiben und darauf abzielen, die Einhaltung dieser Vorschriften zu bewirken. Als eines von mehreren Mustern regulatorischer Varianz zeigt sich, dass internationale Organisationen mit starker Partizipation der Wirtschaft hohe Anteile an strenger Regulierung produzieren.

Zweitens fragt die Arbeit, wie und inwieweit Unternehmen und ihre Umweltpraktiken umstrittene Entscheidungen in der Gestaltung internationaler Regulierungen beeinflussen oder formen können. Ich entwickle die Theorie der argumentativen Koproduktion, wonach Umweltpraktiken von Unternehmen in regulatorischen Disputen über Technologie ausschlaggebend sein können. Aufbauend auf psychologischen Annahmen über Konsistenz suchende Entscheider argumentiere ich, dass die progressiven Umweltpraktiken von Vorreiterunternehmen wirkmächtige Belege für die Machbarkeit strengerer Regulierung liefern. Meine Theorie unterscheidet sich von Modellen, die Ideen von Aktivisten und Wissenschaftlern oder Interessen und Machtressourcen materiell dominierender Unternehmen und Staaten als Treiber von Regulierung hervorheben. Die Erklärungskraft der verschiedenen Modelle wird anhand zweier qualitativer Fallstudien von Schifffahrtsregulierungen der Internationalen Seeschifffahrts-Organisation erprobt.

Im Ergebnis der Fallstudien sind die empirischen Beobachtungen am kongruentesten mit der Theorie der argumentativen Koproduktion. Bei der Regelung von Nährstoffeinträgen von Passagierschiffen in der Ostsee reüssierten Argumente für anspruchsvolle Standards dank der Entwicklung und Anwendung neuer Abwasserreinigungstechnik durch einige Vorreiterfirmen. Bei der Regulierung von Schiffstreibstoffen in der Arktis unterstützte der freiwillige Umstieg auf sauberere Treibstoffe durch immer mehr Unternehmen die Entwicklung eines Schwerölverbots. Die Ergebnisse legen nahe, dass internationale Umweltregulierungen sich nicht trotz, sondern wegen der Einbindung der Wirtschaft in Verhandlungen dynamisch entwickeln. Die Dissertation folgert, dass grüne Vorreiterunternehmen konstruktive Partner in der internationalen Umweltpolitik sind und daher systematischer in Regulierungsprozesse eingebunden werden sollten.

1 Introduction

Over the past 70 years, states have adopted a vast number of international rules, standards, and guidelines to control negative environmental impacts of industrial activities. An early example was the regulation of oil discharges from ships in 1954. Since then, the International Maritime Organization (IMO) has regulated many environmental impacts of ships, including discharges of noxious substances, sewage, and garbage, emissions of air pollutants, and the introduction of invasive species. In parallel, regional seas organizations have addressed other sources of marine pollution like offshore hydrocarbon production, waste dumping, and various land-based sources. International regulation has not been confined to the marine environment. In the realm of air pollution, the Montreal Protocol of 1987 has regulated the production and use of ozone-depleting substances. Instruments under the UNECE Convention on Long-range Transboundary Air Pollution have controlled emissions of nitrogen oxides, sulfur, and other pollutants causing acid rain and human health problems. International provisions have also been developed on chemical pollution, including persistent organic pollutants, hazardous wastes, pesticides, and mercury. Indeed, many international responses by states to environmental problems have taken a regulatory form (Gehring 2008; M. A. Levy, Keohane, and Haas 1993, 404; O. R. Young 2014, 279).

Today, environmental regulation continues to be a dynamic area of international cooperation. The heyday of international environmental cooperation may be over as far as the creation of new treaties is concerned (Hale, Held, and Young 2013, 216, 234; Mitchell et al. 2020, 5). Yet, states continue to review, amend, and extend existing regulation (Gehring 2008). In 2016, they amended the Montreal Protocol to regulate hydrofluorocarbons, which have replaced ozone depleting substances but contribute to global warming. In 2017, the IMO adopted stricter limit values for nitrogen oxide emissions from ships in the Baltic and North Seas. In 2019, the parties to the Stockholm Convention decided to eliminate or further restrict the use of certain industrial chemicals which are classified as persistent organic pollutants. States also continue to develop entirely new international regulations. In 2017, the International Civil Aviation Organization (ICAO) adopted the first global carbon dioxide emission standard for aircraft. In 2019, the coastal states of West, Central, and South Africa signed a new protocol with environmental requirements for offshore oil and gas activities. Currently, the International Seabed Authority (ISA) is developing exploitation regulations for deep-seabed mining and the IMO is discussing greenhouse gas reduction measures for ships. Hence, the body of international environmental regulation seems to keep growing.

At the same time, business actors have become closely involved in the negotiation of international regulations targeting their environmental conduct (Ratner 2008). Shipping is probably the most striking example: business representatives take part in IMO meetings both through industry associations with consultative status and as members of national delegations. Similarly, industry representatives have joined national delegations in negotiations on ozone-depleting substances (Falkner 2008, 74; Litfin 1994, 107). In many other areas, business actors hold at least observer status in regulatory negotiations. This includes the bodies regulating persistent organic pollutants and hazardous wastes, and regional seas organizations like the OSPAR Commission for the North-East Atlantic. Even without observer status, business is frequently consulted. Examples are the Arctic Council and the Abidjan Convention that govern maritime activities in the Arctic Ocean and along the Western coast of Africa, respectively. In both cases, oil industry associations without formal status in these organizations were invited to meetings in relation to the development of offshore oil and gas standards (IOGP 2018; PAME 2008, appendix I, 5). Thus, business is never far away when states develop new regulations for corporate conduct.

The Puzzle: Dynamic Regulation Despite Business Involvement?

According to conventional wisdom, it seems puzzling that international environmental regulation has developed so dynamically while regulatory targets are closely involved in its making. One might expect that profit-oriented businesses oppose any regulation that requires them to implement more costly environmental practices. This opposition should usually succeed given the large lobbying resources of business compared to other actors, such as environmental nongovernmental organizations (NGOs) (Lund 2013). But how come then that new regulations have emerged for shipping in Arctic waters, hydrocarbon extraction along the Atlantic coast of Africa, carbon dioxide emissions of aircraft, industrial chemicals, and many other environmental impacts of industry? My dissertation explores this overarching puzzle within the specific area of international maritime environmental regulation. As I am going to explain later in this introductory chapter, the properties of shipping and offshore oil and gas render these maritime industries well-suited for examining the puzzle from different angles.

The puzzle of dynamic international environmental regulation under business participation can be approached from two angles. One angle is to critically assess the design of international regulation. It could be argued that only toothless regulation sees the light of the day because of a policymaking process that is characterized by insincerity and hypocrisy (Stevenson 2020, 2) and captured by business actors. Capture regulation does not force real changes in corporate conduct and hence does not serve the public interest (Mattli and Woods 2009, 4–5). Moreover, states without overlapping interests in regulatory harmonization may agree on sham standards "to relieve or redirect any domestic or civil society pressure for significant global regulations" (Drezner 2008, 81). Some examples of regulations seem to support this possibility: environmental guidelines for offshore oil and gas production in the Arctic are neither mandatory nor precise (Offerdal 2007, 146); and carbon dioxide standards for new aircraft in 2028 do not require emission reductions beyond present performance levels (ICCT 2018a). By contrast, other regulations seem to have more teeth: existing bans of ozone-depleting chlorofluorocarbons and persistent organic pollutants are legally binding and have required substantial externality reductions (P. M. Haas 1992a, 212–14; Krueger and Selin 2002, 335–38). These examples suggest that the picture of regulatory design may be one of diversity rather than just capture, sham, and window-dressing. Yet, there is no systematic empirical assessment that could substantiate this impression. While ample data exists on international environmental agreements and regimes (e.g., Breitmeier, Young, and Zürn 2006b; Mitchell 2020), data on the design of the individual regulations embedded in them is scarce.

A systematic empirical assessment of the quality of international environmental regulations is important because it constitutes the starting point for causal inquiries. Accordingly, and with an empirical focus on maritime regulations, the first research question of my dissertation asks: *To what extent are international environmental regulations designed to exert control over corporate environmental conduct?* I assess whether and when regulations go beyond mere window-dressing by requiring major improvements in corporate environmental practices and aiming at the elicitation of corporate compliance with these requirements. This assessment presupposes conceptual tools suitable for comparing the design of international environmental regulations and empirical data for identifying patterns of variance. In answering the research question, I therefore propose two innovations: I develop the novel concept of regulatory stringency to assess the quality of international environmental regulations that eventually target business behavior. Moreover, I compile new stringency data on international environmental regulations of maritime shipping and offshore oil and gas production. The data analysis is going to demonstrate that a sizeable part of regulations in these industries is designed in ways that go beyond mere window-dressing in the control of corporate conduct.

Another angle to approach the puzzle of dynamic regulation under business involvement is to examine the role of business actors in international regulatory negotiations. Some scholars would argue that proper regulation can emerge *despite* business involvement in its development. They hold that networks of non-business actors, including activists and scientists, can facilitate international environmental cooperation. These networks comprise environmental NGOs (Betsill and Corell 2008), transnational advocacy coalitions (Keck and Sikkink 1998), and epistemic communities (P. M. Haas 1989; 1992a). Major disasters as well as high uncertainty are two conditions under which activists and scientists may gain influence. Their ideas can inspire policies that force new technologies and practices on business.

Other scholars would argue that regulation does not emerge *despite* but *because of* business involvement. DeSombre (2000) has shown that environmental NGOs and industry have repeatedly joined forces in pushing for an internationalization of US domestic environmental regulation. One of her examples is the internationalization of protection measures for sea turtles in shrimp fishing (DeSombre 2000, 61–64, 179–91): In the US, domestic legislation required fishers to install so-called turtle excluder devices on their shrimp nets. Both environmentalists and US shrimp fishers then pushed for an internationalization of this practice to achieve their protection targets and avoid cheap competition, respectively. Following economic pressure by the US on other states, turtle excluder devices became codified in an inter-American agreement with 15 contracting states. This example suggests that environmental and economic interests are not necessarily opposed; and that international regulation may codify preexisting best practices of business.

Business has increasingly become understood as a non-unitary actor with diverse interests. A growing literature has identified conditions under which certain companies adopt proactive environmental strategies, while others remain reactive (e.g., Kolk and Levy 2001; Meckling 2015; Skjærseth and Skodvin 2003; Vormedal and Skjærseth 2019). Amongst others, this research shows that some companies can economically benefit from regulation, for instance, those with superior environmental technology. A classic example is the large US chemical company DuPont with its strong capacity to research and develop substitutes for ozone-depleting chlorofluorocarbons (CFCs) (Maxwell and Briscoe 1997, 281). The company's announcement to end CFC production facilitated agreement among states to rapidly phase out CFCs under the Montreal Protocol. This regulatory decision has been explained primarily with the technological, lobbying, and market power of DuPont (Falkner 2005b; 2008; Maxwell and Briscoe 1997). Similar developments can be observed in climate politics, where progressive business strategies have contributed to the rise of emissions trading as well as to the legally binding Paris Agreement (Meckling 2011; 2018; Vormedal 2012).

The role of business in international environmental politics is not only about interests but also about practices and expertise. In their study of global business regulation, Braithwaite and Drahos (2000, 560–62) discovered that regulation is sometimes modelled after first-mover practices of progressive companies. In the ozone case, DuPont not only supported a phaseout of CFCs politically; it also made announcements that underscored the practical feasibility of such a move (Maxwell and Briscoe 1997, 282–83). Technology assessments by industry experts identified further possibilities for reducing ozone-depleting substances (Parson 2003, 9–10). It is doubtful though whether these processes can be understood in purely material terms. For instance, Litfin (1994, 95) has argued that the availability of CFC substitutes was not a mere material fact but rather subject to perception and interpretation. On a more general note, the field of science and technology studies suggests that technology and knowledge are not neutral realities but subject to social construction and contestation (Bijker 1987; Callon 1980; Jasanoff 2006). This line of scholarship has argued that technological innovation is multidirectional rather than linear; and that rhetoric and arguments play a role in stabilizing one out of several possible process outcomes (Pinch and Bijker 1987, 28–46). By implication, the business practices that may inform regulatory decisions are potentially contested. Such contestation has not been systematically examined as an aspect of international regulatory negotiations yet.

The idea that new technologies and practices of business may be at the roots of international environmental regulation would be a counterintuitive solution to our puzzle. As alluded to above, existing theories make competing predictions about whether and how such a causal influence is possible. Therefore, the second research question of the dissertation asks: *How and to what extent can business and its environmental practices influence or shape contentious decisions about international regulatory design?* In particular, I am interested in the impact that business practices may or may not have on regulation in situations where the state of technology is contested. To answer the research question, propositions about business influence need to be integrated into a theory of international environmental negotiations. I accomplish this by developing a new theoretical model of the argumentative coproduction of corporate practices and regulatory decisions. I probe its explanatory power compared to existing approaches in two case studies of recent international shipping regulations. Below, I provide short previews of my arguments, findings, and contributions in relation to the two research questions.

Mapping International Environmental Regulation

The first part of the dissertation explores to what extent international environmental regulations are of a quality that exceeds mere window-dressing in the control of corporate conduct. By mapping maritime regulations, I am going to show that many of them are designed in ways that are likely to require improvements in corporate environmental practices and elicit corporate compliance with these requirements. This section previews the conceptual argument and empirical findings of that first part. I outline the novel concept of regulatory stringency, describe the empirical analysis of regulatory stringency in maritime industries, and highlight the resulting contributions to academic literature and regulatory practice.

The Novel Concept of Regulatory Stringency

My conceptual argument is that the design of international environmental regulation can be fruitfully captured and compared in terms of regulatory stringency. Stringency covers those formal and substantives properties of regulations that matter for the control of corporate behavior. Stringent regulation requires targeted corporations to implement significant behavioral changes and leaves them with little room to deviate from these requirements. It is thus formally tight and substantively ambitious. Conversely, lax regulation, which comes closest to the idea of window dressing, is loose in form and unambitious in substance. This means that it requires almost no behavioral change from businesses or leaves them with considerable leeway to deviate from the requirements. Other combinations of formal tightness and substantive ambition fall in between these poles of stringent and lax regulation.

The formal tightness and substantive ambition of a regulation reflect three design elements each. Formal tightness denotes the legal character of a regulation, the precision of its provisions, and the strength of its monitoring and enforcement system. Together, these design elements circumscribe the leeway that regulatory targets have in complying with substantive provisions. Regulations are formally tight when they are legally binding, precise, and have a strong monitoring and enforcement system. Regulations are loose when they are nonbinding, imprecise, and lack monitoring and enforcement provisions. The substantive ambition of a regulation refers to its scope as well as to its requirement levels in terms of externality reduction and in global comparison. These three elements jointly determine the extent of behavioral change that a regulation requires from compliant actors compared to nonregulation. Regulations are substantively ambitious when they cover all pollution sources, virtually eliminate the targeted externality, and go beyond requirements of similar regulations in other regions. They are unambitious when they spare the major pollution sources, only require small externality reductions, and are less demanding than similar regulations elsewhere.

Regulatory stringency extends concepts that scholars at the intersection of international relations and international law have traditionally used to study international regimes and agreements (Hafner-Burton, Victor, and Lupu 2012, 72–82). The concept of legalization focuses on the formal side of rules and defines the hardness of law as a function of obligation, precision, and delegation (Abbott et al. 2000, 401–2). Depth deals with the substantive side and designates the amount of change in state behavior that a treaty requires (Downs, Rocke, and Barsoom 1996, 383). An approach encompassing both formal and substantive design is the triangle of legality, substance, and structure. This framework assesses whether agreements are legally binding, what change from the status quo they require, and how they monitor compliance and sanction noncompliance (Raustiala 2005, 581). This framework as well as the concepts of legalization and depth have proven useful for studying international regimes and agreements.

The stringency concept moves empirical research from the general design of regimes and agreements to the more specific design of their embedded regulations. This is a continuation of recent research which has disaggregated international environmental regimes and found that regulatory design has implications for regime effectiveness (Stokke 2012, 234). Stringency closes the gaps that emerge when traditional design concepts are used to assess rules, standards, and guidelines as micro-foundations of regimes and agreements. Stringency is more comprehensive than many existing concepts because it accommodates both formal and substantive regulatory design. Moreover, it considers the eventual targets of regulation by capturing design elements that appear particularly relevant for controlling corporate behavior. The proposed concept also innovates in terms of operationalization by aggregating information on formal and substantive design in a stringency index. This quantitative index allows for highly condensed comparisons across regulations.

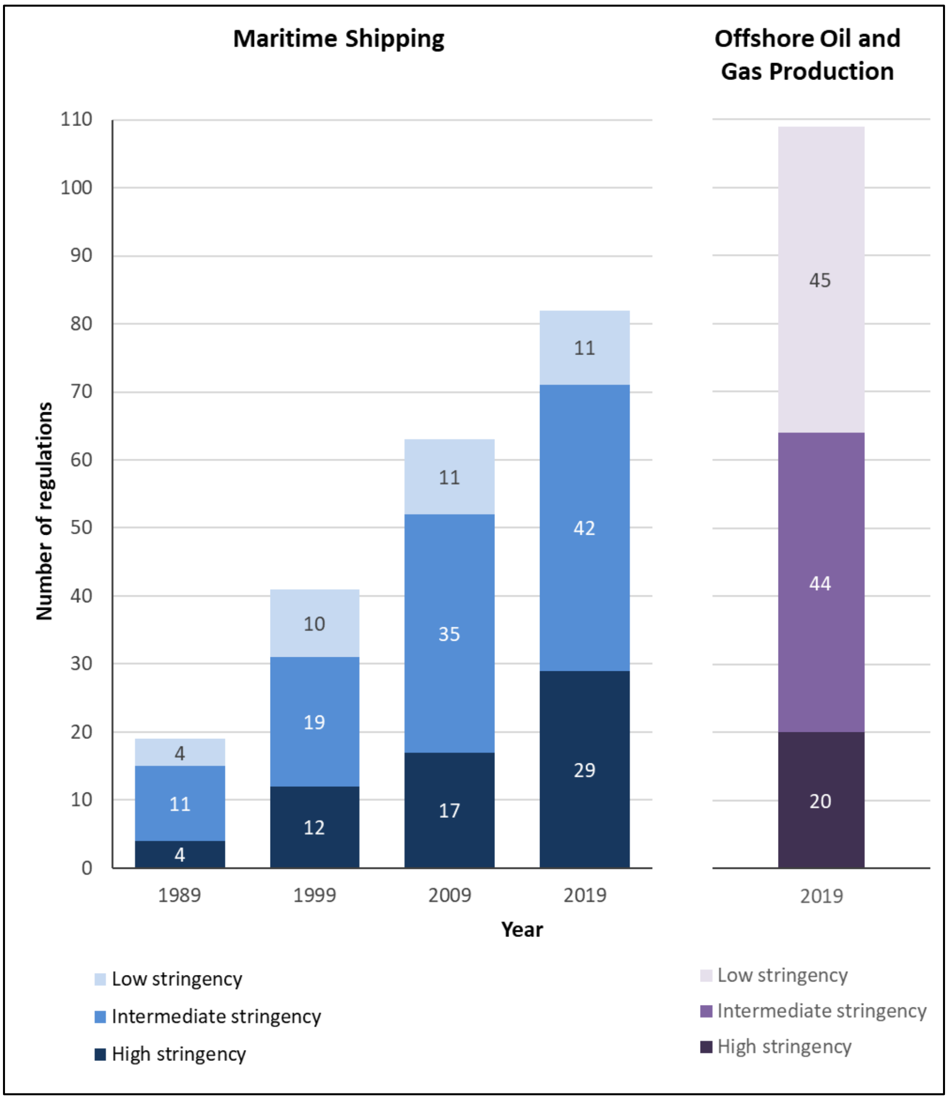
Data on the Stringency of International Maritime Environmental Regulations

I apply the stringency concept to international environmental regulations in two maritime industries. The International Maritime Environmental Regulation (IMER) Database developed for this dissertation covers all international shipping regulations in 1989, 1999, 2009, and 2019, as well as all offshore oil and gas regulations in 2019. My data goes beyond existing datasets like the International Environmental Agreements Database (Mitchell 2020) and the International Regimes Database (Breitmeier, Young, and Zürn 2006b). Instead of agreements, regimes, or regime components which usually comprise dozens of different regulations, I code individual regulations. I develop a comprehensive protocol with transparent coding criteria and numerous examples for all formal and substantive elements of stringency. The coding and analysis on the level of regulations allows for a fine-grained analysis of policy dynamics within established regimes or agreements.

The empirical application of the stringency concept provides new insights into regulatory design variance. The descriptive analysis of the data reveals that the stringency of international environmental regulations varies across the two selected industries as well as across types of environmental impacts and sea regions. The data generally confirms the impression that the regulatory landscape is diverse and not dominated by mere window-dressing. A sizeable share of regulations is designed to exert actual control over corporate environmental conduct as they require improvements in corporate conduct and feature provisions for securing compliance with these requirements. In shipping, both the number and stringency of regulations have increased over time (see Figure 1). In offshore oil and gas, a higher number of lax regulations which can count as window-dressing is observed, but still around three fifths of all regulation do not fall into this category. Strikingly, the analysis further reveals that stringent regulations have emerged where business is closely involved in the negotiations. For instance, the IMO with its particularly strong business participation has produced a fair amount of stringent regulations for global shipping. The findings suggest that business has not been willing and/or able to generally obstruct the development of international environmental regulation.

The empirical data confirms that international environmental regimes and agreements covering maritime activities have developed dynamically on the microlevel of regulations. This empirical description resonates with the description of environmental treaty systems which do “not aim at the comprehensive solution of a larger problem at once, but at the rapid conclusion of a set of initial instruments and the establishment of a policy-making process directed at preparing further instruments" (Gehring 2008, 476). Thus, my research injects some optimism into the debate about international environmental cooperation and its alleged "gridlock" (Hale, Held, and Young 2013). It shows that progress is still possible on the level of regulations, where attempts to effectively control business behavior and attempts of window-dressing currently coexist. My description of this variance lays a foundation for redirecting scholarly attention from regimes and agreement to the specific policies embedded within them.

Figure 1: Stringency of international maritime environmental regulations, 1989-2019



Source: Author.

More specifically, the data provides a condensed quantitative assessment of maritime regulation, an area of international environmental law for which so far only qualitative legal overviews exist (e.g., Lyons 2015; Molenaar 2015). This assessment, and the puzzles it raises, can provide the starting point for a new wave of research into international maritime regulation. Additionally, it is relevant for maritime regulators and regulatory stakeholders. The new data could assist them in their work by detecting regulatory gaps and best practices in present maritime regulation. In international maritime regulation and beyond, practitioners could use the systematized concept of stringency as a tool for monitoring and evaluating regulations within and across different international organizations, regions, and industries.

Explaining International Environmental Regulation

Based on the insights of the first part, the second part of the dissertation explores the causal links between business, its environmental practices, and contentious decisions in international environmental regulation. I develop and probe a theoretical model which posits that regulatory design choices are driven by arguments and evidence rooted in expertise on corporate environmental practices. This section previews the causal argument and the empirical findings of that second part. I sketch my theory of argumentative coproduction, summarize the findings of my two empirical case studies, and identify the main contributions to the theory and practice of international environmental regulation.

A Theory of Argumentative Coproduction of Business Practices and Regulation

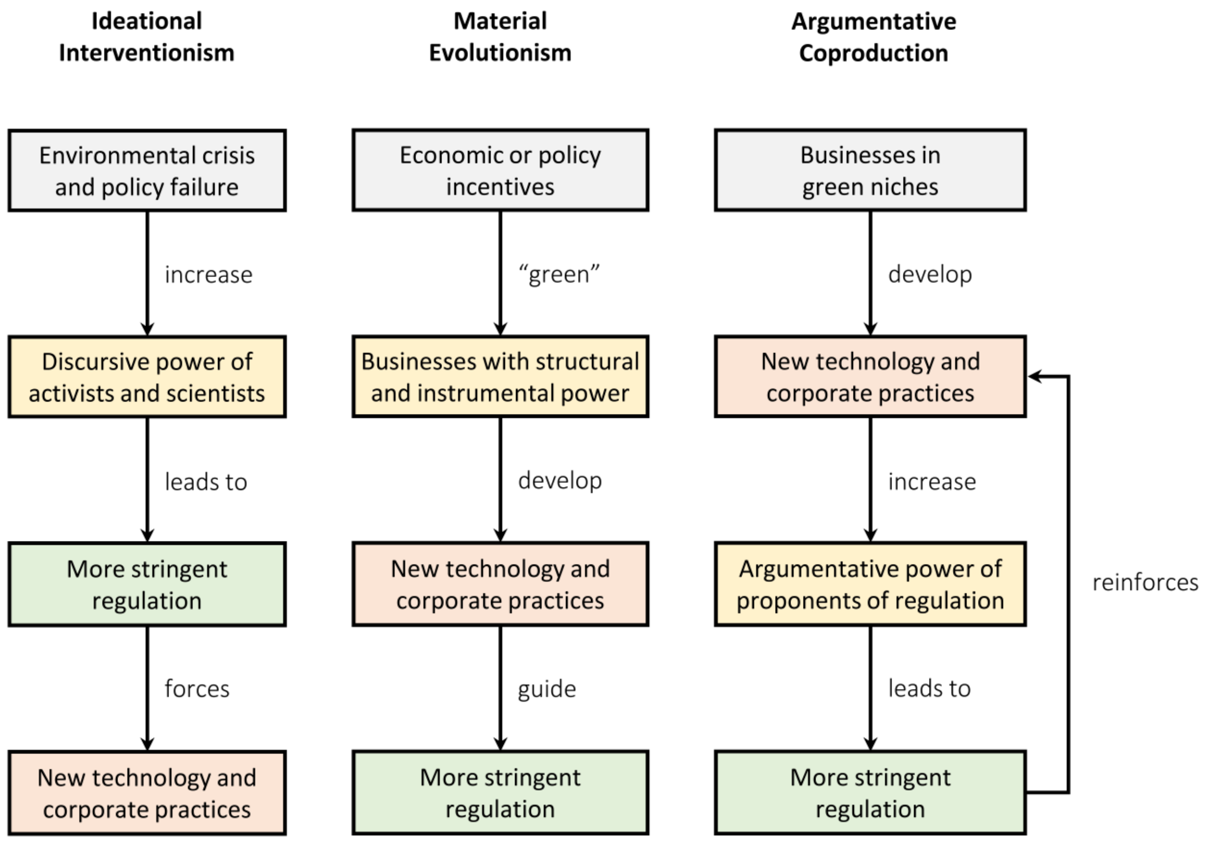
My causal argument is that business practices and international environmental regulation can coproduce each other through processes of argumentation. I posit that change towards more stringent environmental regulation can be inspired and facilitated by improved environmental practices of firms. Firms in green niches develop new environmental technology and adopt more environmental-friendly practices, while other companies are less progressive. This situation gives rise to competing business expertise about the technological feasibility of more stringent regulation. Feasibility is a key theme about which states argue in regulatory negotiations. The outcome of this process of technological arguing depends on the distribution of argumentative power. Arguments about technological feasibility are powerful when referencing existing or emerging first-mover industry practices. Put differently, the claim that stringent regulation is feasible is much more credible when companies are identified that would already be able to comply. The environmental technologies and practices of these first-mover companies increase the argumentative power of those states that advocate more stringent regulation. The resulting regulation reinforces these new technologies and first-mover practices more widely across the industry.

This stylized description of the argumentative coproduction of corporate practices and international environmental regulation relies on some general theoretical tenets. First, state positions in international regulatory negotiations reflect the propositions that decision-makers hold about the need for regulation and the feasibility of it. Proponent states affirm regulatory need and feasibility, opponent states negate both, and audience states are uncertain or hold diverging views on these issues. Second, international regulatory negotiations are argumentative contests. In these contests, proponents and opponents attempt to rhetorically coerce each other, mobilize audience states that already sympathize with their position, and persuade neutral or undecided audience states. Third, business is an important source of arguments as it controls much of the relevant operational and technological knowledge. However, as business actors pursue different regulatory preferences, they may also provide conflicting expertise on the feasibility of more stringent regulation. Fourth, state negotiators deal with competing arguments and business expertise according to a logic of consistency. In pursuit of cognitive consistency, negotiators seek to resolve contradictory claims about technological feasibility. Fifth, existing or emerging corporate practices are particularly credible evidence for evaluating technological propositions and thereby resolving inconsistencies. First-mover companies are thus sources of evidence that can tip the balance towards more stringent regulation. The resulting regulation then reinforces the practices that once inspired it.

Argumentative coproduction differs from other stylized models of international regulatory negotiations and business influence that can be identified in the existing literature (see Figure 2). One of these models is ideational interventionism which assumes that discursive power plays an important role in regulatory negotiations. The main line of conflict runs in between activists and scientists advocating more stringent regulation and business actors opposing such regulation. In normal times, business actors can draw on material, organizational, and discursive resources to maintain their coalitions with states and their superiority (D. L. Levy and Egan 2003; D. L. Levy and Newell 2005). Regulation emerging under such circumstances only requires incremental improvements in corporate practices and thereby preempts more stringent regulation. In exceptional times, however, the "war of position" between reluctant business actors and progressive civil society actors develops differently. Environmental crises and disasters exemplify the failure of existing policies, leading policymakers to search for more appropriate policy ideas (P. M. Haas 1992b, 14–15). In international regulatory negotiations, this creates room for norm- and knowledge-based leadership by activists and scientists (Litfin

1994; Keck and Sikkink 1998; P. M. Haas 1992a). Ensuing shifts in state coalitions enable more stringent regulation which, as a top-down intervention, forces significant improvements in corporate environmental technologies and practices.

Figure 2: Three theoretical roads to more stringent international regulation



Source: Author.

Another model of international regulation is material evolutionism. This model starts from the assumption that regulatory negotiations consist of bargaining over material interests. It acknowledges that the material interests of different business actors may clash, for instance, when firms differ in their levels of innovation (Falkner 2008). Conflicts about regulatory design typically arise between green businesses that would benefit from stringent regulation and grey business interests that would lose (Meckling 2015; Vormedal 2011). The outcomes of these conflicts depend on interest- and power-based leadership of business actors and their state allies. Green businesses can mobilize state support for stringent regulation through traditional lobbying resources, structural market power, and technological power (Falkner 2005b; 2008). Societal pressures on incumbent firms to become greener or subsidies for emerging green firms may facilitate the rise of materially powerful firms with green interests (Lenox and Eesley 2009; Meckling 2018).

These firms adopt progressive environmental practices and have the resources to garner support for more stringent regulation from influential states. In a bottom-up evolution, such regulation follows and codifies the technologies and practices in which influential green firms have competitive advantages.

Evidence on Business Influence in International Environmental Negotiations

In two qualitative case studies of shipping regulations, I probe the explanatory power of argumentative coproduction in comparison to that of ideational interventionism and material evolutionism. The first case study traces the development of relatively stringent regulation of nutrient inputs from discharges of sewage by passenger ships in the Baltic Sea which took effect in 2019. This case approximates the conditions of a typical case of argumentative coproduction and can therefore serve as an initial probe of the theorized mechanism. The second case study analyzes the increasingly stringent regulation of heavy fuel oil (HFO) use in Arctic shipping which is currently being finalized by the IMO. It approximates the conditions of a least-likely case for argumentative coproduction and is therefore suitable for probing whether the causal mechanism operates more widely in maritime regulation and potentially also beyond.

In both case studies, the technological feasibility of more stringent regulation has been contested in the negotiations. Argumentative contests have been driven by conflicting business interests and competing business expertise provided to state delegations. I observe that state support for more stringent regulation usually presupposed that decision-makers had accepted its technological feasibility. A key source of compelling arguments and evidence in this respect have been first-mover companies that adopted environmental technologies and practices beyond regulatory compliance. While these observations generally confirm my theory of argumentative coproduction, I also discover that ideational-interventionist and material-evolutionist mechanisms have partially contributed to regulatory processes and outcomes. The two case studies, which have not been described in the literature yet, expand the empirical body of research on business in international environmental negotiations.

The theory of argumentative coproduction and its empirical probe make two direct contributions to debates about the nature of international environmental negotiations and the role of business. One contribution concerns the debate between constructivists and rationalists about whether international negotiations are best understood as idea- and norm-based deliberations (Finnemore and Sikkink 1998; P. M. Haas 1992a; Litfin 1994) or as interest-based bargaining (Milner 1997; Moravcsik 1997; Sprinz and

Vaahtoranta 1994). My theory carves out a middle ground between these perspectives by conceiving of negotiations as argumentative contests driven by psychological processes. I argue that propositional beliefs of decision-makers matter for understanding state positions. Depending on these beliefs, states adopt different roles in negotiations from active proponents and opponents to more reactive or passive audience roles. Changes in state positions can occur through rhetorical coercion (for proponents and opponents) or argumentative mobilization and sincere persuasion (for audience states). The mobilization and persuasion of audience states depends on how their decision-makers evaluate competing arguments. The decisive factor for which arguments prevail is the quality of the supporting evidence as perceived by decision-makers. I posit that decision-makers primarily seek consistency. This logic of consistency opens up a psychological entry point to argumentative contests which differs from the deliberative approach underlying most literature on arguing (Risse 2000; Deitelhoff 2009). Additionally, my work extend the application of arguing theory to international environmental politics (Orsini and Compagnon 2013) by explicitly considering the role of business.

Another contribution of my dissertation feeds into the debate about whether and how business can play a constructive role in international environmental politics. My focus is on how the involvement of business actors in international negotiations influences or shapes the resulting public regulation. This focus may seem odd in a field where research has devoted increasing attention to the role of business as an agent of public actors and an entrepreneur that, together with other actors or alone, sets its own standards (Green 2013; cf. Auld 2014; Bartley 2018; Bernstein and Cashore 2007; Potoski and Prakash 2013). I do not dispute that these roles of business in global governance have important political, economic, and environmental repercussions. Yet, I contend that this research does not render analyses of business influence in multilateral environmental negotiations superfluous. My research stands in the tradition of this more “classical” strand of research (e.g., Falkner 2008; Orsini 2011; Vormedal 2008). It extends the state of knowledge in this field by examining how developments in corporate environmental practices that are codified in intra- or inter-firm standards affect public regulation. In that sense, I bring the “new” role of business in global environmental governance into the traditional analysis of international environmental politics (cf. Biermann and Dingwerth 2004, 9–11; Falkner 2003).

My findings suggest that firms can inspire more stringent regulation through environmental innovations and practices. The causal mechanism at play centers on how progressive business expertise strengthens or weakens certain technological arguments.

By referencing existing or emerging first-mover practices, business expertise can support the view that more stringent regulation is feasible. Regulation informed by such expertise reinforces the prior technologies or practices of corporate frontrunners. This dialectic relationship of corporate behavior and regulation departs from unidirectional perspectives of technology-forcing and technology-following regulation. The important role of corporate first movers in this relationship suggests that even small innovative firms can inspire regulatory decisions. This goes beyond the prevailing research focus on the political strategies and influence of large multinationals (e.g., Clapp 2018; Kolk and Levy 2001; Kolk and Pinkse 2007; Sæverud and Skjærseth 2007). Moreover, I observe that corporate expertise is a crucial element in the discursive representation of material technology and its translation into policy action. This role of corporate expertise makes business an influential and potentially constructive actor in international environmental negotiations.

More indirectly, the causal inquiry contributes to long-standing debates in international relations about state-society relations and types of power. As for state-society relations, some scholars have argued that the rise of business power is an expression of state power (Gilpin 1975, 4; Krasner 1978, 20, 31–34). Others have claimed that the importance of private actors increases at the expense of state power (Strange 1996, 14). Postmodern work takes yet another perspective and understands the role of business as an expression of neoliberal governmentality in international politics (Sending and Neumann 2006). My dissertation highlights that business has become an indispensable partner for states in the development of international regulations targeting corporate conduct. States are dependent on the operational and technological knowledge of business in their formulation and choice of viable regulatory options. I argue that this is an essential ingredient of what Lindblom (1977, chap. 13) referred to as the “privileged position of business” in policy discussion.

As for power, international relations research has distinguished different types of this central concept (Barnett and Duvall 2005). Studies of business influence have discussed the relative importance of instrumental, structural, technological, and discursive power (Falkner 2008; Fuchs 2005). My dissertation adds to this list the notion of argumentative power defined as the ability to rhetorically coerce, mobilize, or persuade others by means of arguments and evidence. Argumentative power links knowledge about business operations and technologies to ideas about feasible and adequate regulatory designs. It thus sits at the intersection of technological and discursive power. On an abstract level, argumentative power explains choices of decision-makers depending on knowledge about practices from which they are spatially or temporally disconnected. My findings suggest that, in such a context, power resides in the ability of an actor to translate practical knowledge into tangible evidence that supports certain arguments in decision-making and weakens others.

My insights into the argumentative coproduction of business practices and regulation are also of practical value. They inform policymakers, corporations, and environmental NGOs about the conditions under which more stringent regulation is achievable. My findings underscore the importance of incorporating business expertise into the development of international environmental regulations. Without such expertise, policymakers would be unable to translate abstract principles like “best available technology” and “best available practices” into concrete regulatory decisions. Moreover, my findings suggest that public incentives or civil society actions that aim at greening the practices of firms can create new room for stringent regulation of entire industries. These insights could help create favorable conditions for regulations that reduce the environmental footprint of industrial activities beyond the initial sustainability leaders. Having outlined the major contributions of my dissertation, I now turn to defining the key concepts around which my research questions revolve.

Key Concepts

My dissertation builds on three concepts. First, it conceptually explores, empirically assesses, and explains the design of *international environmental regulations*. Second, the explanatory part focuses on the role of *business actors and their environmental practices*, which are communicated through business expertise. Third, it examines how and to what extent these corporate practices may *influence* or *shape* contentious regulatory design decisions. Below, I offer definitions of these concepts.

International Environmental Regulation

International environmental regulations are explicit and formal rules, standards, and guidelines agreed by two or more states to control external effects of business activities that are perceived to degrade the natural environment. This definition treats business as the eventual target of regulation. Legal scholarship has previously noted that international environmental law “typically aims to control not merely state conduct but private conduct” (Bodansky 2013, 184). International regulations may apply directly to targeted business activities or affect them indirectly by shaping domestic policy choices of states (Abbott and Snidal 2009, 50; Bodansky 2013, 70; Cortell and Davis 1996). Furthermore, the definition focuses on operational impacts causing environmental degradation. Operational impacts are usually attributable to certain point sources.[1] Degradation refers to the "non-consumptive use" of environmental resources that exceeds their regenerative capacity (Mitchell 2010, 31).

An international regulation of environmental impacts of industrial activity often presupposes some transboundary context. In an international environmental politics perspective, a transboundary context exists when environmental problems extend beyond state borders. Some transboundary problems represent a tragedy of the commons, in which states causing the problem eventually also suffer from it (Ostrom 1990, 2–3). Other problems have an upstream-downstream structure, in which perpetrators and victims are not identical (Mitchell 2010, 33–34). In an international political economy perspective, a transboundary context can also result from the transnational structure of regulated industries (Abbott and Snidal 2009, 58–59). Transnational industries are characterized by global value chains, globalized markets, and multinational corporations (Braithwaite and Drahos 2000, 8). International regulations addressing transboundary environmental problems or impacts of transnational industries are typically developed in intergovernmental organizations (IGOs). These regulatory bodies may range from large global organizations to smaller regional forums.[2]

The definition of international environmental regulations delineates the scope of the dissertation. First, my focus is on regulations that address "traditional" physical externalities, which may involve policy externalities created by domestic regulation. By contrast, I do not discuss "network externalities" which refer to coordination problems in the creation of technological and transactional interconnectivity (Abbott and Snidal 2001, 347–50). Second, and related to that, I explain public regulation rather than private or hybrid standards (cf. Abbott and Snidal 2009; Büthe and Mattli 2011, 19; Falkner 2003). Standards developed by nonstate actors are only considered as far as they have inspired or preempted regulation by states. Third, norms and principles are outside of scope. Both analytical categories are more abstract and generic than specific rules, standards, and guidelines (Braithwaite and Drahos 2000, 19–20; Krasner 1982, 186). Fourth, the focus on formal and explicit regulation excludes customary law and "unspoken" rules (Kratochwil 1999, 55–56). Fifth, also excluded are regulations that have not

[1] For the difference between point and nonpoint sources, cf. Hill (2010, 239–40).

[2] For the purposes of this dissertation, I exclude the European Union (EU) from this definition as it represents an organization "sui generis" which transcends domestic and international spheres (Risse-Kappen 1996; see also Appendix III).

resulted from international cooperation but from coercive imposition or uncoordinated diffusion outside of international bodies (Busch and Jörgens 2005, 863–67; Elkins and Simmons 2005). Sixth, in terms of output, I focus on assessing and explaining regulations of intergovernmental bodies rather than mere political declarations of intent. Yet, political declarations may be highly relevant elements in the processes that lead to new regulations (Skjærseth 2003, 267–68). Seventh, I do not consider regulations that exclusively address problems of resource over-appropriation or accidental harm, non-environmental externalities of business, or non-business activities. Instead, the focus is on regulations that address operational environmental impacts of corporate activities.

Business and Its Environmental Practices

My dissertation focuses on the role of business actors in international environmental regulation. Business actors comprise individual companies and business associations. A company is any enterprise engaged in profit-oriented industrial or commercial activity, irrespective of its legal form, structure, and ownership. Subsequently, I use the terms company, corporation, and firm interchangeably. Business associations are nongovernmental organizations that represent their business members.[3] There are national business associations, such as the Norwegian Shipowners' Association, and international ones, like the Baltic and International Maritime Council (BIMCO). The membership of international business associations can comprise individual firms, as exemplified by the Cruise Lines International Association (CLIA), or national industry associations, like in the International Chamber of Shipping (ICS). Both business associations and individual companies may become involved in regulatory processes. Individual companies, such as Hapag Lloyd, COSCO, or Carnival Cruise Line, are the ones that implement environmental management practices and are eventually targeted by regulation.

Corporate environmental practices are all "techniques, policies and procedures a firm uses that are specifically aimed at monitoring and controlling the impact of its operations on the natural environment" (Montabon, Sroufe, and Narasimhan 2007, 998). This includes all technological, operational, organizational, and other kinds of business behavior related to environmental externalities. Enhanced, improved, or progressive corporate environmental practices describe behavioral change that reduces environmental externalities. Corporate environmental practices are often codified in standards on

[3] A technical term used to refer to these associations is "business and industry nongovernmental organizations" or "BINGOs" (Arts 2006; Nasiritousi, Hjerpe, and Linnér 2016, 114). I stick to the non-technical terminology though to avoid any confusion with environmental NGOs.

intra-firm or inter-firm level (Albareda 2008; M. Epstein and Roy 1998). Intra-firm standards may be global or local and typically address health, safety, and environment (HSE) and corporate social responsibility (CSR). Inter-firm standards comprise recommendations, guidelines, and best practices compiled by groups of firms or industry associations. They may also involve transnational standards jointly developed by private and public actors (cf. Abbott and Snidal 2009; Mattli 2003).

In regulatory processes, corporate environmental practices are communicated through business expertise. Business expertise here refers to all ideas that business actors directly or indirectly provide to policymakers about the operations, technologies, and economic considerations of firms or whole sectors. It conveys these material aspects to policymakers in the form of causal ideas and propositional statements. Given my focus on corporate environmental practices and their regulation, I deal with expertise that somehow relates to environmental externalities. According to Abbott and Snidal (2009, 64), business expertise is essential in the negotiation of international standards "to ensure that the standard will mesh with business practices and be cost-effective." Business actors can communicate such expertise to policymakers both within and outside of international regulatory bodies. Business expertise is not identical with business preferences. Expertise reflects positive statements or factual claims, whereas preferences are normative descriptions of desired outcomes. The two are intertwined though as in-house experts can inform company preferences and predefined company preferences can color expertise. While business expertise is thus not necessarily objective or true (Bernhagen 2007, 60–61), its positive guise makes it attractive for consideration in argumentative contests.

Influence

In this study, I define influence as an actor´s full or partial success in inducing a desired regulatory decision that would not have occurred absent his or her activities. Success includes both the adoption of a preferred regulatory design and the abandoning of an undesired one. The proposed definition builds on classical as well as more recent conceptualizations. Classical accounts have defined influence as a social relationship that involves the inducement of behavioral change of other actors. According to Lasswell and Kaplan (1950, 73), each incidence of influence has a certain weight (or degree), scope (or content), and domain (or addressee). More recent interest group research largely follows this classical definition by stressing what is influenced and how. Dür (2008a, 561) defines influence parsimoniously as "an actor's ability to shape a decision in line with her preferences." Arts and Verschuren (1999, 413) note that successful influence can be "caused by one's own intervention or by the decision-makers' anticipation." My definition of influence is meant to comprise these complementary building blocks.

Influence can operate through different channels. Material channels of business influence include the selection of policymakers, voice or outside lobbying, and structural coercion (Dür 2008b, 1221–23). Ideational channels comprise, amongst others, the promotion of roadmaps to address uncertainty (Goldstein and Keohane 1993), the social construction of understandings and norms, as well as argumentation and persuasion (Finnemore and Sikkink 2001, 400–403). Influence understood as "the realization of a single effect" rests on different types of power which confer "the general ability to influence" (Arts and Verschuren 1999, 413; cf. Cox and Jacobson 1974, 3–4). Scholars have linked the material influence of business to instrumental, structural, and technological types of power; and ideational influence to discursive power (Falkner 2008, 27–32; Fuchs 2005, 75–94).

The research question guiding my causal inquiry refers to how business and its practices can influence or shape contentious regulatory choices. According to the previous remarks, influence is the intended result of conscious action. I introduce the term "shape" to incorporate the idea that the effects of business practices may sometimes be unintended. Shaping includes the inducement of behavioral change that does not necessarily reflect or follow the preferences of its initiator. In the most extreme case, a company could shape regulatory decisions unintentionally through its practices in ways that even contradict its own policy preferences. The bottom line of both influencing and shaping is what James March (1955, 438), in another classical definition of influence, described as an intervention "which induces behavior on the part of the individual at time t_1 different from that which might be predicted on the basis of a knowledge of the individual organism at time t_0."

Why Maritime Shipping and Offshore Oil and Gas?

The empirical analysis of stringency patterns in international environmental regulation focuses on commercial maritime shipping and takes in offshore oil and gas production for purposes of comparison. It is a priori quite conceivable that regulation in these strategically important sectors is the result of corporate capture and only serves for window-dressing. Maritime transport accounts for more than four fifths of the world merchandise trade (UNCTAD 2019, 4). Its economic weight suggests that regulation might merely follow the interests of powerful corporations and states (Strange 1976). Indeed, shipping has been described as a sector that is "largely unaccountable" for its environmental impacts (Lister, Poulsen, and Ponte 2015, 185) and that is subject to several governance failures (Roe 2013, 20–27). The strategic importance of offshore oil and gas production is also high. Offshore represents more than a quarter of the global oil and natural gas production as well as large shares of the remaining conventional resources (OECD/IEA 2018, 13–16). Some oil and gas companies have adopted progressive climate strategies (Kolk and Levy 2001; Nasiritousi 2017; Skjærseth and Skodvin 2003). Yet, the sector is also known for major environmental disasters like the Deepwater Horizon oil spill in the Gulf of Mexico in 2010 and damaging operational practices such as flaring. A sizeable presence of stringent regulation in these two sectors would thus strongly support the view that the dynamic developments in international environmental regulation reflect attempts to really control corporate conduct.

The environmental impacts of maritime industries are governed by a diverse complex of global and regional institutions (Humrich 2013; Lister, Poulsen, and Ponte 2015; van Leeuwen 2010). Global institutions include the International Convention for the Prevention of Pollution from Ships (MARPOL), the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), and issue-specific conventions on ballast water and anti-fouling systems of ships and platforms. These conventions and their protocols are administered by the IMO, which is a specialized agency of the United Nations. Regional institutions comprise conventions for the marine environmental protection of the Baltic Sea (Helsinki Convention), the Mediterranean Sea (Barcelona Convention), the North-East Atlantic (OSPAR Convention), the Persian Gulf (Kuwait Regional Convention), and many other sea areas. Several of these regional instruments have own executive bodies, such as the Helsinki Commission (HELCOM), the OSPAR Commission, and the Regional Organization for the Protection of the Marine Environment (ROPME, responsible for the Kuwait Regional Convention). Outside of marine framework conventions, international organizations or forums like the World Bank and the Arctic Council also contribute to the governance of maritime industries. This institutional landscape can be understood as a regime complex, a concept which has been applied to the governance of climate change, forests, and genetic resources (Keohane and Victor 2011; Orsini 2013; Raustiala and Victor 2004).

The selected maritime sectors have governance characteristics similar to those of other global industries. To begin with, the regulated activities and impacts transcend the territorial boundaries of the state. Ships routinely sail in international waters and their environmental impacts on air, water, and ecosystems almost never stop at state borders. Offshore hydrocarbon extraction is still limited to the exclusive economic zones of states but may have transboundary environmental impacts as well. Moreover, the regulatory objects are quite complex and technical in nature. Both offshore platforms and ships are highly engineered systems requiring specialized knowledge for their regulation. Lastly, maritime industries have witnessed a rise of private governance within the regime complex. Examples are "green shipping" initiatives (Lister 2015) and environmental guidelines developed by industry associations (Kao and Gao 1998, 116–17; van Leeuwen 2010, 127). Transboundary environmental impacts, technical complexity, and private governance also characterize other global industries, including aviation (Henriksen and Ponte 2018), chemicals (Delmas and Montiel 2008; Prakash 2000), and energy (Florini and Sovacool 2009). Insights from an empirical study of maritime regulations can therefore be relevant for other sectors, too.

The empirical probe of the causal theories about the link between business practices and contentious regulatory design decisions relies on cases from maritime shipping. This is a suitable sector for a theory probe because it seems amenable to existing explanations but also features the basic conditions for the operation of my theoretical model. An ideational-interventionist model of regulation is likely to apply because, in the past, shipping regulation has been driven by major disasters (Mitchell 1994a). Crises and policy failures create opportunities for scientists and epistemic communities to shape the ideational basis of regulation (Braithwaite and Drahos 2000, 561–62; P. M. Haas 1992b). A material-evolutionist model also appears likely considering that the global regulator IMO has been depicted as captured by industry interests (Amin, McDevitt, and Gibbs 2018; InfluenceMap 2017). Its regulations should thus primarily reflect the interests of dominant business actors. At the same time, the argumentative coproduction of progressive business practices and more stringent regulation is at least conceivable. The central role of technology for reducing environmental impacts of ships and the resulting technical nature of many regulations create the basic conditions for the potential operation of my model.

Shipping is a good sector for studying the influence of business practices on regulation because its corporate landscape is relatively diverse. It includes owners and operators of ships in different market segments (cruises, containers, bulk cargo, tankers, etc.), charterers, shippers, shipyards, equipment suppliers, and classification societies, amongst others (cf. Tan 2006, 34–45). The companies involved are diverse in structure.

Some are large multinationals, such as the leading container ship operator Maersk. Others are small national firms, such as Royal Arctic Line which operates supply routes to Greenland. Furthermore, some companies are entirely or mainly owned by the state, including the largest Russian shipping company Sovcomflot. Others are owned by private investors, such as the Norwegian equipment supplier Scanship, or controlled by families, like the major Swiss-based shipping company MSC. This structural diversity promises a certain openness in terms of different business interests as well as forms of business power and influence.

Finally, maritime industries are generally relevant study objects because they put environmental pressures on our oceans. Oceans cover more than 70% of the earth's surface. Half of all species on the globe live in the sea with fish stocks being an important food source for a growing world population. Moreover, three-quarters of all large cities are located on shorelines. We use oceans and coastal areas for trade, transport, energy production, resource extraction, fishing, tourism, and recreation. The yearly value of goods and services from oceanic and coastal environments is estimated at 2.5 trillion US dollars and the ocean's total asset value at 24 trillion US dollars (Hoegh-Guldberg 2015, 14–15). Environmental impacts of maritime industries pose threats to some of these goods and ecosystem services as well as to human health. In the literature, externalities such as oil pollution (Mitchell 1994a) and carbon dioxide emissions (Hackmann 2012; Skjærseth and Skodvin 2003) have received most attention. However, maritime industries also discharge noxious chemicals, sewage, and garbage into the sea, pollute the air with particulate matter, nitrogen and sulfur oxides, introduce invasive species to ecosystems, and cause physical disturbance. Addressing these and similar impacts is a societal challenge.

My dissertation studies two cases not yet examined by political scientists. The first case focuses on nutrient standards for sewage discharges from ships in the Baltic Sea. Nutrient inputs lead to eutrophication and to the spread of so-called "dead zones" with no or little oxygen on the sea bottom. The second case deals with the use of heavy fuel oil (HFO) as fuel by ships in Arctic waters. Accidental spills of HFO can cause high environmental damages and its burning as a fuel produces emissions of black carbon, an air pollutant that contributes to Arctic warming. Proper regulation can limit these and other environmental impacts on the way "towards a sustainable and equitable blue economy" (N. J. Bennett et al. 2019). My research seeks to understand some of the conditions under which such regulation emerges. It contributes to broader efforts of natural and social science research for ocean protection. These efforts are set to gain new momentum in conjunction with the upcoming United Nations Decade of Ocean Science for Sustainable Development from 2021 to 2030.

Methodological Approach

Methodologically, this dissertation follows a pragmatic approach that bridges the dualism between positivist and interpretivist traditions. This approach adopts a needs-based perspective on concept development and the choice of research methods (Johnson and Onwuegbuzie 2004, 17). Concepts and methods are judged by their usefulness for answering the research question at hand (Blatter 2017). Pragmatism understands conceptual frameworks as tools that need to be developed prior to empirical analyses (Dewey 1938, 136) and is open towards both qualitative and quantitative methods (Johnson and Onwuegbuzie 2004, 17). Pragmatists have further proposed an abductive approach to causal inquiry. According to Peirce (1965, 5:172), abduction "suggests that something *may be*." Based on abductively formulated propositions, theoretical predictions can be deduced and then tested or probed empirically (Peirce 1965, 5:172). The empirical probe allows for assessing the theory's explanatory power, but pragmatism acknowledges that the resulting findings are tentative (Dewey 1938, 142) and that multiple complementary explanations of empirical observations may coexist (Johnson and Onwuegbuzie 2004, 18). With respect to the purpose of scientific research, pragmatists value practical theory that endorses shared societal values, such as democracy and progress (Dewey 1940, 225; Johnson and Onwuegbuzie 2004, 18).

These methodological foundations of pragmatism can be translated into more specific premises guiding the different parts of my dissertation. The first part of my dissertation deductively develops a concept of regulatory design and then applies it to identify empirical patterns of variance. The concept development works from the premise that scientific concepts need to generate "*some* shared meaning" and be "useful for making sense of the world we live in" (Davis 2005, 51). I extend this minimal definition in two directions: first, concepts create shared meaning only if properly differentiated from neighboring ones; and second, concepts prove useful only if they are transparently operationalized and bring added value to theorizing and empirical analysis. This understanding of conceptual quality falls in between the cultural approach of interpretivists (Davis 2005, 31–58; Schaffer 2015; Schwartz-Shea and Yanow 2012, 49–51) and the rigid criteria of positivists (Gerring 2012, 117; King, Keohane, and Verba 1994, 109–12; Sartori 1984, 63–64). The data analysis uses descriptive statistics to detect empirical patterns of regulatory design variance. The identification of empirical puzzles through systematic description is an important starting point for causal inquiry.

The second part of my dissertation deductively probes the explanatory power of my novel theoretical model in comparison to alternative models. The proposed model is meant to explain "streams of behavior" (Davis 2005, 177) that include both regulatory outcomes and the processes leading to them. The broad propositions of the model draw on previous research findings, theoretical building blocks, and own previous empirical observations (which are unrelated to the cases studied). I derive observable implications from these theoretical propositions and probe them in two empirical case studies. I assess the explanatory power of the different theories by means of congruence analysis and causal process tracing around key moments in the decision-making process. In addition to theory probing, the case studies also serve to better delineate the scope conditions of these theoretical models. The specification of scope conditions is made possible by varying the contextual conditions of the selected cases. Again, this approach is located in between the two extremes of interpretivism's grounded theory and positivist hypothesis-testing. Finally, and in line with pragmatism's call for practical theory, my dissertation generates lessons for the future development of international policies serving the broader societal goal of environmental protection.

Structure of the Dissertation

The remainder of this dissertation proceeds as follows. Chapter 2 develops the notion of regulatory stringency as a conceptual tool for assessing the design of international environmental regulations. The chapter proposes qualitative and quantitative operationalizations of stringency and illustrates their application with empirical examples from shipping regulation. The chapter then maps stringency patterns in international environmental regulation of maritime shipping and offshore oil and gas. In presenting new quantitative data on regulatory stringency, the chapter finds that numerous international environmental regulations are clearly not just attempts of window dressing as they require major improvements in corporate environmental performance and aim at eliciting compliance with these requirements. The chapter also identifies patterns of regulatory variance across industries, environmental externalities, regions, international organizations, and over time. One of these patterns is that international organizations with strong business involvement have produced a sizeable number of stringent regulations.

Chapter 3 delves into explanations for this specific puzzle. It reviews existing theories of business influence in international regulatory negotiations and presents my own theoretical model. My theory of argumentative coproduction posits that progressive corporate environmental practices reflected in arguments and evidence of business experts can inspire more stringent regulation. The chapter outlines the micro-foundations of a process in which states argue over the technological leeway for regulation. Chapter 4 describes my research strategy. It outlines the qualitative case study approach that I used for probing the explanatory power of argumentative coproduction against that of ideational interventionism and material evolutionism. The chapter formulates theoretical expectations about observable empirical processes and explains why my two case studies are suitable theory probes.

The following two chapters contain the empirical case studies. Chapter 5 presents the case of new IMO regulations for the discharge of sewage from ships in the Baltic Sea. The case study analyzes the corporate sources of the relatively demanding discharge limits for nutrients from passenger ships. It shows that the argumentative power of medium-sized equipment manufacturers and their state allies trumped that of the much larger and well-organized cruise companies and their flag states. Ironically, progressive practices of a few cruise lines undermined the arguments that supported their own policy preferences. Chapter 6 presents the longitudinal case study of IMO regulations on the use of heavy fuel oil (HFO) as fuel by ships in Arctic waters. The chapter examines the link between corporate practices and the transition from nonregulation to a nonbinding recommendation and further towards a mandatory ban. It demonstrates that increasing commitments of shipping companies to an HFO phaseout have supported arguments for banning this environmentally damaging fuel. At the same time, techno-economic barriers in a core segment of Arctic shipping have provided arguments for temporary, yet far-reaching exemptions from this ban.

Chapter 7 summarizes the findings of the empirical analysis and discusses their generalizability and limitations. For both case studies, argumentative coproduction provides a more complete explanation of observed processes and outcomes than ideational interventionism and material evolutionism. Yet, I also find that these theories are not mutually exclusive and operate to varying extents under different contextual conditions. An important scope condition for the operation of argumentative coproduction is that politics are relatively "quiet." Quietness does not mean that an issue is unimportant in terms of environmental impact, but rather that decisions are taken in a technocratic setting. My dissertation sheds light on these frequently hidden decision-making processes.

The concluding chapter discusses the implications of my findings for future research and formulates lessons for practitioners of international environmental regulation. A key recommendation emerging from my work is that, to facilitate regulatory progress and environmental protection, green first-mover businesses should be involved more systematically in regulatory processes.

Summary

In a nutshell, my dissertation is about the design of international environmental regulations and its roots in corporate practices. It makes two main contributions to the literature on international environmental policymaking and the role of business therein. First, I develop the concept of regulatory stringency and empirically apply it to identify patterns of variance in regulatory design. The concept of stringency goes beyond existing design concepts. It comprises both formal and substantive design elements, focuses on those elements that matter for the control of corporate conduct, and is operationalized through a novel index. Likewise, the empirical application of the stringency concept extends existing datasets on regime and agreement design. Exemplary data collected for maritime shipping and offshore oil and gas production provides a more detailed picture of how regulatory design varies. This enables an analysis of regulatory variance over time as well as across industries, externalities, regions, and international organizations.

Second, I develop a theory of argumentative coproduction which posits that environmental practices of corporate first movers can influence or shape contentious regulatory design choices. The causal mechanism stresses the role of business expertise in translating corporate practices into technological arguments that guide regulatory decisions. The resulting regulations then reinforce the technologies and practices of corporate frontrunners more widely across the industry. I probe the explanatory power of this model in two in-depth case studies of shipping regulation. The analysis confirms that argumentative coproduction fills gaps left by theories focusing on material and ideational sources of technology-following and technology-forcing regulation, respectively. My explanation is particularly well-suited for making sense of situations in which the feasibility of more stringent regulation is contested. It outlines psychological and argumentative dynamics that can account for such processes of technological arguing and their outcomes.

This chapter began with an overview of the landscape of international environmental regulation. The next chapter zooms in on regulatory developments in maritime industries. It explores to what extent regulation has been developing dynamically and is designed to control corporate conduct. To go beyond window-dressing, regulation should require improvements in corporate environmental practices and seek to elicit corporate compliance with these requirements. I develop the concept of regulatory stringency which captures design elements contributing to these goals. I illustrate the concept development by means of three exemplary regulations applicable to shipping in the North Sea. The North Sea is one of the world's most heavily used sea areas. The systematic application of the stringency concept to international maritime environmental regulations will show that it is also one of the most protected regions. The next chapter presents an analysis of newly collected regulation data and identifies patterns of variance in regulatory stringency. Amongst other patterns, it reveals that international organizations with strong business involvement have adopted a relatively high share of stringent regulations. This empirical puzzle prepares the ground for the causal part of the dissertation.

2 Concept and Data: The Stringency of International Maritime Regulations

This chapter lays the conceptual and data-related foundations for moving the study focus from international environmental regimes and agreements to the less explored microlevel of regulations. My point of departure in the previous chapter was that, in contrast to the slowed-down emergence of new regimes or agreements, international environmental regulations seem to develop dynamically. It appears puzzling that this dynamic unfolds in a governance context in which business is strongly involved in the development of regulations that target its conduct. Critics of business influence would solve this puzzle by arguing that the dynamic development of environmental regulation is a sham. In this view, negotiations with extensive business participation only produce regulations that do not really alter business behavior. This chapter confronts that critique by examining *to what extent international environmental regulations are designed to exert control over corporate environmental conduct*. The goal is to map whether and where regulations go beyond window-dressing as they require major improvements in corporate environmental practices and aim at securing corporate compliance with these requirements. I seek to substantiate the introductory claim about the dynamic development of regulation and grasp patterns of variance within it.

For these purposes, conceptual tools for comparing the design of international environmental regulations and a description of its empirical variance are needed. In the first part of the chapter, I develop the novel concept of stringency to assess the design of international environmental regulations that typically target corporate behavior. I conceptualize regulatory stringency as the product of tightness and ambition. Tightness refers to formal design elements, such as legality. Ambition denotes substantive design elements, such as required reductions in environmental impact. I describe the relevant design elements qualitatively using three examples of shipping regulations in the North Sea. I then operationalize the concept of stringency in the form of an index for use in quantitative research and discuss possible links between regulatory stringency and effectiveness. Filling gaps of existing concepts of regime and agreement design, the stringency index enables the collection of large-n data on international environmental regulations.

In the second part of the chapter, I analyze newly collected data on the stringency of international environmental regulations for maritime shipping and offshore oil and gas. I introduce the International Maritime Environmental Regulation (IMER) Database as a new dataset going beyond existing regime and agreement data. Its descriptive analysis in this dissertation serves two purposes. First, it substantiates the claims that international environmental regulation of maritime industries develops dynamically and is not mere window-dressing. Notably, states have agreed on a sizeable number of regulations with high or intermediate stringency for maritime industries. Second, the analysis identifies patterns of regulatory variance across several dimensions. The analysis finds that stringent regulation is more abundant in shipping than in offshore oil and gas production. It also finds that different types of impacts have been subject to distinct regulatory waves. Moreover, the amount and stringency of regulations is found to vary across regions and international regulatory bodies. Finally, the analysis identifies design configurations that have become particularly frequent over time. Based on these patterns of variance, the chapter formulates specific empirical puzzles to which different theoretical models of international regulatory negotiations should speak.

Why Yet Another Concept?

The study of international environmental regulations presupposes appropriate conceptual tools for assessing their design. Such tools should consider that international environmental regulations, either directly or indirectly through state policies, eventually target private actors (Bodansky 2013, 184; Mitchell 1994a, 308). They should thus primarily capture those elements of regulatory design that matter most for corporate conduct. Specifically, both the form and substance of regulations should be covered as these are two sides of the same coin. I posit that ambitious regulations without formal teeth as well as formally strong regulations without ambition face potential limitations in controlling corporate environmental impacts. Additionally, it should be kept in mind that form and substance may be traded off against each other in negotiations (Guzman 2010, 156; Raustiala 2005, 582; Skjærseth, Stokke, and Wettestad 2006). Finally, regulatory design concepts should grasp and operationalize the dimensions of form and substance similarly well. Applying these criteria to existing concepts of regime and agreement design identifies some major gaps.

A first major design concept from regime and agreement studies is legalization. Legalization covers the formal elements of obligation, delegation, and precision (Abbott et al. 2000). The major strength of the legalization concept is its fine-grained analysis of legal design elements that determine sovereignty costs for states. Its greatest limitation is the conscious omission of substantive design elements (Abbott et al. 2000, 402). This neglects the possibility that legalization may be achieved without or even at the expense of substantive ambition, and vice versa (Skjærseth, Stokke, and Wettestad 2006, 118). Few would consider a highly legalized rule a major achievement if it did not also require reductions in environmental pollution. Moreover, the concept of legalization is very state-centric. For instance, the delegation variable focuses on rulemaking and interpretation authority as well as on dispute settlement. These elements appear to be of limited importance with respect to controlling corporate environmental conduct.

A second major design concept from regime and agreement studies is the notion of depth, which typically captures their substance. The depth of a treaty denotes "the extent to which it requires states to depart from what they would have done in its absence" (Downs, Rocke, and Barsoom 1996, 383). A two-dimensional operationalization of depth assesses to what extent a regime's rule density and/or specificity reach up to the level "considered necessary for managing the problems in the issue area" (Breitmeier et al. 1996, 85). This operationalization seems to reflect what is commonly understood as ambition. However, its reliance on a normative judgement about what would be needed for controlling the environmental problem is unfortunate. People differ in their perception of environmental problems (Mitchell 2010, 22–23), and so may the depth values they code.[4] More recently, a six-dimensional concept of the depth of international environmental agreements has been proposed and operationalized in positive terms (Bernauer et al. 2013). While its formal and substantive variables (e.g., dispute settlement and secretariats) shape sovereignty costs for states, they do not seem particularly relevant for controlling business behavior. Furthermore, no aggregate level of depth is derived from the variable values. A comprehensive aggregate concept of depth has been developed in research on trade agreements (Dür, Baccini, and Elsig 2014, 359–60). The authors measure agreement depth through the presence of certain pre-defined types of substantive provisions. Translated into an environmental context, such an approach might reveal how comprehensive an agreement is but not how far-reaching its provisions are for the regulatory targets.

A third concept from the study of international agreements is the tripartite framework of legality, substance, and structure (Raustiala 2005). Legality denotes binding law or nonbinding pledges; substance is equivalent to depth; and structure refers to monitoring systems. The framework also discusses empirical interactions between these formal

[4] An example from the International Regimes Database are the depth values for the ship oil pollution regime (Breitmeier, Young, and Zürn 2006b). Another source of ambiguity in the two-dimensional variant is the "and/or" operator that links rule density and specificity in the operationalization (Breitmeier et al. 1996, 85).

and substantive design elements (Raustiala 2005, 603–9). Despite this important contribution, the framework cannot be used for empirically assessing a large number of international environmental regulations. The three design elements are not fully operationalized for coding and it is unclear how different combinations of them could be compared on an aggregate level. Moreover, like the concepts discussed above, the understanding of the design elements is colored by the state-centered interest that motivates this framework. Additional adaptions are needed to capture the essence of regulations when focusing on the control they exert over corporate environmental conduct.

In short, existing concepts of regime and agreement design do not seem suitable for assessing and comparing the design of international environmental regulations. They treat form and substance in isolation, focus on design elements that matter for states but are less important for business targets of regulation, or suffer from insufficient operationalization. I do not dispute that these concepts serve the purposes for which they have been developed in the first place, namely the study of international regimes and agreements. I also acknowledge that they offer valuable building blocks on which the study of international regulations can draw. However, moving from the study of regimes and agreements to the microlevel of regulations calls for conceptual innovation. This is what the concept of regulatory stringency seeks to accomplish.

The Qualitative Foundations of Regulatory Stringency

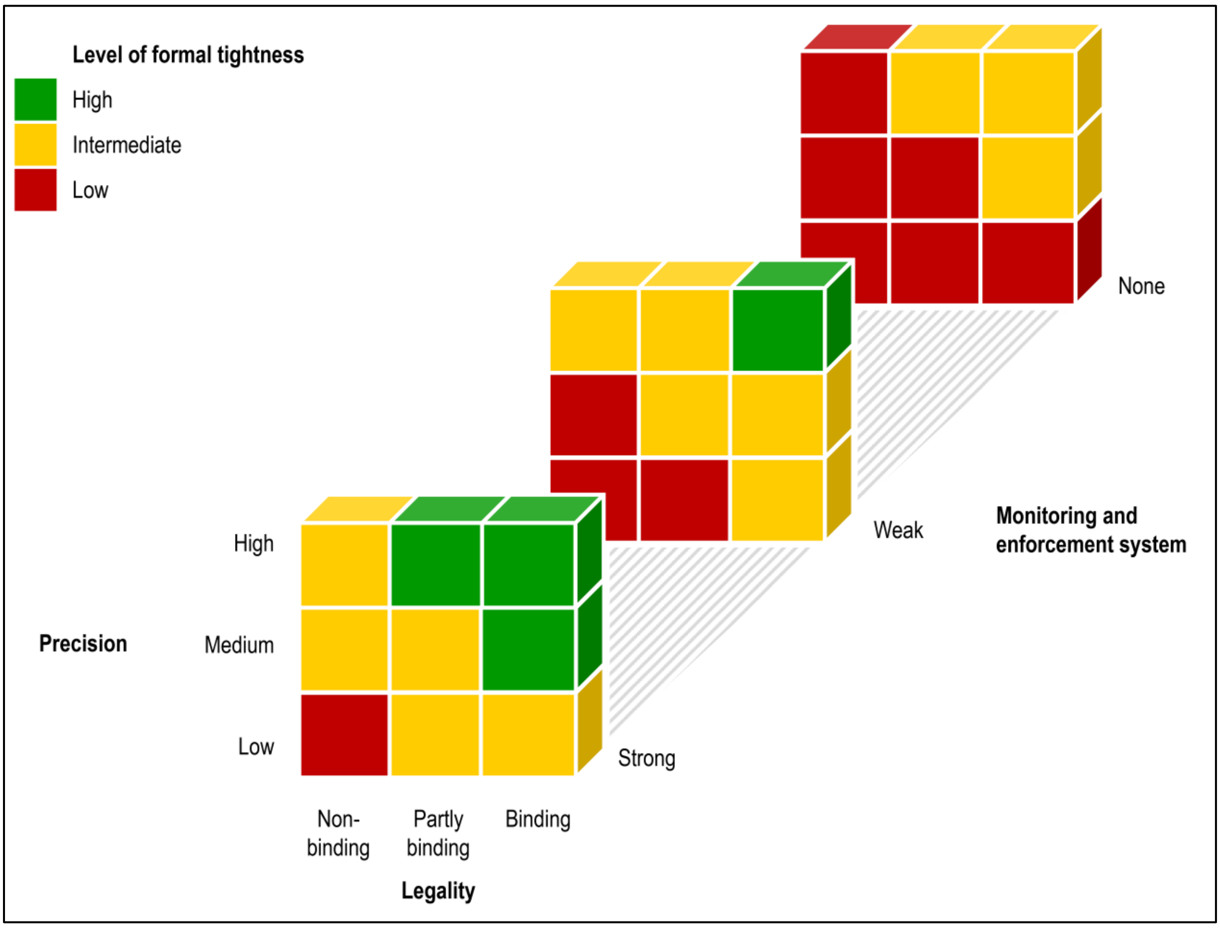
Stringency springs from the formal tightness *and* substantive ambition of regulations. This deviates from purely substantive connotations of the term (e.g., Abbott et al. 2000; Bodansky 2010). Formal tightness refers to the legality, precision, and monitoring and enforcement system of regulations. These elements shape domestic policy implementation of and corporate compliance with the regulatory substance. Substantive ambition relates to the scope of provisions, required externality reductions, and requirement levels in comparison to other international regulation. I posit that these design elements determine how much regulatory targets need to change their behavior to comply. Together, formal and substantive design elements produce the degree of regulatory control of business practices. From the perspective of a regulator, the elements of tightness and ambition represent the means for achieving a certain policy end, for instance, an overall emission reduction of a pollutant by 20%. In the next two sections, I outline the novel concept of regulatory stringency in qualitative terms as a basis for elaborate operationalizations (see codebook in Appendix III).

I illustrate the concept development using three examples of diverse environmental regulations that were applicable to ships in the North Sea in 2019. The North Sea has one of highest shipping intensities in the world (Wu et al. 2017) and is sufficiently well-researched to offer some evidence for regulatory effects. The sample regulations address the sulfur content of ship fuel, discharges of oily machinery space bilges, and underwater noise. The sulfur content of ship fuel determines the amount of sulfur oxides in engine exhaust. Sulfur oxides contribute to acid rain and respiratory health problems (Seyler et al. 2017, 10998–99). Machinery space bilges resulting from condensation, leakages, and cleaning contain oil and other pollutants from engine rooms and onboard machinery (CE Delft and CHEW 2017, 9; US EPA 2011c, 1). Discharges of oily bilge water can adversely affect marine life like seabirds by contributing to chronically elevated concentrations of oil along shipping lanes (Camphuysen 2010, 1305; Magnusson et al. 2018, 576). Underwater noise is caused by ship propellers, engines and machinery, and hydrodynamic flow past ship hulls (Erbe et al. 2019, 3). It can adversely affect marine mammals in various ways, and possibly also fish and crustaceans (Erbe et al. 2019, 13–14; Southall et al. 2017, 3–4). What form and substance did the regulation of these shipping externalities have in the North Sea in 2019?

Three Elements of Formal Tightness

Formal tightness reflects the legality, precision, and monitoring and enforcement system of a regulation. Regulations that are legally binding, precise, and have strong monitoring and enforcement provisions achieve the highest level of tightness. These regulations are most likely to elicit corporate compliance with the substantive provisions, either directly or via strong domestic regulation. By contrast, regulations that are nonbinding, imprecise, and lack compliance systems score lowest in terms of tightness. Multiple grades of tightness exist in between these two poles. To reduce complexity, I simply distinguish regulations with high, intermediate, and low tightness (see Figure 3). Below, I discuss all three formal design elements and provide qualitative indicators for their assessment. The indicators partly draw on existing notions of legalization (Abbott et al. 2000) and legality and structure (Raustiala 2005). I focus on those formal design elements that seem most relevant for eliciting compliance of business actors targeted by regulation.

Figure 3: Elements of formal tightness



Source: Author.

Legality denotes whether a regulation features provisions that are binding, partly binding, or nonbinding. Legal scholars disagree on the continuous or binary nature of this variable (Shaffer and Pollack 2010, 712–14; Weil 1983, 414–15, fn. 7). Abbott et al. (2000, 410) distinguish six obligation levels, whereas Raustiala (2005, 586–90) argues that states choose between binding and nonbinding instruments. Regime literature suggests that binding regulations generally "have a higher capacity to facilitate implementation and compliance" (Andresen, Rosendal, and Skjærseth 2013, 427). This is especially true when other incentives for compliance are low (Bodansky 2010, 220), which arguably applies to many environmental externalities of industrial activities. Nonbinding regulations have limited leverage in this respect, even though they can be efficient when binding rules are difficult or costly to achieve (Skjærseth, Stokke, and Wettestad 2006). The dichotomous operationalization of legality is thus generally suitable with respect to regulatory control of business behavior. However, I refine it by considering the possibility that binding and nonbinding provisions may coexist for the same environmental externality.

Legal status follows from explicit language or from implicit conditions expressed in related political treaties, such as framework conventions (Abbott et al. 2000, 410). Normally, the empirical distinction of binding and nonbinding provisions should be straightforward as disputes over legal status are rare (Raustiala 2005, 587). Discharges of bilge water and the sulfur content of ship fuel are regulated in Annexes I and VI to the MARPOL Convention. The Convention states that its parties "undertake to give effect to the provisions of the present Convention and the Annexes thereto by which they are bound" (MARPOL 1973, art. 1). The regulatory provisions on both impacts feature binding terminology, such as "shall be prohibited" and "shall not exceed" (MARPOL 2019, annex I, reg. 15.3, annex VI, reg. 14.4). By contrast, underwater noise from ships in the North Sea and elsewhere is covered by nonbinding global guidelines developed by the IMO. The document explicitly states that: "These non-mandatory Guidelines are intended to provide general advice about reduction of underwater noise to designers, shipbuilders and ship operators. They are not intended to form the basis of a mandatory document" (IMO 2014f, para. 3.1). Examples for partly binding regulations are non-binding standards or guidelines that the IMO adopts to specify binding MARPOL provisions.

Precision refers to how unambiguous the substantive provisions of a regulation are (Abbott et al. 2000, 401). Many researchers argue that precise rules can foster effectiveness by clarifying obligations, facilitating compliance activities, and reducing opportunities to shirk (Abbott and Snidal 2000, 446; Böhmelt and Pilster 2010; Mitchell 1994a, 317; Skjærseth, Stokke, and Wettestad 2006, 117; Stokke 2012, 54). Some others doubt that precision necessarily improves environmental performance (Y. Kim, Tanaka, and Matsuoka 2017, 86; Raustiala 2005, 583, fn. 10). This apparent contradiction can largely be resolved by differentiating more clearly between precision and substantive flexibility. The widely acknowledged Porter Hypothesis stipulates that regulation can encourage innovation if it sets ambitious goals while allowing for technological flexibility (Porter and Van der Linde 1995, 110–11). Precise provisions, such as emission limits that can be met with multiple technologies, do not necessarily reduce flexibility. Flexibility more directly depends on the choice between command-and-control and performance- or market-based regulation (Ambec et al. 2013, 4–5). Precision, by contrast, determines how clearly compliant and noncompliant behavior can be distinguished. This is important for regulations targeting corporate actors that may be unwilling to comply.[5]

Precision is operationalized by combining two existing indicators (Abbott and Snidal 2000, 413–15; Breitmeier et al. 1996, 82). Precise regulations contain clear limit values, technical specifications, and/or unambiguous conditions for exemptions that leave little room for interpretation.[6] Both the sulfur and bilge water regulations set clear numerical limit values for the allowed sulfur content of marine fuel and the maximum oil content in bilge water discharges (MARPOL 2019, annex I, reg. 15, annex VI, reg. 14). Imprecise regulations lack all abovementioned properties, thus leaving substantial discretion in interpretation. Precision is intermediate when precise and imprecise elements coexist, as in the IMO guidelines on underwater noise from ships. These guidelines describe best practices for noise reduction and reference noise measurement standards but do not specify what noise levels would be appropriate (IMO 2014f).

The monitoring and enforcement system is assessed regarding its strength in surveilling and enforcing corporate compliance. This is distinct from state-centered notions of delegation and structure. Delegation somewhat ambiguously refers to third party authority in rule implementation, interpretation, application, and development (Abbott and Snidal 2000, 401; Bélanger and Fontaine-Skronski 2012, 245–47). Structure denotes monitoring, including reporting and verification, and enforcement mechanisms vis-à-vis state parties (Raustiala 2005, 585; cf. Wettestad 2007). I agree that states are crucial intervening forces. For instance, strategic noncompliance or insufficient legal transposition and policing capacities can result in moribund hard law (Marcoux and Urpelainen 2012; Raustiala 2005, 585). However, the review of state behavior is analytically different from monitoring and enforcement mechanisms that apply to corporate actors once states implement regulations. I submit that the latter is more relevant for an assessment that considers business conduct as the eventual target of international regulation.

Strong monitoring and enforcement systems coerce corporate compliance ex-ante through equipment requirements, certification, and continuous monitoring provisions

[5] Note the difference to treaties regulating state behavior for which scholars highlight potential benefits of imprecision when states are willing to apply the general policy underlying a treaty (A. Chayes and Chayes 1993, 189).
[6] Some level of imprecision is likely to be inherent in all regulations. The reason is that “human beings are exposed to a diverse range of cultural and environmental stimuli, which structure the ways in which we perceive the world” (Davis 2005, 6). Thus, precise regulation reduces but does not eliminate the room for interpretation, including the possibility of loopholes.

(Mitchell 1994b, 433–35, 454–56).[7] The bilge water regulation requires ships operating in the North Sea to be equipped with certified oil filtering equipment, including a device that automatically stops discharges when the oil content exceeds the limit value (MARPOL 2019, annex I, reg. 14.7 and 15.3). Compliance with the equipment and discharge requirements is subject to inspections by state authorities. Weak compliance systems only rely on deterrence, i.e., usually patchy surveillance and ex-post prosecution of noncompliance (Mitchell 1994b, 454–56; Reiss 1984, 91). Compliance with the sulfur limit for ship fuel can only be controlled via port state inspections as well as occasional aerial or land-based emission surveillance (Topali and Psaraftis 2019).[8] Some regulations even lack monitoring and enforcement provisions altogether. The guidelines on underwater noise note possible prediction and measurement methods (IMO 2014, paras. 5–6) but do not require any noise monitoring of ships by state authorities.

Formal tightness, the first dimension of stringency, reflects the legal status, precision, and monitoring and enforcement system of a regulation. The thresholds for distinguishing different levels of tightness can be set in various ways. Recall that I want to challenge the critique that international maritime environmental regulations do not really attempt to control corporate behavior. To make this a tough probe, I set the thresholds restrictively, so that high tightness is hard to achieve. High tightness requires high scores on two design elements and at least a medium score on the third element. The North Sea shipping regulations for the sulfur content of fuel and discharges of oily bilge water pass this threshold. Intermediate tightness presupposes at least medium scores on all three design elements or one high and one medium score. Low tightness captures all regulations scoring below this threshold, such as the guidelines for underwater noise from ships. In general, high tightness is assumed to increase the ability of a regulation to elicit corporate compliance with its substantive requirements. I now turn to the second dimension of regulatory stringency, which is substantive ambition.

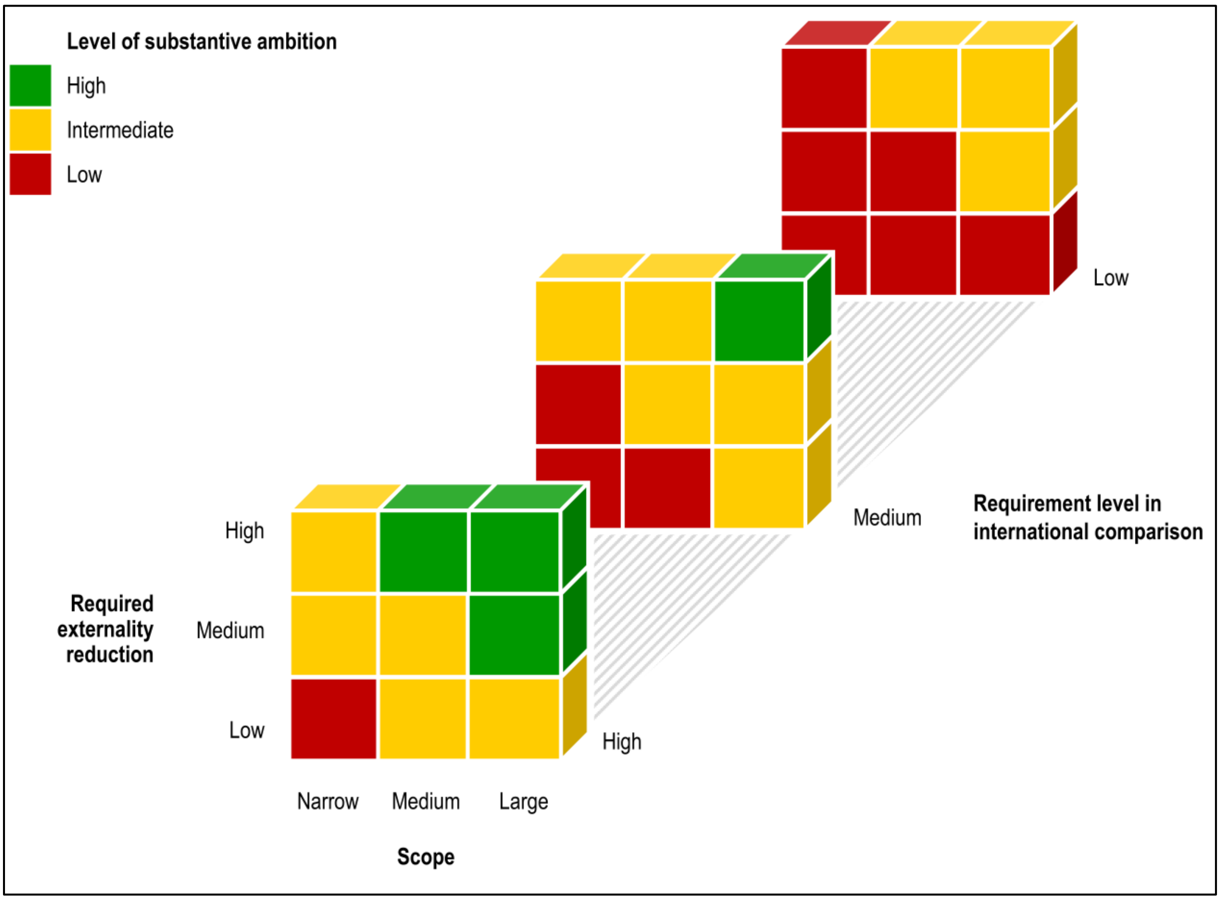
[7] This operationalization reflects an enforcement logic. Note that the literature also stresses the value of a management approach in eliciting state compliance (e.g., A. H. Chayes, Chayes, and Mitchell 1995; Stokke 2012, 282–83). I agree that managerial measures like capacity building can support domestic implementation of international regulations, even though the empirical evidence here is not particularly strong (Breitmeier, Young, and Zürn 2006a, 232). However, I contend that the main problem with regulations targeting corporate actors is that these utility-maximizing actors may violate provisions when the benefits of noncompliance are greater than its potential costs (Rugman and Verbeke 1998, 821–23). This behavioral assumption fits the enforcement approach (Bodansky 2010, 235–38).

[8] According to MARPOL Annex VI, ships may use an alternative method for complying with the sulfur limit which is at least as effective. One alternative method is the use of exhaust gas cleaning systems. In that case, states can control the equipment of ships with a certified exhaust gas cleaning system or control compliance based on continuous emission monitoring (IMO 2015e; Topali and Psaraftis 2019, 206–7).

Three Elements of Substantive Ambition

Substantive ambition results from the scope, required externality reduction, and the level of these requirements in relation to other international regulations. Regulations that have a large scope, require a high externality reduction, and rank among the most demanding regulations globally are considered most ambitious. These regulations require the greatest behavioral change from compliant businesses. By contrast, regulations that are narrow in scope, require no or only a small reduction in environmental impact, and demand less than other international regulations are least ambitious. Again, there is a wide spectrum in between these two extremes which I structure into regulations with high, intermediate, and low ambition (see Figure 4). Below, I explain all three substantive design elements and describe their qualitative indicators. I deviate from concepts of regime and agreement design in that I focus on regulatory design elements that determine the extent of required change in corporate rather than state conduct. The operationalization of these design elements also seeks to reduce some of the ambiguities found in existing notions of depth (e.g., Breitmeier et al. 1996; Downs, Rocke, and Barsoom 1996).

Figure 4: Elements of substantive ambition



Source: Author.

Scope denotes whether a regulation covers most, many, or only a few units from the entire population of pollution sources. This population is conceived of as a specific combination of pollution source and externality. One example are exhaust emissions of nitrogen oxides from seagoing ships. In this example, the larger the scope of the regulatory requirements, to the more ships and ship engines producing these emissions they apply. This leads to higher total externality reductions as if the same requirements applied to fewer ships and engines. This definition deviates from the state-centered notion of scope which focuses on the number of issues covered by an international institution (Koremenos, Lipson, and Snidal 2001, 770–71). It also differs from the use of scope to refer to the breadth of state participation (Barrett 2005, 355; Bernauer et al. 2013).

Regulations with a large scope cover most, if not all, of the relevant pollution sources. All three sample regulations are large in scope as their operational requirements apply to both new and existing commercial ships of all sizes. For instance, the underwater noise guidelines contain design recommendation for new ships but also mention noise-reducing technologies and operational measures for existing ships (IMO 2014f, paras. 7–10). The regulatory scope is narrow when requirements do not apply to the most relevant sources, such as heavily polluting engine or vehicle classes. A hypothetical example would be if restrictions on oily bilge water discharges only applied to smaller ships, which tend to produce less bilge water than large ships (CE Delft and CHEW 2017, 22). Scope is intermediate when some, but not all, of the most relevant sources are exempted.

Regulatory requirements differ in how much reductions in environmental impact they demand. Higher requirements imply greater behavioral change of compliant targets. The level of required reductions is best assessed against the nonregulation counterfactual for a compliant average pollution source. For instance, how much reductions in greenhouse gas emissions of aircraft do new carbon dioxide standards require compared to a situation without regulation? The baselines and cut-off points needed for answering this kind of question can be adapted to the externalities and industries at hand. For example, for externalities that have been regulated for a very long time, it may make sense to use the requirement level of early regulations as a benchmark. While being somewhat flexible, this operationalization should not be linked to any normative judgements about adequate requirement levels. This is a major difference to measuring depth via rule density and specificity (Breitmeier et al. 1996, 85).

Requirements are on the highest level when they eliminate the targeted externality completely or almost completely. Air pollution regulation in the North Sea limits the sulfur content of ship fuel to maximum 0.1% (MARPOL 2019, annex VI, reg. 14.4.3). This requirement virtually eliminates the externality, as it represents a reduction of more than 95% compared to previous levels.[9] Intermediate requirements demand major externality reductions compared to nonregulation but leave some room for improvement. The discharge limit for bilge water requires a reduction of the oil content to 15 parts per million. This represents a substantial reduction compared to 100 parts per million prior to the adoption of MARPOL in the 1970s but not yet a zero or almost-zero discharge requirement.[10] The guidelines on underwater noise recommend several measures promising substantial noise reductions, including reduced ship speed and diesel-electric propulsion (IMO 2014f, para. 8.3, 10.4), but leave out other important mitigation options.[11] In contrast to these examples, low requirements do not significantly go beyond nonregulation.

The requirements of a regulation must also be seen in the context of comparable international regulations. Global or regional requirements that exceed those of all other international regulations can be drivers of environmental innovation, even beyond their initial geographic ambit.[12] The reason is that multinational firms pursuing a global company standard (e.g., for equipment) adjust to the most demanding legal requirements. While this is costly, the alternative pursuit of several different regional standards may prove even costlier in the long run (M. Epstein and Roy 1998, 289). Thus, requirements that go beyond those of other international regulations are likely to yield greater improvements in corporate environmental practices.

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[9] This reduction was calculated based on the observation that the average sulfur content in ship fuel in the EU was 3.0% in 2005 (EEA 2006, 18). This value is comparable to the global average sulfur content of ship fuel before the IMO sulfur limit of 4.5% entered into force in 2005 (Kolle and Skjølsvik 2003, 10). The estimated reduction of over 95% appears plausible when compared with other data that uses slightly different base years (Kalli et al. 2013, 139; IMO 2009a, 5).

[10] The 100 part per million (ppm) benchmark reflects the level of international regulation under the International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL), which applied before MARPOL came into force in 1983 (Mitchell 1994a, 96). Note, however, that this benchmark is on the lower end of observed initial oil concentrations in bilge water (US EPA 2011c, 1). Today, most bilge separators reduce oil concentration to below 15 ppm, with some equipment even achieving 5 ppm (US EPA 2011c, iii–iv). The retention of bilge water in onboard holding tanks and discharge into port reception facilities would be a zero-discharge option in ship-side regulation (CE Delft and CHEW 2017, 22).

[11] A recent review has compiled a comprehensive list of noise reduction measures, many of which do not form part of the guidelines yet (cf. Vard Marine Inc. 2019, appendix A).

[12] I focus here on a comparison to other international regulations. A more detailed assessment could also consider requirements in domestic regulations of major market powers, like the US and the EU (Drezner 2008, 35–39).

Requirements are comparatively high when exceeding those of all other international regulations or when virtually eliminating the externality. The North Sea is an emission control area under MARPOL Annex VI with much more demanding sulfur requirements than the global level (MARPOL 2019, annex VI, reg. 14.1 and 14.3).[13] Intermediate requirements form a middle group in between the most and least demanding international regulations. Requirements are low when they are global and leave room for improvements or when falling short of other international regulations. The former applies to the underwater noise guidelines, the latter to the bilge water discharge limit in the North Sea. The regional oil discharge limit is identical with the global standard but less demanding than Arctic and Antarctic rules, which prohibit these oil discharges (IMO 2015b, part II-A, para. 1.1.1; MARPOL 2019, annex I, reg. 15).

Substantive ambition is the sum of the scope of a regulation, the externality reduction it requires, and the level of these requirements in comparison to other international regulation. Again, thresholds can be set in different ways and I take a conservative approach which ensures that it is relatively difficult for regulations to score high. High ambition requires maximum scores on two design elements and at least a medium score on the third element. Among the three examples, only the sulfur regulation falls into this category. Intermediate ambition requires at least medium scores on all three design elements or one high and one medium score. This is the case for the other two sample regulations. Low ambition refers to all regulations that do not pass this threshold. Regulations with higher ambition are likely to demand greater changes in the environmental practices of targeted companies. Substantive ambition and formal tightness together determine the level of regulatory stringency. Based on these qualitative foundations of the stringency concept, I now move on to its operationalization in quantitative terms.

A Quantitative Index of Regulatory Stringency

This section develops a quantitative index expressing the level of regulatory stringency in absolute terms. The index translates the values of the design elements described above into numerical codes and aggregates them in two steps. In a first step, the formal and substantive design scores are aggregated separately. I assume the three design elements within each dimension to be partially compensatory. An example justifies this assumption: A binding and precise regulation with strong compliance provisions is quite likely to elicit corporate behavioral change directly or through state implementation. If this

[13] In 2019, the global sulfur limit was 3.5%, compared to 0.1% in the North Sea emission control area.

regulation was made nonbinding, its precision and monitoring would still exert some direct or indirect pressure on businesses to meet the substantive requirements. The proper mathematical operation for aggregating partially compensatory elements, or family resemblance structures, is addition (Goertz 2006, 60, 115). I make the simplifying assumption that the three formal and three substantive design elements are of roughly equal importance for tightness and ambition, respectively. For instance, exempting some pollution sources from restrictive emission limits may reduce the sum of behavioral changes as much as more permissive limits for all sources. Therefore, all scores enter with the same weight, with the resulting tightness and ambition scores ranging from 0 (lowest) to 3 (highest).

In a second step, the scores for tightness and ambition are aggregated into a single stringency score. The integration of form and substance into one framework is a major improvement compared to existing concepts of regime and agreement design. Choices in both dimensions represent means that serve a regulatory end, like a certain overall reduction in environmental impact. Tightness and ambition are assumed to be necessary for regulatory stringency as they shape the control of business practices in complementary ways. Rules that are formally tight but unambitious merely codify status quo behavior. Conversely, ambitious standards that lack formal tightness call for significant behavioral changes but can hardly facilitate corporate compliance. The complementary functions of formal tightness and substantive ambition suggest that both dimensions should be weighted equally. This is underscored by the observation that they can be traded off against each other in negotiations (Guzman 2010, 156; Raustiala 2005, 601–9). Stringent regulation is then only achieved when the trade-off between tightness and ambition is overcome.

The literature suggests two possible aggregation rules for necessary elements: the minimum operator and multiplication (Goertz 2006, 111). The minimum operator implies that the total score equals the "weakest link." A binding regulation that is imprecise and lacks compliance provisions would be lax, irrespective of its level of ambition. However, for corporate actors that comply with this regulation simply because it is binding, higher ambition can make a big difference in terms of environmental practices. It is therefore more appropriate to multiply the tightness and ambition scores. Multiplication relegates very loose and/or very unambitious regulations to the pole of low stringency. At the same time, it provides for rather differentiated classifications as soon as some level of tightness or ambition is present. The stringency index score can take nineteen values from 0 (lowest) to 9 (highest) (see Table 1).

Table 1: Composition and interpretation of the stringency index

Tightness (T)		**Ambition (A)**	
Legality (X_T)		Scope (X_A)	
1	Binding	1	Large
0.5	Partly binding	0.5	Medium
0	Nonbinding	0	Narrow
Precision (Y_T)		Required externality reduction (Y_A)	
1	High	1	High
0.5	Medium	0.5	Medium
0	Low	0	Low
Monitoring and enforcement system (Z_T)		Requirement level in international comparison (Z_A)	
1	Strong	1	High
0.5	Weak	0.5	Medium
0	None	0	Low

Aggregation: Stringency (S)

$S = T*A = (X_T + Y_T + Z_T)*(X_A + Y_A + Z_A)$

S	**Level**	**Interpretation**
9.00	19	High stringency
7.50	18	High stringency
6.25	17	High stringency
6.00	16	Intermediate stringency
5.00	15	Intermediate stringency
4.50	14	Intermediate stringency
4.00	13	Intermediate stringency
3.75	12	Intermediate stringency
3.00	11	Intermediate stringency
2.50	10	Intermediate stringency
2.25	9	Intermediate stringency
2.00	8	Low stringency
1.50	7	Low stringency
1.25	6	Low stringency
1.00	5	Low stringency
0.75	4	Low stringency
0.50	3	Low stringency
0.25	2	Low stringency
0.00	1	Low stringency

Source: Author.

The stringency index ranks regulations on an ordinal scale, which I structure into three levels of stringency to ease interpretation. Again, class boundaries could be defined in various ways.[14] The option pursued here strictly follows the qualitative architecture developed for the dimensions of formal tightness and substantive ambition. This means that regulations need to score high on both tightness and ambition ($T\geq2.5$; $A\geq2.5$) to achieve high stringency. Intermediate stringency captures all regulations with intermediate tightness and ambition (T=1.5-2.0; A=1.5-2.0). A regulation scoring low on tightness and ambition ($T\leq1.0$; $A\leq1.0$) also possesses a low level of stringency. Combinations of different levels of tightness and ambition fall into the categories of low or intermediate regulation. The basic mechanism is that a low score on either formal tightness or substantive ambition drives down the overall stringency score of the regulation. The

[14] For a more fine-grained interpretation scale and an earlier, condensed version of the preceding concept description, see Hofmann (2019, 219–21). Note that the simplified scale used here paints over some of the inevitable ambiguities in concept measurement (Davis 2005, 34). Thus, it should be kept in mind that class boundaries are inherently fuzzy and remain adjustable to other regulatory and methodological contexts.

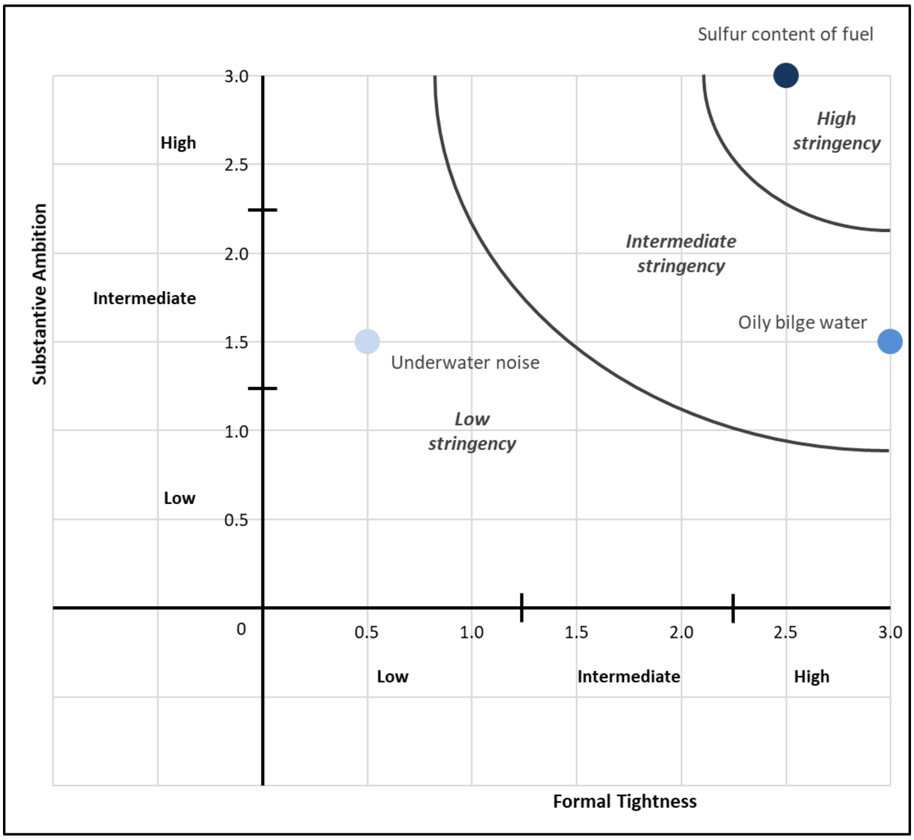
theoretical assumption behind this is that a regulation which lacks tightness or ambition is likely to struggle with eliciting major reductions in corporate environmental impacts. Application of these aggregation and interpretation rules leads to a differentiated ranking of the three sample regulations (see Table 2).

Table 2: Stringency index scores of three shipping regulations, North Sea, 2019

	X_T	Y_T	Z_T	T	X_A	Y_A	Z_A	A	S	Interpretation
Sulfur content of fuel	1	1	0.5	2.5	1	1	1	3	**7.5**	**High**
Oily bilge water	1	1	1	3.0	1	0.5	0	1.5	**4.5**	**Intermediate**
Underwater noise	0	0.5	0	0.5	1	0.5	0	1.5	**0.75**	**Low**

Source: Author.

Figure 5: Stringency, form, and substance of three shipping regulations, North Sea, 2019



Source: Author.

Three notes on limitations of the stringency index are in order. First, the index is not an interval scale and therefore cannot quantify stringency differentials among regulations. It would not be meaningful to state that a regulation is twice as stringent as another one.

Second, the index captures absolute stringency and thus cannot make visible all changes in consecutive regulations. For instance, more demanding requirements may reduce environmental impacts without necessarily passing the next coding threshold. Third, the index scale does not distinguish between regulations with numerically similar, yet structurally different dimension scores (e.g., T_1=3.0; A_1=1.0 compared to T_2=1.0; A_2=3.0). These regulations control business behavior to roughly comparable extents but differ in whether they primarily do so via form or substance. The snapshot provided by the index score can be differentiated by means of a graphical analysis mapping both tightness and ambition scores (see Figure 5). Yet, it remains an empirical question whether these different design compositions have different effects on actual business behavior.

Are Stringent Regulations More Effective?

The concept of stringency is built around design elements of international environmental regulations that are particularly relevant for exerting control over corporate behavior. This raises the question of whether higher stringency leads to higher effectiveness. My theoretical assumption is that, all else being equal, regulations with high stringency have the best chances of yielding an effect in terms of reducing corporate environmental impacts. The extent of required reductions depends on a regulation's substantive ambition; and corporate compliance with these requirements is shaped by its formal tightness. According to this simplified reasoning, high stringency reflects an attempt to actually control corporate conduct and low stringency should come closest to mere window-dressing. In other words, high-flying environmental ends of regulators typically call for the means of stringent regulation.

Anecdotal evidence for the three sample regulations supports the idea that regulatory effectiveness is linked to stringency. First, following the entry into force of the current sulfur regulation in the North Sea, observed sulfur dioxide emissions from ships declined sharply. The allowed sulfur content of fuel was lowered from 0.5% to 0.1% on January 1, 2015. In situ air pollution measurements (via a so-called "sniffer") before and after this date near the shipping lane to the port of Hamburg suggests that over 95% of all ships complied with the 0.1% sulfur limit (Kattner et al. 2015, 10090–91).[15] Before the entry into force of the new sulfur limit, only small ships ran on fuel with less than 0.2% sulfur (Kattner et al. 2015, 10091). Another study using data from optical remote sensing at a different location along the same shipping route confirms a significant

[15] Measurements in the neighboring Baltic Sea emission control area found similarly high compliance rates (Mellqvist et al. 2017).

reduction in sulfur dioxide emissions from ships following the new regulation (Seyler et al. 2017). The large reduction appears consequential, considering the high stringency of the regulation. Yet, some instances of noncompliance reflect the weakness of a monitoring and enforcement system that primarily relies on inspections (cf. Zis and Cullinane 2020).

Second, regional IMO regulations for the North Sea reduced operational oil pollution but did not eliminate it. The so-called North West European waters, which include the North Sea, became a special area for various kinds of operational oil discharges from ships in 1999. Data from aerial surveillance in the Belgian sector of the North Sea, where no offshore oil and gas activity takes place, suggests that many ships have complied with the relevant provisions (Lagring et al. 2012, 649).[16] Research into oil rates of stranded birds in the Netherlands confirms that chronic oil pollution has decreased (Camphuysen 2010, 1303–4). However, discharges of oily bilge water continue to contribute to "minor" slicks which may adversely affect seabirds (Lagring et al. 2012, 650). Oil contamination of seabirds is "still relatively common" along shipping routes farther away from coasts, with bilge water discharges being most likely the main source (Camphuysen 2010, 1305). This assessment corresponds to the intermediate stringency of the current regulation for oily discharges from machinery space bilges. Specifically, it reflects the intermediate level of ambition which involves the continued possibility to legally discharge certain quantities of oil into the sea.

Third, the IMO underwater noise guidelines, which were published in April 2014, have not resolved the problem of ship noise. A study of noise levels in UK waters in the summers of 2013 and 2014 identified shipping as a major anthropogenic noise source in North Sea locations (Merchant et al. 2016). Although long-term monitoring data is not available yet, the guidelines are unlikely to have caused major changes since then. They certainly have been considered in the underwater noise notations of ships that classification societies offer, but these notations already began to emerge before 2014 (e.g., DNV GL 2019). Besides, noise reduction in shipping often still has the character of pilot projects. One such project, involving the Danish operator Maersk, found a 75% reduction in source sound pressure level from container ships after major retrofit measures in 2015/16 (Maersk and Starcrest Consulting Group 2019, 41; Gassmann et al. 2017, 18–19). However, the intent of these retrofit measures "was clearly energy efficiency" and underwater noise reduction only a "co-benefit" (Maersk and Starcrest Consulting Group

[16] Note that, according to the study, complementary EU measures on port reception facilities were another major contributor to reduced oil pollution.

2019, 40–41).[17] A recent policy initiative by Canada, which may lead to a revision of the IMO guidelines, underscores that the guidelines have had only limited effects up to now (Canada 2018a; Canada and New Zealand 2018). The limited effectiveness of the IMO underwater guidelines corresponds to their low stringency, especially their loose form.

The differences in the effectiveness of the three regulations reflect their different levels of stringency. While a causal link thus appears plausible, one major caveat applies: neither do I claim that less stringent regulations are necessarily ineffective, nor do I expect that stringent regulation is always effective. Indeed, a multitude of intervening factors has been demonstrated to operate on the levels of international regimes and domestic implementation of international commitments (e.g., Breitmeier, Underdal, and Young 2011; Skjærseth 2000; 2010; Underdal 2002; O. R. Young 2014). For instance, capacity-building has been identified as an important factor for increasing regime effectiveness (Breitmeier, Young, and Zürn 2006a, 158; M. A. Levy, Keohane, and Haas 1993, 414–15). By implication, stringent regulation may fail when certain states and their business actors lack the capacity to comply with the demanding requirements. Furthermore, domestically fragmented competences in pollution control may hinder the effective implementation of international regulation (Skjærseth 2000, 269–70). The interaction of regulatory design with these and other intervening factors may be worth exploring in the future. In this dissertation, however, I have limited myself to examining the variance of regulatory stringency and its causal roots in corporate practices. For this purpose, it suffices to assume that, because of its strong control of business behavior and ambitious requirements, regulation with high stringency stands a better chance of reducing environmental externalities.

To draw an interim conclusion, the preceding sections have shown that regulatory stringency is an adequate concept for comparing the design of international environmental regulations. It goes beyond existing concepts of international regime and agreement design and closes the gap between these concepts and those capturing transnational business standards (cf. Michaelowa and Michaelowa 2017; van der Ven 2015). The stringency concept creates a basis for compiling systematic data on the design of international environmental regulations as a new study object. Such data can substantiate the introductory claim of this dissertation that, in contrast to international environmental

[17] The project referred to here was conducted on the US West Coast. Other pilot projects for reducing underwater noise from cargo as well as passenger ships have been reported from British Columbia (Canada 2018a, paras. 6–11). No comparable projects seem to have taken place in the North Sea.

agreements, regulations have continued to develop dynamically. It also allows for identifying empirical patterns that theories about business influence on international regulatory decisions should explain. For these purposes, I compiled the new International Maritime Environmental Regulation (IMER) Database.

The International Maritime Environmental Regulation (IMER) Database

The IMER Database maps the design of international regulations addressing operational environmental impacts of maritime shipping and offshore oil and gas production. It covers all formally effective regulations for shipping in 1989, 1999, 2009, and 2019. This allows for tracking regulatory developments over four decades since the entry into force of the global MARPOL Convention in the 1980s. Additionally, the database includes all regulations that applied to offshore oil and gas platforms in 2019. This allows for an up-to-date comparison of two major maritime industries. The database records values for the six design elements of regulatory stringency described earlier in this chapter. This data is aggregated into values for formal tightness, substantive ambition, and overall stringency according to the established index procedures.

The unit of analysis is the regulation of a single externality in a given industry, sea area, and year. This means that I do not code the structure of regulatory documents. I rather ask how an externality (e.g., oil) from a specified operational source (production water) and activity (offshore drilling) was regulated in one region (North-East Atlantic) by a certain international organization (OSPAR Commission) at a given point in time (2019). Regulatory provisions can be contained in documents of different legal quality, including conventions, protocols, decisions of international organizations, recommendations, standards, guidelines, and the like. While practitioners would probably hesitate to refer to standards and guidelines as “regulation,” this understanding is consistent with comprehensive scholarly conceptions of global regulation (Braithwaite and Drahos 2000, 19–20; Kerwer 2005; Mattli and Woods 2009). The database lists the relevant regulatory documents and the international regulatory body that issued them.

The IMER Database fills two gaps. The first gap relates to existing data on international environmental regimes and agreements. The two most relevant datasets are the International Environmental Agreements Database (IEADB) and the International Regimes Database (IRD). The IEADB lists more than 3,700 international environmental agreements and contains data on the type of provisions of over 150 multilateral environmental agreements (Mitchell 2020). The IRD features comprehensive design data for 21 regimes, structured into 172 regime elements (Breitmeier, Young, and Zürn 2006b). While these are valuable initiatives for enabling quantitative research into *agreement* and *regime design*, their data is too crude for assessing variance in impact-specific *regulatory design*. Both the IEADB and the IRD lump together many regulations of varying design in one agreement or regime element coding (Breitmeier, Young, and Zürn 2006a, 53).[18] The IMER Database fills this gap by coding individual regulations, which are the constituent parts of many international environmental agreements or regimes. This data collection effort contributes to moving the empirical focus from agreements and regimes to the microlevel of regulations.

The second gap in existing data concerns the empirical field of maritime regulations. The literature offers several qualitative overviews of international environmental regulations of shipping and offshore oil and gas activities (e.g., Lyons 2015; Molenaar 2015; Rochette et al. 2014, 11–17; Tan 2006). The virtue of these works is that they can delve into the manifold legal complexities of the international law of the sea. Their main shortcoming is that they need to be selective in the regulations they discuss. This makes it difficult to pin down empirical patterns and identify puzzles that apply to the entire population of international maritime environmental regulations. The IMER Database fills this gap by creating quantitative data on the design of these regulations. To my knowledge, this is the first attempt of its kind with respect to operational externalities of shipping and offshore oil and gas production. At the expense of neglecting some of the legal intricacies, the data will enable a more comprehensive and systematic assessment of the maritime regulatory landscape. While not being representative of any other industries, this assessment may inspire similar efforts in other sectors.

[18] For some design elements, such as depth, the IRD only attributes one coding score per regime component. An example is the North Sea regime (OSCOM, PARCOM, and OSPAR) between 1984/1992 and 1998. In this period, the respective international organizations took more than 45 decisions and recommendations which varied in their regulatory design (e.g., strength of monitoring system, level of requirements in relation to externality). They also covered many different issues, including the disposal of disused offshore platforms, the reduction of pollutant emissions from different land-based industries, and the phaseout of certain industrial chemicals. Another example is the Baltic Sea protection regime where regulation of all pollution sources is treated as a single regime component. By contrast, for design elements like legal status and precision, the IRD codes a multitude of individual provisions from regulatory documents. Some of these provisions, while all relating to the same externality, receive different coding scores. Here, the starting point for coders was apparently the regulatory text rather than the environmental externality. For these reasons, the IRD data cannot be fed into the IMER Database.

The fine-grained coding of individual regulations requires limiting the scope of the database.[19] One limitation in scope is the focus on two maritime industries with partly overlapping externalities. This enabled me to acquire deeper knowledge of and familiarity with the issue area and its key technical aspects. Another limitation in scope is the focus on four coding years across four different decades. This selection served to save resources while still enabling meaningful comparisons over time. Ten years are a sensible interval because, as the case studies will show, it is unusual that more than one major regulatory revision takes place and enters into effect during this time.[20] These limitations in scope allowed me to cover all operational environmental impacts caused by ships (35 impacts) and offshore platforms (45 impacts).[21]

To make the coding as transparent and replicable as possible, I compiled a comprehensive database protocol (see Appendix III). The protocol outlines the scope and structure of the database, describes the coding criteria, provides numerous examples for their application, and lists the sources used. In the database itself, I provide a short qualitative justification for each value assigned to the design elements (see Hofmann 2020).[22] Together with the examples in the protocol, this allows the reader to retrace my coding decisions. The limited scope of the database increased the time available per coding and thus also data quality. To avoid slippage in coding criteria over time, an initial coding round and a separate review round were conducted. The validity of the data is underscored by the fact that, as will become clear below, many of the obtained results can be linked to more specific assessments in existing qualitative literature. I now turn to a structured analysis of the data.

[19] For a brief discussion of the problems with coding the substance of large, multi-issue sets of provisions, see Mitchell et al. (2020, 9–10).

[20] An occasional exception to this is the phased entry into force of requirements within less than a decade. However, given the rather coarse categories for capturing requirement levels, the coded values would only change in few of these cases.

[21] For a discussion of some uncertainties in the identification of potential externalities, see the database protocol in Appendix III.

[22] This is a measure to increase the credibility of my single-coder data. International relations researchers have called for datasets that are widely agreed upon by the community of scholars and have noted that the documentation of coding criteria and decisions is crucial in this respect (e.g., Lebow and Stein 1990, 340, 349). I provide this information and encourage other scholars of maritime regulation to retrace and review my coding decisions as a step towards such a more broadly agreed dataset.

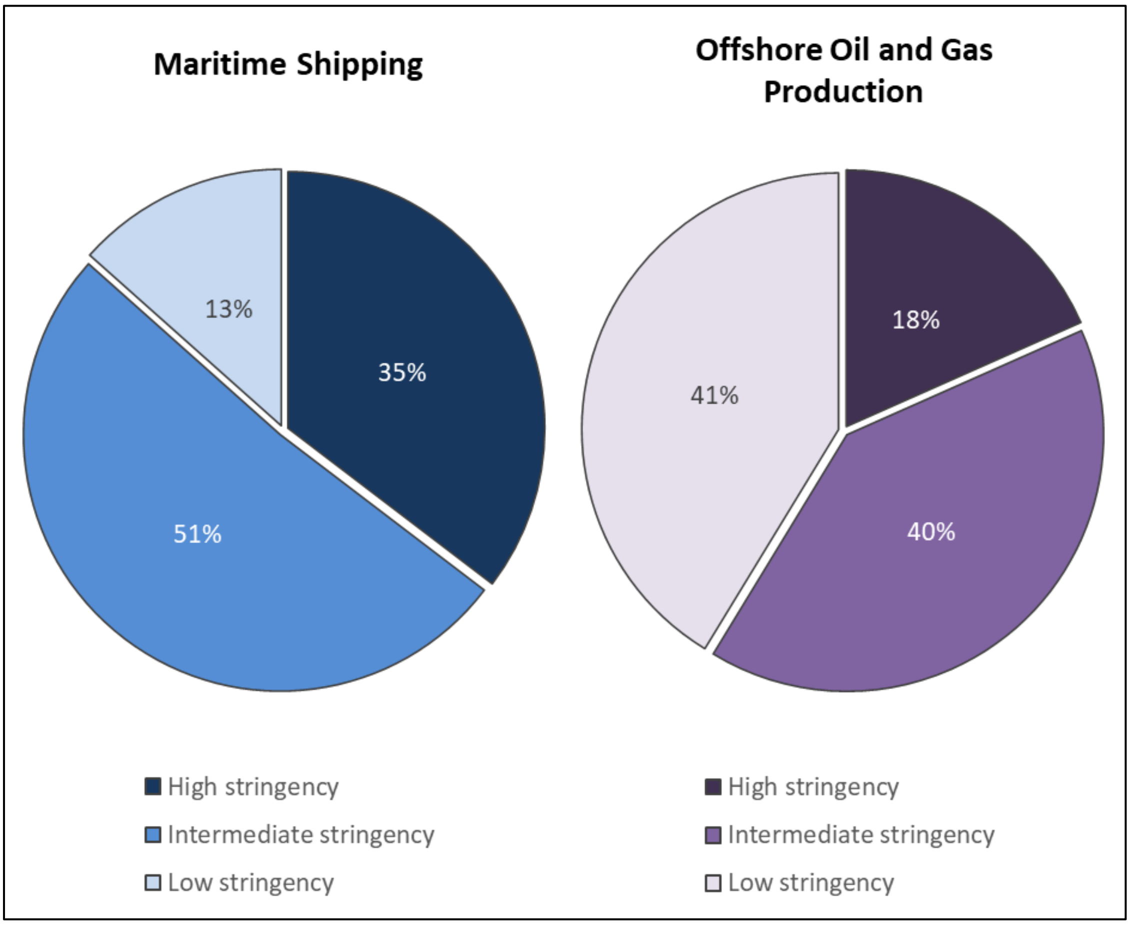
Five Puzzles in the Empirical Variance of Regulatory Stringency

Based on the IMER Database, I quantitatively describe the empirical variance in the international environmental regulation of maritime shipping and offshore oil and gas production. The main finding of the analysis is that international environmental regulation is more than window-dressing as numerous regulations with high and intermediate stringency exist. More specifically, the analysis identifies five empirical puzzles that merit causal exploration as we shift our analytical focus from regimes to regulations. First, a cross-industry comparison finds that shipping is subject to more stringent regulation than offshore oil and gas. Second, an analysis by type of externality reveals that stringent regulation emerged earlier for oil and other types of water pollution than for air pollution and other ecosystem impacts. Third, a cross-regional analysis shows that sea areas in Northern Europe and around the poles are subject to the most extensive and/or stringent regulation. Fourth, a comparison of international bodies reveals that rather extensive and stringent sets of regulations have been produced by organizations with strong business participation. Fifth, an analysis on the level of regulatory design elements demonstrates that, over time, ever more regulations have overcome the alleged trade-off between tightness and ambition. The following sections outline these puzzles in more detail and discuss their importance in relation to existing knowledge in the study of maritime regimes and regulations.

Variance across Industries

A cross-industry comparison reveals that environmental impacts of maritime shipping are subject to more stringent international regulation than impacts of offshore oil and gas production. Figure 6 shows the share of regulations with high, intermediate, and low stringency in both industries at the end of 2019. Over 80 regulations covered shipping externalities, with more than a third having a high level of stringency. Offshore oil and gas impacts were addressed by over 100 regulations, but only less than one fifth of them scored high on the stringency index. The reversed picture is observed for the share of international environmental regulations with low stringency (13% in shipping and 41% in offshore oil and gas). Intermediate stringency represented the largest category in both industries accounting for half of all shipping regulations and two fifths of offshore oil and gas regulations. Thus, a sizeable part of regulations in both industries goes beyond mere window-dressing standards which do not aim at eliciting corporate compliance with requirements for significant improvements in environmental performance.

Figure 6: Regulatory stringency by industry, 2019



Note: Figure is based on count of all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas). Total of percentage shares may slightly deviate from 100% due to rounding.

Source: Author.

The cross-industry comparison puts diverging regulatory evaluations into perspective. It notably raises serious doubts about assessments which, drawing on a few externalities, have depicted shipping regulation as deficient (Lister 2015, 124–25; Roe 2013, 20–27). Instead, it supports those that, based on comparisons with regulation for aircraft or land-based pollution sources, have described shipping regulation as rather demanding or intense (Ovodenko 2017, 38–39; Tan 2006, 14). With respect to offshore oil and gas, the data largely confirms the view that this sector "is not as regulated as other impacting activities" (Rochette et al. 2014, 32). While this view might seem too pessimistic when considering the total number of regulated externalities, it accurately captures the differences in regulatory stringency. Overall, the IMER data raises the puzzle of why two maritime industries that cause similar types of externalities (e.g., oil, chemical, and air pollution) are regulated so differently on the international level.

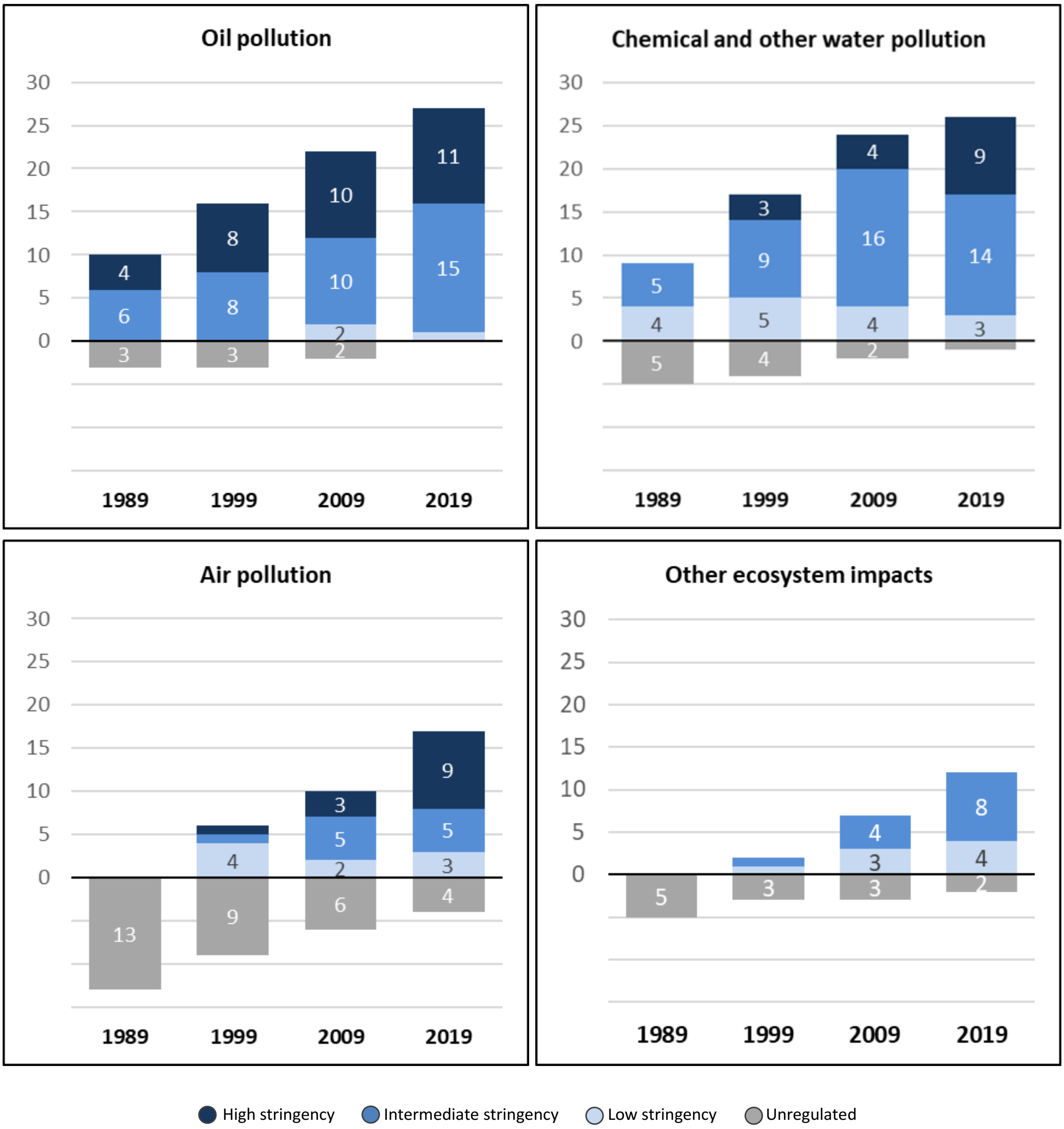
Variance across Externalities

A cross-issue analysis shows that stringent regulation has emerged earlier for oil and other types of water pollution than for air pollution and other ecosystem impacts. Figure 7 depicts the number of regulations on each stringency level and the number of unregulated externalities in maritime shipping by type of impact from 1989 to 2019. Four types of impacts are distinguished: oil pollution, chemical and other water pollution, air pollution, and other ecosystem impacts. The data suggests that these types of externalities have been addressed in different regulatory waves. A first wave of stringent regulation targeting operational oil pollution began before 1989. A second wave of stringent regulation covering chemical and other kinds of water pollution emerged in the 1990s. A third wave of stringent regulation addressing air pollution impacts began to unfold in the 2000s. A possible fourth regulatory wave is heralded by the increasing number of regulations for ecosystem impacts like the introduction of invasive species and underwater noise.

These regulatory waves share three characteristics. First, regulations with intermediate and low stringency usually preceded more stringent regulation. Examples are the increases in regulatory stringency for discharges of garbage and sewage in the Baltic Sea. Second, the number of stringent regulations continued to grow after its initial emergence. This often reflected the extension of stringent regulation to additional sea areas, like special areas in which MARPOL prohibits certain discharges from ships. From 1989 to 2019, the number of formally effective special areas rose from 4 to 18 across impacts. Third, also the number of regulations with intermediate stringency continued to increase throughout the regulatory waves. Intermediate stringency has been typical for global regulations of impacts for which more demanding regional requirements existed as well as for regulations of previously unregulated externalities. At the same time, the number of unregulated externalities has continuously decreased.[23]

[23] The regulation of one externality occasionally created or increased other externalities, which later became regulated. For instance, more stringent air pollution regulation has encouraged the use of control technology (e.g., exhaust gas cleaning systems and exhaust gas recirculation) that produces new wastewater streams (cf. Turner et al. 2017). These wastewater streams have been responded to with new international regulation for preventing oil and other water pollution.

Figure 7: Number and stringency of shipping regulations by externality type, 1989-2019

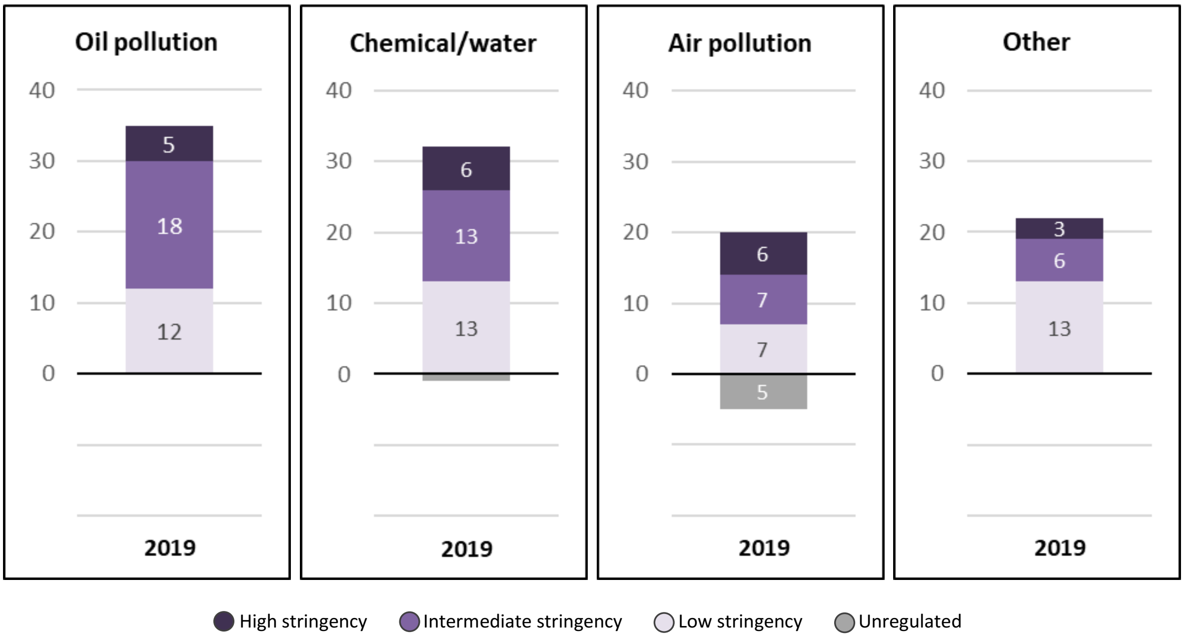


Note: Figure shows count of all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas). The number of unregulated externalities refers to externalities that are not subject to international regulation in any sea area. For the number of coded externalities per type, see Appendix III.

Source: Author.

In 2019, regulatory patterns for ship impacts partly resembled those for offshore oil and gas impacts. Figure 8 shows the distribution of regulations with high, intermediate, and low stringency by type of externality as well as the number of unregulated externalities of offshore platforms as of 2019. Like in shipping, the highest number of regulations applied to oil as well as chemical and other water pollution from platforms. Other similarities with shipping are several unregulated air pollution impacts[24] and a relatively lax regulation of other ecosystem impacts. Impacts of major concern, like air emissions from flaring and venting, were not among the stringently regulated air pollution externalities. Unlike in shipping, regulations with low stringency were numerous for all types of platform impacts. This is due to sets of offshore guidelines that address many externalities but are loose in form: the World Bank's global Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development, and the Arctic Council's regional Arctic Offshore Oil and Gas Guidelines (cf. Koivurova 2018).

Figure 8: Number and stringency of offshore oil and gas regulations by externality type, 2019



Note: Figure shows count of all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas). The number of unregulated externalities refers to externalities that are not subject to international regulation in any sea area. For the number of coded externalities per type, see Appendix III.

Source: Author.

The puzzle arising from the analysis is that stringent regulation emerged earlier for some types of externalities than for others. The IMER data suggests that the expansion of shipping regulation (Molenaar 2015, 187) has occurred in four waves. These waves have been reflected in the shifting empirical focus of studies on shipping regulation. Early

[24] Note that in shipping, several air pollution impacts which are not directly regulated are reduced as co-benefits of regulations addressing another air pollutant. For instance, limits for the sulfur content of ship fuel also reduce the number of sulphates, which is a component of particulate matter.

studies dealt with rules for limiting oil pollution (e.g., M'Gonigle and Zacher 1981; Mitchell 1994a). More recent studies have considered air pollution and other ecosystem impacts (Gritsenko and Yliskylä-Peuralahti 2013; Tan 2006). Regarding these latter impacts, the temporal patterns in the data suggest that it may be too early to speak of policy failures (Lister 2015; Roe 2013, 20–27). While current levels of regulation may not be sufficiently protective (cf. Turner et al. 2017), they are probably just a snapshot from ongoing regulatory waves. Overall, the conclusion that "the regulation developed under IMO's auspices to reduce various pollutants generated by ships have become consistently broader and more stringent over time" remains valid today (Mitchell 1994a, 336). More generally, the analysis underscores the value of a comprehensive empirical assessment as a complement to debates that center on a few highly contentious issues, such as the decommissioning of offshore platforms (e.g., Jørgensen 2012; Lyons 2014; Osmundsen and Tveterås 2003; Woodliffe 1999).

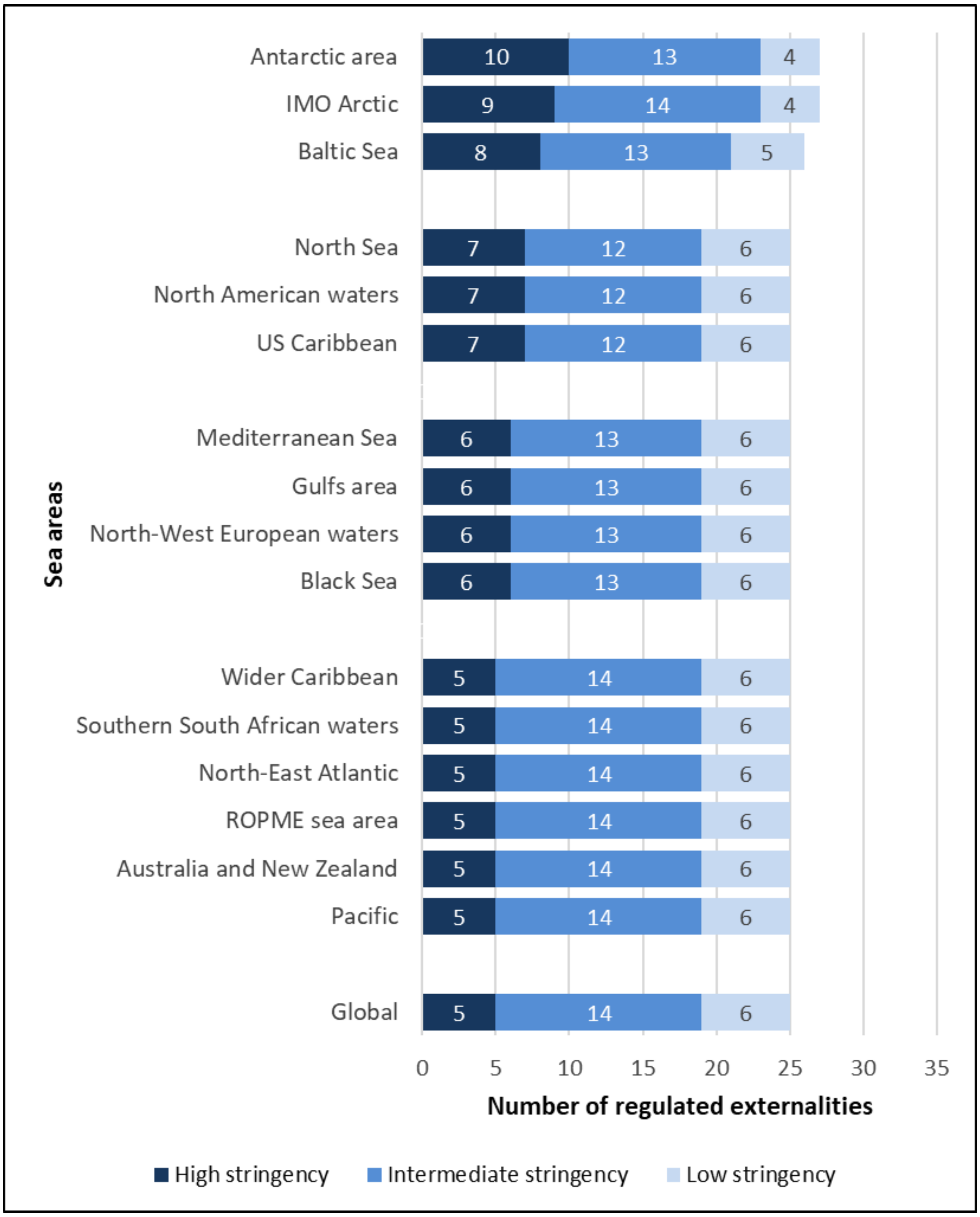
Variance across Regions

A cross-regional analysis identifies polar waters and some sea areas in Northern Europe as hotspots in the international environmental regulation of maritime industries. Figure 9 shows the number of regulated shipping impacts and the stringency of regulations by sea area at the end of 2019. The Antarctic area, the Arctic as defined by the IMO, and the Baltic Sea had the highest numbers of regulated shipping impacts (26-27 out of 35) and of stringent regulations (8-10).[25] In the two polar regions, regulations required ships to greatly reduce or eliminate many operational impacts. In the Baltic Sea, emissions of sulfur oxides and discharges of sewage were more stringently regulated than in many other regions. In another seven sea areas, the number of regulated externalities was identical to the global level (25), but high stringency was slightly more frequent (6-7, compared to 5). The reason for this is that these regions are special areas for oil discharges, garbage, and/or emissions of air pollutants under MARPOL Annexes I, V, and VI. For instance, stringent regulations for exhaust emissions of sulfur oxides and nitrogen oxides apply to North American waters and the US Caribbean. The remainder of sea areas listed in Figure 9 possessed some dedicated regional regulation but did not differ from global regulation in numbers and stringency class. For instance, like the global IMO guidelines, the regional guidelines of Australia and New Zealand for preventing the introduction of invasive species through biofouling (i.e., the settlement of organisms on the underwater

[25] Numbers for shipping and offshore oil and gas regulations in the Arctic differ from those reported in Hofmann (2019) due to the more aggregated grouping of externalities used here (see also Appendix III).

hulls of ships) achieve intermediate stringency. In all the sea areas not listed, only global regulations applied (for a map of all sea areas with regulations, see Figure 26 in Appendix III).

Figure 9: Regulatory stringency in maritime shipping by region, 2019



Note: For a map of sea areas, see Figure 26 in Appendix III. Each externality is only included once. For each externality, the applicable regulation with the highest level of stringency is counted, taking also into account regulations that apply to larger areas in which a sea area may be nested (global regulations are assumed to apply to all regional sea areas). The number of regulated externalities can therefore not directly be compared to the cumulative number of regulations shown in other figures and tables. Sea areas not subject to any dedicated regional regulation are not listed.

Source: Author.

The regional patterns of international environmental regulation of offshore oil and gas production partly differ from those of maritime shipping. Figure 10 visualizes the number of regulated platform impacts and the stringency of these regulations by sea area at the end of 2019. Regional regulations for platforms existed in 12 sea areas, or three quarters of the areas with regional shipping regulation. However, across these regions, the offshore industry exhibited greater variance in the number of regulated externalities and in regulatory stringency. In the Antarctica area, all mining activity is prohibited by the Antarctic-Environmental Protocol. In the Arctic, regulations cover many externalities (36 out of 45) but are rarely stringent. The Baltic Sea, North Sea[26], and North-East Atlantic had the highest number of stringently regulated impacts (8-10, compared to 4-6 in all other areas). Because of overlapping regulatory spheres, the European part of the Arctic also forms part of the North-East Atlantic area covered by OSPAR regulations. This subregion is thus more stringently regulated than the rest of the Arctic (Hofmann 2019; cf. also Humrich 2013).

Regulations with intermediate stringency were most numerous in the Persian Gulf and Oman Sea (Gulfs area and ROPME sea area) as well as in the Mediterranean Sea. Offshore activities in these areas are governed by relatively comprehensive but not very stringent regional instruments. Other sea areas listed in Figure 10, including those around North America, lacked dedicated regional offshore regulation and thus only featured a few shipping regulations applicable to offshore platforms. A region likely to enter the list in the near future is the Western coast of Africa, for which the Malabo Protocol on environmental norms and standards for offshore oil and gas production was adopted in 2019 but has not come into force yet (Rochette, Schumm, and Diagana 2019).

[26] In line with my definition of international environmental regulations, the analysis excludes EU regulations that, through extension to the European Economic Area (EEA), de facto apply to the entire North Sea. Relevant regulatory requirements exist for emissions of greenhouse gases (EU Emission Trading System) and for emissions of air pollutants from combustion engines (EU Industrial Emissions Directive, EU Directive 2010/75/EC). The actual level of protective measures applicable in the North Sea is thus even higher than indicated by my data.

Figure 10: Regulatory stringency in offshore oil and gas production by region, 2019

* In Antarctica, offshore oil and gas production is prohibited. This eliminates all potential externalities.

Note: For a map of sea areas, see Figure 26 in Appendix III. Each externality is only included once. For each externality, the applicable regulation with the highest level of stringency is counted, taking also into account regulations that apply to larger areas in which a sea area may be nested (global regulations are assumed to apply to all regional sea areas). The number of regulated externalities can therefore not directly be compared to the cumulative number of regulations shown in other figures and tables. Sea areas not subject to any dedicated regional regulation are not listed.

Source: Author.

The regulatory picture captured here corresponds to the prevailing abundance of environmental agreements with regional ambit and/or membership (Balsiger and Prys 2016). It is also consistent with the observation that maritime governance has become subject to regionalization processes (van Leeuwen 2015). Furthermore, the analysis of IMER data puts single-region studies of maritime regimes and regulations into comparative perspective. It confirms several literature examples of regions with strong marine protection policies: relatively high levels of regulatory protection are found in the Arctic (Deggim 2018; Ø. Jensen 2016, 69–70), Antarctic (Stephens 2017, 447–48), Baltic Sea (Backer et al. 2010; Gritsenko 2014; VanDeveer 2011), and North Sea (Skjærseth 2000; Skjærseth, Stokke, and Wettestad 2006; Tromp and Wieriks 1994). By contrast, the data suggests that the Mediterranean Sea has not fully continued its early success story (P. M. Haas 1990), at least not in the regulation of maritime industries. Furthermore, the data points to cross-industry differences within regions. The regulation of Arctic shipping is far more stringent than that of Arctic offshore oil and gas. Along North American coasts, the presence of special international shipping regulation contrasts with an absence of dedicated international regulation for offshore oil and gas. The overarching puzzle though is that regulatory activity and stringency concentrate in just a few regions. Some of these regions are characterized by high maritime use (North Sea, Baltic Sea for shipping); in others, maritime activity is still limited (Arctic, Antarctic) (Rochette et al. 2014, 5–7; Wu et al. 2017).

Variance across International Regulatory Bodies

A cross-institutional analysis demonstrates that international regulatory bodies vary greatly in the number and stringency of regulations they produce. Table 3 gives an overview of regulation by international bodies governing environmental impacts from ships and platforms as of 2019. Governance activity for shipping is clearly concentrated in the IMO, with more than a third of its regulations having a high stringency. In the MARPOL framework, the IMO has produced a particularly large share of regulations with high formal tightness. Regional bodies play a limited role in the regulation of shipping externalities. Their regulations mainly serve to implement or complement IMO regulations. For instance, the parties of OSPAR, HELCOM, and the Barcelona Convention early applied global ballast water requirements to prevent the introduction of invasive species in the North-East Atlantic, Baltic Sea, and Mediterranean Sea. In the Antarctic area and the Baltic Sea, provisions adopted under the Antarctic Treaty System (ATS) and HELCOM have complemented IMO regulations and increased their stringency.[27]

[27] The main complementary measure adopted by HELCOM is the no-special fee system for ports in the Baltic Sea (HELCOM 2007c). This system creates financial incentives for compliance of ships with no-discharge provisions by integrating the fees for the use of port reception facilities into port fees independent of whether waste is delivered or not. These incentives increase the strength of the monitoring and enforcement systems of garbage and sewage regulations. No-special fee incentives also exist for

Table 3: Number and stringency of regulations by international body, 2019

	International regulatory body	Number of regulations	Share of high stringency	Share of high formal tightness	Share of high substantive ambition
Maritime shipping	IMO	59	36%	69%	47%
	IMO/ATS	9	67%	78%	78%
	IMO/HELCOM	4	25%	100%	25%
	HELCOM	3	33%	33%	33%
	SPREP	2	0%	0%	50%
	OSPAR Commission	2	0%	0%	0%
	Australia and New Zealand	1	0%	0%	100%
	Barcelona Convention	1	0%	0%	0%
	ROPME	1	0%	0%	0%
Offshore Oil and Gas Production	IMO	21	38%	71%	48%
	World Bank	17	0%	0%	0%
	Barcelona Convention	16	13%	31%	25%
	Arctic Council	15	0%	0%	20%
	HELCOM	12	42%	42%	75%
	ROPME	12	0%	8%	0%
	OSPAR Commission	10	40%	50%	60%
	ACCOBAMS	2	0%	0%	0%
	London Convention	2	0%	0%	0%
	Antarctic Treaty System	1	100%	100%	100%
	Black Sea Commission	1	0%	0%	0%

Note: The table counts all regulations by the respective body in all sea areas (one externality may be subject to multiple regulations in different sea areas).

Source: Author.

The institutional landscape in the environmental regulation of offshore oil and gas platforms is more fragmented. On the global level, regulators include the IMO, the London Convention (which is administered by the IMO), and the World Bank. Many IMO regulations for offshore platforms resemble those applicable to ships. The offshore guidelines of the World Bank are not stringent as they typically lack both formal tightness

oily wastes from machinery spaces but the monitoring and enforcement system under MARPOL Annex I is already strong for these discharges.

and substantive ambition. On the regional level, the leading regulators were HELCOM and the OSPAR Commission with a share of 42% and 40% stringent regulations, respectively. Most of their regulations were ambitious in substance and about one half was tight in form. By contrast, the Barcelona Convention and ROPME covered a sizeable number of environmental impacts, but stringent regulation was almost completely absent. Their regulations were usually less ambitious in substance than HELCOM and OSPAR regulations; and ROPME regulations were also clearly less tight in form. Finally, the Arctic Council has developed offshore guidelines that, despite some ambitious provisions, score low in terms of stringency.

The analysis delivers new insights into institutional fragmentation. As regards shipping, it largely confirms the central position of the IMO and the limited role of regional maritime bodies (Molenaar 2015, 184).[28] However, it highlights that complementary regional regulation, namely by the Antarctic Treaty System and HELCOM, has increased stringency in some areas. As regards offshore oil and gas, differences among international bodies in the number and stringency of regulations confirm the high fragmentation detected by analysts (Lyons 2015; Rochette et al. 2014, 20). This fragmentation corresponds to the more limited geographic scope of offshore hydrocarbon production and its impacts (van Leeuwen 2010, 154). However, the IMER data also reveals weaknesses of existing reviews of offshore oil and gas regulation. Namely, they appear to have focused too much on the global level and/or have overlooked relevant regulatory documents, such as the offshore guidelines of the World Bank (cf. Lyons 2015; Rochette et al. 2014).

Furthermore, the analysis provides new evidence for the performance of different international institutions. First, it corrects the image of the IMO as a reactive, slow-moving, and lax regulator. The organization has been accused of hidden and unregulated industry representation in delegations (Psaraftis and Kontovas 2020) and corporate capture by shipping interests (InfluenceMap 2017). Moreover, its secretariat has been described as "a tanker for the tankers" (Campe 2009, 162). A large number of regulated externalities and substantial share of stringent regulations suggest that the IMO does not perform too badly overall (cf. also Mendenhall 2019, 31–32). Second, the analysis suggests that HELCOM is another progressive regulator of maritime pollution (cf. VanDeveer 2011). Third, it identifies the OSPAR Commission, in which industry actors can

[28] This is not to deny that the IMO has repeatedly come under pressure from threats of unilateral action by the EU and the US (Tan 2006, 86–89; van Leeuwen 2010, 88–92), and is part of issue-specific regime complexes that also involve other international organizations (e.g., Hackmann 2012).

participate as well, as a vanguard in stringent offshore oil and gas regulation in an area with high production (van Leeuwen 2010, 130–34). Fourth, the analysis supports the view that the performance of ROPME has been mixed (Nadim, Bagtzoglou, and Iranmahboob 2008, 564). Fifth, it backs the impression that the Arctic Council has remained relatively constrained and toothless in terms of regulatory functions (Koivurova 2010, 3; O. R. Young 2016, 112–13). In sum, it is very remarkable that the most stringent regulators are characterized by rather strong business participation.

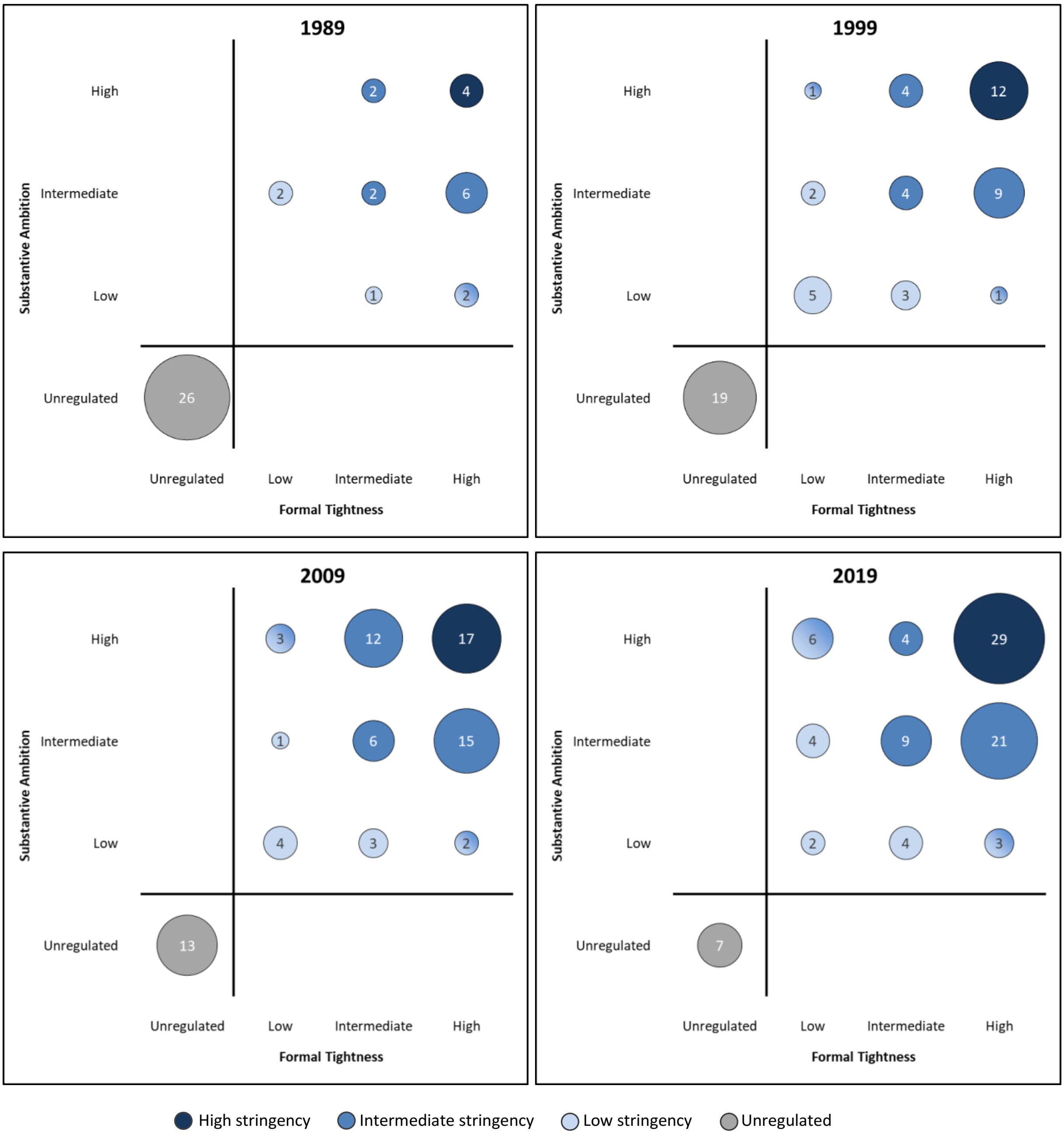
Variance in Formal Tightness and Substantive Ambition

The compiled database also allows for examining the internal design of regulations. Figure 11 depicts the number of shipping regulations according to their level of formal tightness and substantive ambition from 1989 to 2019. Based on this data, three observations can be made. First, a cluster of stringent regulations with high formal tightness and high substantive ambition has emerged over time. In 2019, this cluster mainly consisted of regional regulations under MARPOL and a few global impact bans. The former include regulations that ban or greatly limit certain discharges of oil, noxious liquid substances, and garbage as well as emissions of nitrogen and sulfur oxides. The latter include regulations that ban installations containing ozone-depleting substances as well as the (re-)application of anti-fouling system containing toxic organotin compounds on the underwater hull of ships.

Second, a cluster of intermediate regulatory stringency has built up at the intersection of high tightness and intermediate ambition. It results from the IMO's tendency to adopt more regulations with high tightness than with high ambition. However, as far as other regulations with intermediate stringency are concerned, these are widely distributed across different design combinations (see Figure 21 in Appendix II). Examples for regulations with intermediate stringency are regulations and guidelines that limit the introduction of invasive species through ballast water and biofouling, standards for discharges of sewage, as well as the regulations limiting the oil content of machinery space bilges both within and outside of special areas.

Third, no dominant design has emerged for the few regulations with low stringency. In 2019, these regulations comprised IMO guidelines on previously unregulated externalities and recommendations of regional bodies that complemented IMO regulations. Prominent examples in this category are the global regulations on energy efficient ships requiring a 0-10% emission reduction for new ships as well as a Ship Energy Efficiency Management Plan (SEEMP) for all ships.

Figure 11: Form and substance of regulations in maritime shipping, 1989-2019



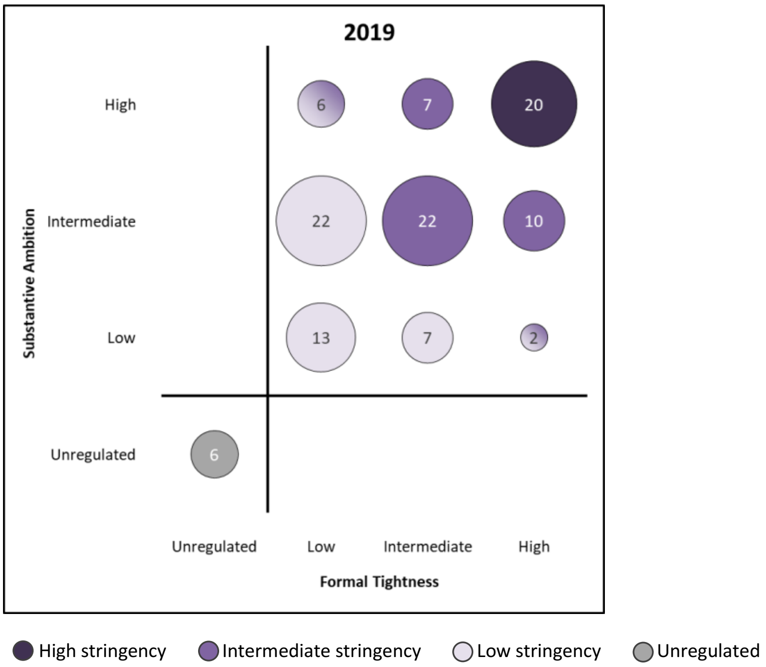
Note: Figure shows count of all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas). The number of unregulated externalities refers to externalities that are not subject to international regulation in any sea area.

Source: Author.

The distribution of design compositions in offshore oil and gas regulations partly differs from those of shipping regulations. Figure 12 shows the number of regulations addressing platform impacts according to their level of formal tightness and substantive ambition in 2019. Three comparisons to shipping can be made. First, like in shipping, stringent regulations with high tightness and high ambition constitute a recognizable cluster.

In 2019, this cluster mainly comprised regulations developed by the IMO, the OSPAR Commission, and HELCOM. An example are regulations in the North-East Atlantic and Baltic Sea that virtually eliminate the use of nonaqueous drilling fluids. Second, in comparison to shipping, regulations with intermediate stringency often have a lower level of formal tightness. The institutional background of this cluster is heterogenous, but several observations relate to regulations by ROPME[29]. For instance, the Continental Shelf Protocol under the Kuwait Convention allows for a higher oil content in discharges of production water than most other regional instruments and does not foresee strong measured for forcing compliance with these limits. Once again, however, intermediate stringency also comes in many design combinations (see Figure 22 in Appendix II). Third, in stark contrast to shipping, many regulations with low stringency cluster at the intersection of low tightness and intermediate ambition. This cluster predominantly comprises the nonbinding guidelines adopted by the World Bank and the Arctic Council.

Figure 12: Form and substance of regulations in offshore oil and gas production, 2019



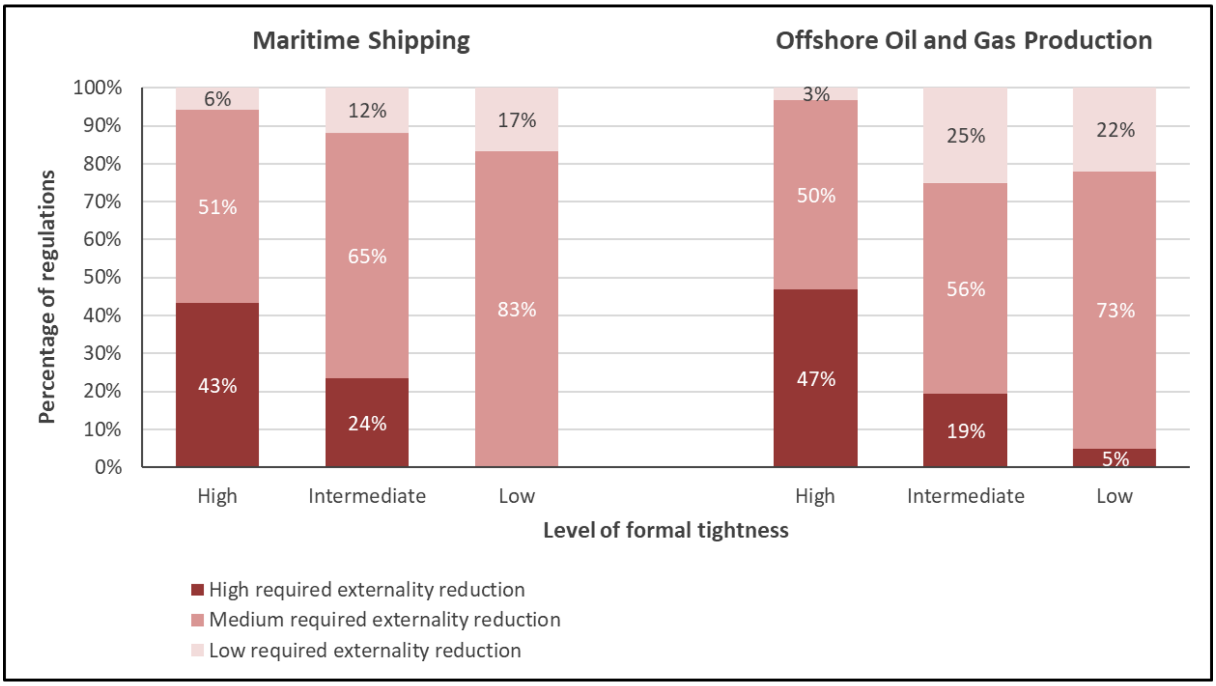
Note: Figure shows count of all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas). The number of unregulated externalities refers to externalities that are not subject to international regulation in any sea area.

Source: Author.

[29] These regulations are often partly binding or exhibit a medium level of precision, have weak monitoring provision, and require medium externality reductions ranking in between requirements of other international regulations.

The database further reveals relationships between design elements. An interesting aspect is the relationship between aggregated elements of formal tightness (legality, precision, and monitoring) and required externality reductions. Figure 13 shows the share of different requirement levels for regulations with high, intermediate, and low tightness in 2019 (see also Table 30 in Appendix II). Both in shipping and offshore oil and gas, tighter regulations more often featured high requirements in the reduction of environmental impacts. More than two fifths of all regulations with high tightness and almost no formally loose regulations required high externality reductions. Conversely, regulations that did not achieve high tightness featured greater shares of medium and low requirements. Another interesting design aspect is the relationship between the legal status of a regulation and its monitoring system. In 2019, binding regulations more often than nonbinding ones established strong monitoring and enforcement systems. An absence of monitoring provisions almost exclusively occurred in conjunction with nonbinding regulation (see Figure 23 and Table 31 in Appendix II).

Figure 13: Requirement levels of regulations by level of formal tightness, 2019



Note: Figure considers all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas).

Source: Author.

The analysis contributes three elements to the study of international regimes and regulations. First, it suggests that the trade-off between the form and substance of regulations (Guzman 2010, 156–57) is empirically not inevitable. High tightness and high ambition are a puzzlingly frequent observation in the regulation of maritime industries, especially in shipping. Second, the data confirms that binding legal status and strong monitoring often go together (Raustiala 2005, 607–8). Accordingly, the legal-institutional framework of regulation (e.g., convention-protocol approach or nonbinding instruments) may strongly shape formal tightness and overall stringency. Third, the IMER data provides detailed insights into the observed growth in the number and stringency of shipping regulation over the past four decades. It shows that states have continuously developed and revised regulations, with a preference for certain designs with intermediate or high stringency. This is an encouraging complement to the observation of a declining annual signature rate of international environmental agreements (Mitchell et al. 2020, 5).

Summary

This chapter explored to what extent international maritime regulations are designed to control corporate environmental conduct. Answering this question presupposed tools for comparing the design of international environmental regulations and data for identifying patterns of empirical variance. In the first part of the chapter, I developed the concept of regulatory stringency as a novel tool for capturing and comparing the design of international environmental regulation. Stringency comprises the formal tightness and substantive ambition of a regulation. Ambition defines the amount of change required in corporate environmental behavior; and tightness shapes the extent to which corporate compliance with these requirements is forced. I outlined the design elements of both dimensions qualitatively and developed a quantitative index that aggregates their values into a stringency score. In addition, I provided anecdotal evidence which suggests a plausible link between regulatory stringency and effectiveness. The stringency concept fills several gaps that emerge when trying to assess regulations through existing concepts of regime and agreement design. This allows for shifting the focus of study from international environmental regimes and agreements to the microlevel of regulations.

In the second part of this chapter, I explored the empirical variance in the stringency of international maritime environmental regulations. I introduced the IMER database, which captures the design of international regulations addressing operational environmental impacts from ships and offshore oil and gas platforms. The overall picture is that of a dynamic field with a substantial number of regulations with high and intermediate stringency. These regulations require improvements in environmental performance and aim at eliciting corporate compliance with these requirements. It would therefore be wrong to dismiss the international environmental regulation of maritime industries as mere window-dressing. The data analysis further identified five major patterns of variance in regulatory design that seem worth exploring. First, regulatory stringency varies across the two industries examined, despite similar types of externalities. Second, within these industries, stringent regulation has emerged earlier for some externalities than for others. Third, the geographic distribution of regulatory activity and stringency is quite uneven. Fourth, some of the observed variance is due to a great variance in the number and stringency of regulatory outputs produced by different international regulatory bodies. Fifth, the number of stringent regulations has grown over time, with the trade-off between high formal tightness and substantive ambition apparently being a lower barrier than commonly assumed.

These basic patterns of variance can be translated into five explanatory puzzles: Why is stringent regulation particularly abundant in the shipping industry? Why has stringent regulation often emerged earlier for externalities related to oil and other water pollution than for air pollution and other ecosystem impacts? Why do the most stringently regulated regions include sea areas with both high and limited industrial activity? How have international organizations with strong business participation been able to produce some of the most stringent sets of regulations? And under which conditions do states agree on regulations that are both tight in form and ambitious in substance? These questions are quite comprehensive. Answering them will require various complementary efforts for collecting data on potential explanatory factors and inquiring into causal relationships.

In the following, and in line with the starting point of this dissertation, I explore one of these causal relationships: the link between business participation and contentious decisions on the stringency of international environmental regulations. A growing literature suggests that this relationship might be able to shed some light on the abovementioned puzzles. Many scholars have recognized the important role of business actors in the development of international regulations targeting corporate environmental practices (e.g., Falkner 2008; D. L. Levy and Newell 2005; Maxwell and Briscoe 1997; Meckling 2011; 2018; Vormedal 2008). However, views on how environmental practices of businesses influence or shape regulatory decisions differ. In the next chapter, I present two models that have dominated the debate so far and highlight some of their gaps. I develop a new theoretical model which posits that business practices and regulatory decisions coproduce each other through a mechanism of argumentation. The explanatory power of the different models is probed in two empirical case studies. Their findings will be linked back to the puzzling data patterns in the concluding chapter.

3 Theory: Business Influence on International Regulatory Decisions

The previous chapter has elucidated part of the overarching puzzle that this dissertation tries to solve, namely why international environmental regulation seems to develop dynamically while business actors are closely involved in its development. The preceding analysis has approached this puzzle from the angle of critically assessing the quality of regulation. It has shown that international environmental regulation is more than window-dressing. A sizeable part of all maritime regulations is designed in ways that promise to exert significant control over corporate conduct. Thus, the initial puzzle cannot be answered by claiming that regulation only develops dynamically because it is designed to fail in affecting change in corporate behavior. The analysis has further identified several patterns of empirical variance in the number and stringency of regulations across industries, impacts, regions, and institutions, as well as over time. One of these patterns is that international regulatory bodies with strong business participation tend to produce relatively high shares of stringent maritime regulations. This not only underscores the overarching puzzle. It also highlights the need for exploring this puzzle from a more political angle which focuses on the role of business in regulatory processes.

How and to what extent can business actors and their environmental practices influence or shape contentious design choices of states in international environmental regulation? I am particularly interested in the effect of corporate environmental conduct on international negotiations which involve questions of technology. Possible answers to this research question can draw on theoretical contributions from the fields of global environmental politics, international political economy, and international negotiations. Based on pertinent building blocks from these fields, I distinguish two stylized models of international regulatory politics. Ideational interventionism typically assumes that more environment-friendly corporate practices and technologies need to be forced by regulation. International regulatory negotiations involve norm-based discourses, in which arguing can play a major role. Accordingly, the drivers of stringent regulation are pro-environmental norms and ideas advocated by networks of activists and scientists. By contrast, material evolutionism posits that new regulation usually follows innovation by large and influential firms from powerful states. Regulatory negotiations take the form of rational bargaining, with rhetoric playing a very limited role. Consequently, stringent regulation is only adopted when it serves the economic interests of those firms and states with superior material power resources.

In this chapter, I argue that these two models overlook the highly dynamic relationship between innovative environmental practices of business and more stringent regulation. They notably neglect the possibility that expertise of progressive business actors can give arguments for stringent regulation a decisive push in international negotiations. Focusing on processes of arguing over technology, I posit that compelling evidence for the feasibility of a regulation can count more than conventional lobbying resources of firms. Views on the feasibility of regulatory options are an important parameter underlying initial state preferences and their change in international negotiations. The feasibility views expressed by decision-makers in international meeting halls far away from regulated practices heavily rely on the on-the-ground expertise of business. As different business actors may pursue conflicting material interests, they may also provide competing technological and operational expertise on whether stringent regulation is feasible or not. These arguments assist or hinder states with clear preferences for more stringent regulation in their efforts to talk other states into supporting their position. Based on psychological literature, I argue that decision-makers deal with competing business expertise according to a logic of consistency. I make the case that consistency-seeking policymakers tend to follow arguments that are supported by tangible references to first-mover business practices. Innovation and practices of corporate first movers thereby facilitate the adoption of more stringent regulation, which in turn reinforces these technologies and practices more broadly across the sector. I refer to this dynamic mechanism as argumentative coproduction. Before developing my theoretical model in detail, I briefly review existing ideational and material approaches.

Ideational Interventionism: Business Hegemony and Technology-Forcing Regulation

The cluster of ideational interventionism posits that stringent international environmental regulation emerges when pro-regulatory ideas of activists, scientists, and policymakers win over business interests. This cluster builds on a constructivist view on international negotiations and can be loosely connected to the neo-Gramscian framework of business influence. Constructivist approaches conceive of international negotiations as social and ideational processes rather than material bargaining. Constructivists assume that decision-makers in international politics follow the logics of appropriateness and arguing. The logic of appropriateness implies that actors behave in accordance with the identity and norms they have previously internalized (March and Olsen 1998, 521–22). The complementary logic of arguing explains interest and preference change through communicative interaction. It posits that "participants in a discourse are open to being persuaded by the better argument" (Risse 2000, 7). In brief, state preferences then reflect ideas and norms that have become dominant through social interaction.

The constructivist reasoning underlying this theory cluster holds that the preconditions for international policy cooperation are primarily ideational. The ability of decision-makers to agree on regulatory measures depends on whether they develop shared problem and policy understandings through webs of discourse (Braithwaite and Drahos 2000, 559–62). In these discourses, activists and scientists frequently act as knowledge brokers and norm entrepreneurs (Litfin 1994; Ulbert and Risse 2005, 354–56). Activists and scientists form part of transnational advocacy coalitions (Keck and Sikkink 1998), epistemic communities (Gough and Shackley 2001; P. M. Haas 1989; 1990; Peterson 1992, 153–54), as well as scientific advisory bodies and assessment panels (Gehring and Ruffing 2008, 128; Parson 2003, 251–52, 263–68; Winickoff and Bushey 2010, 370–74). Their ideas cannot only reduce uncertainty but can also shape actors' identities and interests, reframe issues, and modify the range of legitimate policy options (Finnemore and Sikkink 1998). Thus, for constructivists, leadership in international negotiations is based on the ability to inject new ideas and norms into the process.

Constructivist theories of international negotiations credit arguing and rhetoric with considerable explanatory power in the form of authentic or sincere persuasion. Authentic persuasion is a process of truth-seeking in an ideal speech situation (Deitelhoff 2009, 43; Grobe 2010, 6–8; Risse 2000, 10–12). International institutions create ideal speech situations when enabling nonhierarchical deliberations among their members. Truth-seeking actors engage in these open-ended deliberations with the aim of arriving at a consensus on what is the factually and normatively justified course of action (Deitelhoff 2009, 35). Sincere persuasion relaxes the assumption of an ideal speech situation. It conceives of arguing as a process of social learning about cause-effect relationships that is most likely to operate under conditions of uncertainty (Checkel 2001, 562; Grobe 2010, 8–9; P. M. Haas 1990, 54). Under both authentic and sincere persuasion, interests or preferences are endogenous to negotiations.

Ideational perspectives on global environmental politics offer different views on the role of business. Constructivists conceive of business actors as targets of epistemic communities and government interventions (P. M. Haas 2004, 585; 1992a, 220–24; Hough 2003). They have not further theorized the motives and power resources of businesses though. A more coherent framework of business influence with ideational and interventionist traits is neo-Gramscianism.[30] The neo-Gramscian approach stands in the tradition of critical international relations theory (Cox 1986, 208–10). It seeks to understand how business came to occupy its central role in global environmental politics and how this configuration may change. The framework conceives of regulatory politics as a "war of position" in which a "historical bloc" of hegemonic actors accommodates recurring outside challenges (D. L. Levy and Egan 2003, 812–13). The original framework considers political struggles both between business and nongovernmental organizations as well as among industry sectors with diverging economic interests (D. L. Levy and Newell 2005, 64). The classical tale of this theory cluster, however, is the confrontation between hegemonic business actors and a challenger coalition of activists and scientists.

Neo-Gramscianism suggests that powerful historical blocs only allow for incremental improvements in environmental regulation and performance. Corporations exert political influence on material, organizational, and discursive levels with technology cutting across these levels (D. L. Levy and Egan 2003, 812; D. L. Levy and Newell 2005, 63): On the material level, corporations develop and implement technology strategies. On the organizational level, they form interest groups to bundle technological expertise and to lobby for regulations consistent with their technology strategies. On the discursive level, business uses its technological expertise to challenge scientific assessments of its negative environmental impacts. Moreover, it adopts corporate environmental management practices to accommodate societal concerns and to preempt regulation (D. L. Levy and Newell 2005, 59; Lyon and Maxwell 2008). It follows that regulation often codifies and supports incremental technological innovation by hegemonic businesses (Fuchs and Clapp 2009, 291–92). Many authors in this tradition are therefore skeptical about the prospects for business supporting more stringent policies that would help to achieve "true" environmental sustainability (Clapp 2005, 30–31; Dauvergne and Lister 2013, 158–61; Fuchs and Clapp 2009, 290; Grumbach 2015, 641–43).

In the ideational-interventionist logic, change towards stringent environmental regulation that forces more sustainable business practices is rare. It occurs when activists, scientists, and public pressure trump coalitions built around reluctant business

[30] Note that the neo-Gramscian framework has been formulated in relatively broad terms, which allows it to be linked to different strands in international relations literature. For instance, some authors have highlighted neo-Gramscianism's focus on structure rather than agency (Meckling 2011, 7–9; Vormedal 2012, 261). While acknowledging that this is an important characteristic of the framework, I focus on the role of ideology and discourses as another major building block (D. L. Levy and Newell 2005, 49–60).

actors (Andrée 2005, 157–60; D. L. Levy and Newell 2005, 64). The potential for a weakening of dominant business blocs is highest in times of crisis. Environmental crises increase the perceived urgency of tackling environmental problems. They notably put established policy ideas under pressure and open a window for policy change (Braithwaite and Drahos 2000, 561–62; Jagers, Paterson, and Stripple 2005, 250). Ideas advocated by activists and scientists may then come to steer the preferences of policy-makers towards more stringent regulation. Stringent policy interventions subsequently require significant improvements in environmental-friendly technology and business practices.

Material Evolutionism: Business Conflict and Technology-Following Regulation

The cluster of material evolutionism approaches the relationship between business practices and regulatory decisions from a different angle. It suggests that more stringent international environmental regulation can result from innovation by materially powerful business actors. This cluster consists of a rationalist perspective on international negotiations and the more specific neo-pluralist theory of business influence. Rationalism understands international negotiations as bargaining processes among actors who follow the logic of expected consequences (March and Olsen 1998, 949–51). This logic presumes rational actors who seek to maximize material gains and minimize losses. State preferences can be derived from structural factors or from preferences of dominant domestic actors. Structural factors include knowledge about transboundary effects of environmental problems (Dimitrov 2005, 157; Parson 2003, 8–9), environmental vulnerability and costs of abatement technology (Sprinz and Vaahtoranta 1994, 78–79), domestic income levels and economic institutions (Drezner 2008, 40–43), and political systems (Falkner 2005a, 593–94). Influential domestic actors may be key economic sectors (Drezner 2008, 50–51), interest groups (Falkner 2005a, 594–95; Milner 1997, 34–36), Baptist-and-bootlegger coalitions of environmentalists and industry (DeSombre 2000; Kelemen and Vogel 2010, 444), major companies (Falkner 2005b; Maxwell and Briscoe 1997), or occasionally the broader public (Mattli and Woods 2009, 21–26).

The rationalist thinking underlying this theory cluster highlights different material preconditions for international policy cooperation. On the one hand, realist scholars view international regulation to be driven by great powers. Great powers can bring about international cooperation by means of economic coercion (Drezner 2008, 32–33; Falkner 2005a, 590–91) or their power “to go it alone” (Gruber 2000, 7, 38–42). On the other hand, neoliberal institutionalists hold that cooperative outcomes depend on converging interests and international institutions. Strategic forum shopping is a possibility for actors to shift bargaining to institutional contexts that are favorable to their interests (Murphy and Kellow 2013). To reconcile conflicting interests and facilitate cooperation, political entrepreneurs can create tactical issue-linkages and side-payments (E. B. Haas 1980, 371–73; Putnam 1988, 446–48, 450–51; O. R. Young 1991, 293–98). Leadership in international negotiations under rationalist assumptions is thus primarily power-based or entrepreneurial (Andresen, Rosendal, and Skjærseth 2013, 427–28).

Rationalist theories of international negotiations attribute varying importance to rhetoric and arguing. Many game theoretic approaches either largely neglect speech acts or treat them as instances of signaling (Drezner 2008; Morrow 1994, 399–408; Stone 2011). Two amendments to conventional game theory take rhetoric and arguing more seriously though. One of them is the causal mechanism of rhetorical action. It denotes the "strategic use of norm-based arguments in pursuit of one's self-interest" (Schimmelfennig 2001, 63). Rhetorical action silences opponents by publicly exposing their policy position as falling short of accepted community norms (Schimmelfennig 2001, 64–65). Another addition to game theory is the mechanism of functional persuasion operating under conditions of uncertainty. Functional persuasion refers to the selective adoption of new causal knowledge that serves own interests and revises the international bargaining game (Grobe 2010, 11–13). Both in rhetorical action and in functional persuasion, state interests remain exogenous to international negotiations.

Many rationalist researchers consider business an important nonstate actor in international negotiations. Realists initially conceived of multinational firms as an expression of hegemonic state interests and power (Gilpin 1975, 4, 40–42) or as subjected to the leadership of state actors (Krasner 1978, 19–20). This view has later been pushed aside by perspectives that treat business as a nonstate actor with own interests and power resources (Falkner 2008; Keohane 2002, 45, 202–4; Strange 1988, 31; Drezner 2008, 34–35). The most advanced framework of business influence within this cluster is neo-pluralism. Neo-pluralism is a problem-solving theory (Cox 1986, 208–10) that is interested in when and how business drives regulatory policy decisions. It conceives of the political process as an open competition of different organized interests. However, neo-pluralists usually consider competition between business and NGOs to be less important than business conflict (Orsini 2012, 962–64). Conflicting policy preferences and different political strategies of firms may result from differences in regulatory pressure, distributional effects of policy options, and domestic politics (Meckling 2015, 21–22;

Skjærseth and Skodvin 2003, 204–7). Conflicts typically arise between transnational and national firms, technology leaders and laggards, and firms along the supply chain (Falkner 2008, 32–35). Scholars disagree though on whether these conflicts weaken overall business influence (Falkner 2008, 43, 196; Orsini 2012) or not (Jansen 2017, 63).

Neo-pluralism posits that business innovation can enable international environmental regulation in an evolutionary manner. Firms possess technological power arising from "their ability to produce technological innovations that help to solve environmental problems" (Falkner 2008, 30). This form of structural power can create new regulatory options and alter coalitions by aligning previously opposed economic and environmental interests. In addition, business actors can influence international policy decisions through their instrumental, discursive, and structural market power (Fuchs 2005). Empirical research has shown that especially large firms from powerful states can make effective use of technological power (Falkner 2005b, 130; 2008, 72–74; Vormedal 2012, 259–61). Because of the diverse interests and technological power of firms, many authors conclude that business actors can be constructive partners in global environmental governance (Bled 2009, 167–68; Marcoux and Urpelainen 2014, 932; Ougaard 2010, 25; Vormedal 2011, 1–6). States can support this constructive role through industrial policies, such as subsidies that strengthen green business interests and reduce technology costs (Meckling 2018, 61–66). Regulatory policies then mainly codify existing environmental technologies and practices of materially powerful companies. Overall, material evolutionism is thus in many respects opposed to the model of ideational interventionism (see Table 4).

The Argumentative Coproduction of Business Practices and Regulation

Practitioners and observers of international environmental regulation will find the two existing models useful for structuring their thinking about processes they are acquainted with. However, they may also discover some important gaps in the stories that these models tell us. Both ideational interventionism and material evolutionism recognize that business actors possess technological power and expertise they can use in international environmental negotiations (e.g., Andrée 2005, 148–52; Falkner 2008, 31–32; D. L. Levy and Newell 2002, 96). Material evolutionism stresses the possibility of business conflict and assumes that material power resources eventually determine which business interests prevail. This neglects that the technological power of business does not exist independent of its ideational or discursive representation in negotiations. If business influence and bargaining were mostly material, why would business and state actors invest time and resources into collecting and presenting technical evidence backing their policy positions? And why would business send representatives to expert bodies instead of focusing all its resources on lobbying the political bodies that take the final decisions on contentious regulatory designs?

Table 4: Three strands of thinking about international regulatory politics

	Ideational interventionism	**Material evolutionism**	**Argumentative coproduction**
Logic of action followed by decision-makers	Logic of appropriateness (and arguing)	Logic of consequences	Logic of consistency
Mode of interaction in negotiations	Social learning, truth-seeking	Bargaining, power politics	Technological arguing
Types of leadership in negotiations	Norm-based, knowledge-based	Interest-based, power-based	Argument-based, evidence-based
Form of rhetoric and arguing in negotiations	Authentic persuasion, sincere persuasion	Functional persuasion, rhetorical action, cheap talk	rhetorical coercion, argumentative mobilization, sincere persuasion
Role of business actors in regulatory politics	Targets of science- and activist-driven regulation	Drivers of state interests and power	Sources of regulatory arguments and evidence
Character of business regulation	Technology-/practice-forcing	Technology-/practice following	Technology-/practice reinforcing

Note: This table represents three stylized approaches to international regulatory politics. Within the first two strands of thinking, several theoretical variants exist. Within the last strand, no overarching and coherent framework has emerged yet.

Source: Author.

Ideational interventionism is more sensitive to the discursive dimension of international negotiations while downplaying the possibility of business conflict. But is it meaningful to treat business as one dominant bloc when its representatives advocate diverging views on what technological solutions would be appropriate guides for policy decisions? Furthermore, the ideational-interventionist model has not fully unpacked yet how policy-makers deal with competing business expertise. When contradictory views on the technological leeway for stringent regulation are put forward, around which view will an epistemic community emerge and why? These questions suggest that the existing theoretical models might miss potentially relevant parts of the empirical story—a suspicion that I am going to substantiate later in two case studies. I argue that the shortcomings of existing models can be alleviated by embedding theoretical propositions about business influence into a revised theory of arguing in international negotiations. In principle, such links could be established based on material or constructivists logics of action. I choose a different route though; a route that I consider more promising based on my own prior observations of international regulatory negotiations.[31] This route is compatible with the call by regime scholars to pay greater attention to the role of arguing and communication as a source of behavior (Breitmeier, Young, and Zürn 2006a, 235).

My model of argumentative coproduction carves out a middle ground between ideational interventionism and material evolutionism. It understands international negotiations of regulations addressing physical externalities as processes of two-level arguing. State delegates have to justify their policy positions on the international and domestic levels (Müller 2004, 422–25; Putnam 1988, 433–34). Two recurring issues in technology-related environmental negotiations are the need for regulation and the feasibility of different policy options (Dimitrov 2005, 34; Mitchell 2010, 124–25; Sprinz and Vaahtoranta 1994). I assume that propositions or premises (the terms are used interchangeably here) about regulatory needs and feasibility are underlying state preferences in international environmental negotiations. Propositions about the need for regulation reflect demands of societal actors and ideas of policymakers. Propositions about the feasibility of regulatory options primarily stem from expertise provided by business actors. Below, I develop theoretical assumptions on how decision-makers come to adopt each of these propositions.

The core of my model then concerns how states with different preferences interact in argumentative contests over the technological basis for stringent regulation; and how business practices and expertise influence or shape the outcome of these contests. I flesh out the novel causal mechanism of argumentative coproduction by assembling and systematizing streams of literature from four fields: corporate environmental management, business in global environmental politics, arguing in international negotiations, and the psychology of evaluating competing arguments. I illustrate the theory

[31] I worked for the Central Commission for the Navigation of the Rhine (CCNR) between 2012 and 2015. This enabled me to observe international regulatory negotiations involving business actors in the area of European inland navigation. Although my theory is not generated directly from these observations, some building blocks and examples are clearly inspired by them.

development with an invented example. The example is about the regulation of transboundary emissions of a fictional air pollutant P from a type of source S_P.

Sources of State Preferences I: Society and the Need for Regulation

A model of international environmental regulation requires making theoretical assumptions about how states come to perceive a need for policy action. State positions on regulatory needs rely on a set of propositions that provide answers to important questions like: Is the given environmental externality severe enough to justify regulatory action? How much does regulatory action need to reduce the externality? How does regulation have to be designed to achieve the necessary reductions? And what amount of costs do the expected benefits justify? The sources of propositions answering these and related questions depend on the salience of the issue at hand. High issue salience in the domestic arena creates "noisy politics" involving the media, political parties, mass publics, and electoral pressures on ministers and parliamentarians (Culpepper 2010, 5). When governments or parliaments define state positions, they issue narrow negotiation mandates for state representatives. Empirical data suggests that a few major global or regional environmental problems, including climate change, ozone depletion, and acid rain, have been noisy for limited periods of time (Schreurs et al. 2001, 349–54). International negotiations on many other environmental problems seem to receive much less domestic attention. Lower issue salience among domestic voters leads to a situation that resembles what political economists call "quiet politics" (Culpepper 2010, 4). For the example of air pollutant P, I assume that its adverse health and environmental effects attract limited public attention, so that politics remain relatively quiet.

In rather quiet international environmental politics, executive branch officials develop and represent state positions in negotiations (Mitchell 2010, 123). In the absence of electoral pressures, ministers and parliamentarians have little incentive to engage actively in policymaking. The need for regulation is therefore assessed by state officials based on relevant propositions, which are understood here as principled and causal beliefs (cf. Goldstein and Keohane 1993, 8–9; P. M. Haas 1992b, 3). These propositions about policy needs are rarely invented by decision-makers alone. They rather have their roots in domestic arenas. Some general premises may already be embedded in national policy strategies, government programs, or paradigms of the administration. For instance, a national air quality strategy may formulate a general preference for reducing emissions of air pollutant P.

Propositions that reflect general state preferences may be underspecified though. For instance, multiple types of sources may emit P and the national air quality strategy may omit quantifying the contribution of source S_P to the stipulated reduction goal. State officials therefore take stock of the views and demands of societal actors, including business, environmental NGOs, and scientists, through formal or informal stakeholder consultations (Boehmer-Christiansen 2019, 287–88; Putnam 1988, 436). Domestic institutions can vary in the roles that they accord business and non-business actors in such consultations (Tzankova 2009). I assume that these domestic consultations can bring up different propositions with material and principled-ideational facets, so that state bureaucrats enjoy a certain leeway in the conclusions they draw. This also creates room for an influence of transnational knowledge-based networks, in which state officials may be embedded (P. M. Haas 1992b, 7; P. M. Haas and McCabe 2001). In short, the range of state preferences regarding the need for regulation is shaped by societal demands and their interpretation by decision-makers.

My assumptions on how states form their positions on the need for international environmental regulation differ from pure material and ideational approaches. I do not treat states as mere transmission belts for preferences of domestic actors (Moravcsik 1997, 518). I also do not assume that state officials exclusively pursue own policy ideas and use societal inputs as mere ammunition in intra-bureaucracy struggles (Hopgood 1998, 50–51). I rather assume that both domestic demands and ideas of decision-makers shape propositions on regulatory need. In the invented example, scientists may express the view that an 80% reduction of P from S_P would eliminate almost all its adverse health and environmental impacts. Environmental NGOs point out that health and environmental benefits can only be achieved when the reduction target is made mandatory on owners of S_P. The owners of S_P argue that the expected environmental benefits need to be weighed against the costs of such new regulatory requirements. I treat these premises as given, circumscribing a zone of possible regulatory preferences. Within this zone, officials define and specify state preferences based on propositions about the feasibility of different regulatory options.

Sources of State Preferences II: Business and the Feasibility of Regulation

To identify feasible policy options among all possible regulatory preferences, state bureaucracies rely on business expertise. Major questions around the feasibility of regulation are for example: For which regulatory options is compliant technology available on the market? Can these new technologies or practices be readily applied in the targeted operations? And are they affordable, reliable, and safe? On these and similar questions, state officials and civil society actors often only have limited knowledge (Vormedal 2008). Extensive first-hand, specialist expertise on operational and technological aspects of environmental regulation is controlled by business as part of its technological power (Falkner 2008, 30; cf. Mattli and Woods 2009, 36). In the example at hand, producers of air emission control equipment as well as engine manufacturers have knowledge about technologies for reducing P, such as advanced filters or more efficient engine designs. Moreover, the owners of S_P possess insights into operational aspects that may constrain or facilitate the installation of these technologies. Such business expertise helps state officials to narrow down possible policy positions. Notably, information on new environmental technology makes it easier to justify stringent regulation and harder to argue for lax regulation. Business expertise thus enables policymakers to specify state preferences within the zone circumscribed by propositions on regulatory needs.

Business can provide its expertise to decision-makers through different channels. The most direct channel is to submit information on innovation and corporate practices straight to state representatives. This happens through formal domestic consultations, informal contacts with the bureaucracy, as well as advisor and observer roles in international organizations or in national delegations to these bodies (Raustiala 1997; Vormedal 2008, 60–61). For example, ahead of international negotiations about the regulation of P from S_P, the producers of emission filters may be consulted domestically by their host countries. The engine manufacturers and owners of S_P may be organized in industry associations that partake both in domestic consultations and directly in international regulatory negotiations. Where business actors cannot participate in international organizations directly and independently of states, domestic institutions have an impact on their ability to influence international negotiations. Important preconditions for influence are timely information of domestic business actors and the representation of their expertise at the international level (Büthe and Mattli 2011, 43).

A less direct channel for communicating business practices is their codification in publicly visible private standards. Self-regulation of corporate environmental conduct or business agreement on new functional interoperability standards can (sometimes even unintentionally) signal advances in environmental technology. For example, some progressive owners of S_P may choose to launch an eco-label to certify voluntary reductions in emissions of P. The suppliers of advanced filters for P may develop an interoperability standard which ensures that their products can be implemented on all sources S_P.

Policymakers may use such private environmental standards as models for or building blocks of public regulation (Pattberg 2006, 250–51, 263).

The least direct channel for the communication of corporate knowledge is to inform intermediaries about environmental technologies or practices. Intermediaries here comprise research institutes, consultancies, environmental NGOs, or media that reach out to state officials. For instance, the international organization in which a possible regulation of P is on the agenda may commission a study to monitor emissions and mitigation efforts of the industry. The consultant conducting the study then compiles data on proven operational and technological options for reducing emissions of P. The prevalence of these different channels of expertise provision may reflect various factors, including domestic systems of interest representation (Katzenstein 1976), depth of business access to international organizations (Tallberg et al. 2013, 61–63), and organizational resources of firms (Falkner 2008, 28–29).

Business expertise is not always consensual as material business interests may conflict. In some situations, certain firms push for more stringent regulation for predatory reasons (Vormedal and Skjærseth 2019, 6–8). One such situation is the existence of innovation differentials, meaning that some firms can comply with more demanding environmental requirements at lower costs than others (Falkner 2008, 33–34). Technology leaders have an interest in stringent regulation that "raises the bar" and thus also the costs for less advanced competitors (Reinhardt 2000, 60–61). Such cost-increasing regulation can reduce the market shares and profits of competitors, perhaps even forcing them out of the market or making them targets for acquisitions (Bartel and Thomas 1987; Heyes 2009, 14–18; Pashigian 1984; cf. Salop and Scheffman 1983). Accordingly, technology leaders provide expertise for the feasibility of such regulation, while technology laggards challenge their assertions. For example, producers of highly advanced filters may argue that emissions of P can be reduced by up to 70%, whereas less advanced producers contend that more than 30% are unrealistic.

Another situation for the instrumental use of regulations is when incumbents fear competition from new market entrants. Stringent regulation can create new barriers to market entry by requiring higher upfront investments in environmental technology and increasing administrative burdens, such as certifications (Heyes 2009, 6–13). Some incumbents may thus provide expertise that supports the feasibility of more stringent regulation. For example, some owners of S_P may fear that low-cost competitors might enter the market. They may therefore be willing to accept a legally binding emission limit for P which would require the installation of more costly equipment. Their hope is that the additional costs weigh much more for potential competitors and thus deter them from entering the market.

Yet another situation for the predatory use of regulation is when new technology has distributional effects along the supply chain. Manufacturers of abatement technology, less polluting equipment, and greener industrial supplies are dependent on the willingness of their business customers to pay for environmental protection (Reinhardt 2000, 76). Innovative suppliers benefit from public regulation that forces their customers to buy more advanced and costly environmental equipment (Maxwell and Briscoe 1997). When their technology is established as a regulatory standard, and other suppliers are not able to offer compliant technology, these firms additionally benefit from increasing market shares. In the example at hand, producers of advanced filters push for a mandatory emission reduction of 70%, while less advanced suppliers call for a maximum reduction target of 30%. Innovative engine manufacturers may prefer a slightly less demanding emission reduction of 60% that balances externality reduction and affordability, so that the demand for new engines does not dry out. By contrast, most owners of pollution sources S_P would advocate adopting a nonbinding recommendation or refraining from regulation altogether. Suppliers with technology leadership thus highlight the leeway for more stringent regulation that codifies their technology. Conversely, their customers and less advanced competitors question the availability, reliability, or affordability of that technology. To forcefully demonstrate the feasibility of regulation, technology leaders, incumbents, and innovative suppliers with a predatory motivation may choose to overcomply with international requirements (Reinhardt 2000, 61, 65).

Firms can also have more defensive reasons for becoming environmental first movers or frontrunners that go beyond compliance. First, corporations may want to secure their “social license to operate” to avoid costly consumer boycotts and negative media campaigns by NGOs (Gunningham, Kagan, and Thornton 2004; Lyon and Maxwell 2008). Especially large, visible, and polluting firms are likely to become the targets of naming and shaming activities of environmental NGOs (Bloomfield 2014; Haufler 2015; Lenox and Eesley 2009). Second, firms may be forced to overcomply with international standards in some states because of more stringent domestic regulation. Such regulation disadvantages these firms compared to competitors abroad (Mattli and Woods 2009, 35). Third, some transnational companies may want to voluntarily pursue a global company standard, which typically reflects the most ambitious local standards (M. Epstein and Roy 1998, 285–86). A particularly powerful predictor of differences in corporate environmental strategies is the domestic political context of companies’ home countries (Skjærseth and Skodvin 2003, 202–3). In general, however, companies with operations in many different countries prefer international over national regulation (Falkner 2008, 33). Fourth, some firms under the threat of future regulation may want to increase predictability by adapting early to mounting regulatory pressures (Vormedal 2011, 4).

In our fictional example, defensive motivations may trigger some owners of the pollution source S_P to become first movers. Despite the absence of international regulatory requirements, they begin to install new equipment that lowers emissions of P significantly. Most first-moving owners may prefer the installation of new engines that reduce emissions of P by 60% and are a more cost-efficient solution than retrofitting old engines with advanced filters. Nevertheless, first movers face competitive disadvantages vis-à-vis ordinary compliers if eventually not a more stringent international level playing field is established.[32] Again, conflicts between these potential winners and losers of stringent regulation give rise to competing corporate expertise about regulatory feasibility.

My argument about competing business expertise echoes some existing theoretical perspectives on business influence while departing from others. I share the political-economic standard assumption that firms primarily strive for profit maximization. Like the neo-pluralist approach in material evolutionism, I treat business as a non-unitary actor that comprises firms with different technologies, policy preferences, and power resources (Falkner 2008, 25–27). Like the neo-Gramscian approach in ideational interventionism, I recognize that market and technology strategies of firms have political implications (D. L. Levy and Egan 2003, 812). However, I do not share the pessimistic neo-Gramscian view that progressive corporate behavior generally serves to preempt or prevent stringent public regulation (D. L. Levy and Newell 2005, 59). Quite to the contrary, I argue that new corporate technologies and practices may inspire more stringent regulation. As for neo-pluralism, I doubt that empirical observations of business conflict reducing overall business influence are generalizable (Falkner 2008, 196; Orsini 2012). Instead, I argue that, even under business conflict, firms remain a major source of operational expertise. The key question rather is which pieces of competing business

[32] Some kinds of environmental overcompliance are economically beneficial without additional regulation. For instance, firms can save costs by reducing production inputs and reap price premiums or additional market shares by exploiting sustainability as a selling point (Dauvergne and Lister 2013, 80–81; Reinhardt 2000, 17–18, 79–80). New market entrants are often quicker in pursuing sustainability-related opportunities and can trigger incumbents to engage in sustainable entrepreneurship (Hockerts and Wüstenhagen 2010).

expertise prevail: the claim of advanced filter producers that a 70% reduction of P is possible; the 60% reduction proposed by engine manufacturers which would balance emission reduction and affordability; the claim of the less advanced filter suppliers that P cannot be reduced by more than 30%; or the claim of most owners of S_P that a reduction is not affordable at all?

Constellations: Proponent, Opponent, and Audience States in International Negotiations

Propositions that decision-makers hold about regulatory need and feasibility shape the preferences of states in international negotiations and thus also their social role. I follow the ideational assumption that policymakers generally prefer certainty over uncertainty (P. M. Haas 1992b, 4). Uncertainty here refers to a lack of propositions about regulatory needs or feasibility. Moreover, I adopt the psychological assumption that decision-makers prefer convergence in their propositions over divergence (Jervis 2006, 653–54). Divergence or ambivalence denotes the presence of trade-offs across decision-making dimensions (Gawronski 2012, 654). Uncertainty and ambivalence about the need and feasibility of regulation produce reactive or passive stances in international negotiations. Decision-makers who do not know whether a regulatory proposal is feasible are reluctant to endorse it. Likewise, decision-makers who believe that stringent regulation is feasible but not needed struggle to arrive at clear preferences. By contrast, policymakers holding many convergent propositions about regulatory needs and feasibility actively advocate these views. The number of premises held by decision-makers and their convergence are introduced here as theoretical constructs for interpreting different roles of states in negotiations. I do not aspire to probe these constructs empirically though.

States assume three different roles in international regulatory negotiations depending on the certainty of decision-makers and the convergence of the premises held.[33] First, some states are active proponents and opponents of stringent regulation in international negotiations. Decision-makers in proponent and opponent states hold many convergent premises about regulatory needs and feasibility (see Table 5). Proponents consider more stringent regulation both necessary and feasible, while opponents believe the opposite. The internal convergence of progressive proponent and reluctant opponent views reflects compatible societal demands, ideas of state officials, and business

[33] I borrow the terminology for these roles from political science scholarship on rhetorical coercion (Krebs and Jackson 2007) and from educational literature on debates and argumentation (Broda-Bahm, Kempf, and Driscoll 2004, 103–5).

expertise. Convergence around stringent regulation can result from domestic coalitions of "Baptists and bootleggers." These coalitions comprise domestic industries and environmental NGOs that, for individually different reasons, jointly support international regulation (DeSombre 2000, 39–40). An example would be if advanced filter suppliers and environmental NGOs in one country together pushed for a binding 70% reduction requirement for emissions of P from S_P. Convergence may to some extent also result from "belief system overkill." The term denotes the psychological tendency of policymakers to produce excess reasons and eliminate trade-offs in decision-making (Jervis 2017a, 24–26; 2017b, 129). Decision-makers who believe that a large emission reduction is needed may also want to believe that it is feasible, despite not having solid information on this.

In international negotiations, proponent and opponent states with strong and stable preferences act as argumentative leaders. Although their positions are not necessarily diametrically opposed, it is common that proponents and opponents perceive them as irreconcilable (Bazerman, Moore, and Gillespie 1999). Proponents and opponents coordinate and submit written documents to committees and working groups, account for most of the oral interventions, and their views typically structure meeting reports. Before and in between negotiations, decision-makers of proponent and opponent states are the ones that approach other delegations to fathom possibilities for support. To assert their position in the negotiations, proponents and opponents try to rhetorically undermine each other's arguments (Krebs and Jackson 2007, 36) and to mobilize or persuade states with weaker and less stable preferences.

Table 5: Propositions held by policymakers and roles of states in international negotiations

	Progressive (propositions held converge around more stringent regulation)	**Reluctant** (propositions held converge around regulatory status quo)	**Undetermined** (propositions held diverge or are underspecified)
Certain (many propositions held)	Proponent *(active negotiator)*	Opponent *(active negotiator)*	Undecided audience *(passive negotiator)*
Uncertain (few propositions held)	Favorable audience *(reactive negotiator)*	Unfavorable audience *(reactive negotiator)*	Neutral audience *(passive negotiator)*

Source: Author.

Second, some states take the reactive role of a favorable or unfavorable audience. Officials in favorable and unfavorable audience states hold converging preferences that are at least partly congruent with those of proponents or opponents, respectively. In contrast to proponents and opponents, however, they experience uncertainty as they hold fewer premises about regulatory need or feasibility. For instance, decision-makers in favorable audience states may believe that a 50% to 80% reduction in emissions of P from S_P is needed. At the same time, they are uncertain about whether filters or engines for meeting this target are available. Policymakers in unfavorable audience states tend to believe that reducing P is not really needed and presumably also not feasible. Yet, they also recognize that they know too little to take a definite decision. Because of such uncertainties, favorable and unfavorable audience states take more cautious stances in international negotiations. They become more active though when uncertainty is reduced.

Favorable and unfavorable audience states are partly visible in international negotiations but less so than proponents and opponents. They may come to cosponsor some written submissions to international organizations, occasionally take the floor to align with statements by proponents or opponents, and appear in minutes of meetings. However, they usually do not coordinate the drafting and submission of position papers and rarely inject new arguments into the discussion. The delegates of favorable and unfavorable audience states are also those that, ahead or on the sidelines of negotiations, are frequently approached by proponents and opponents, respectively. Proponents and opponents can reduce uncertainty among audience states by providing new arguments about the need for regulation and its feasibility. In doing so, argumentative leaders try to mobilize support for their position and demobilize potential opposition.

Third, some states remain passive in the role of an undecided or neutral audience. Delegates of undecided states hold divergent propositions about regulatory need and feasibility. For instance, one the one hand, they think that the problems caused by emissions of P warrant binding reduction requirements. On the other hand, they believe that the filter and engine technology to comply with such requirements is not available yet. In other words, societal demands, ideas of decision-makers, and business expertise point in different policy directions (for a visualization, see Figure 25 in Appendix II). Delegates not falling into the psychological trap of belief system overkill are unable to resolve this divergence and, accordingly, do not take sides in international regulatory discussion. By contrast, delegates of neutral audience states do not hold any meaningful propositions on whether regulation is needed or feasible. Accordingly, these states do not pursue any specific preferences and, like their undecided counterparts, adopt a passive wait-and-see stance.

Both undecided and neutral audience states are almost invisible in international negotiations. They do not cosponsor written submissions to international negotiations, they refrain from oral interventions, and are hardly mentioned in minutes of meetings. While the difference between them is difficult to detect, undecided audience states possibly show somewhat greater interest in the negotiations. For instance, they might participate more extensively in working group meetings than neutral audience states, but usually in a passive listener role. Scholars have noted that delegates without clear country preferences sometimes spontaneously develop positions in international negotiations (Hisschemöller and Gupta 1999, 160). I posit that, in this context, arguments presented by proponents and opponents can have a causal impact by reducing uncertainty and ambivalence. Hence, both undecided and neutral audience states are potential targets for efforts at persuasion by proponent and opponent states.

The initial roles that states adopt in international negotiations are the starting point for the central part of my causal model. I outlined theoretical elements and some operationalizations that help distinguishing the ideal typical roles of proponents and opponents, favorable and unfavorable audience states, as well as undecided and neutral audience states. While I consider this to be a useful heuristic, it may not always be possible to distinguish neatly between these ideal types in practice.[34] Moreover, I assumed that states play active roles and take clear stances only when their decision-makers have many convergent views on regulatory need and feasibility. Note that I do not attempt to empirically demonstrate this assumption in a systematic fashion.[35] Instead, the focus of my model is on how business expertise on technological feasibility plays out in argumentative contests about contentious regulatory design choices. I refer to this facet of international regulatory negotiations as "technological arguing."[36] Next, I theorize how

[34] For instance, an audience state may refrain from expressing a position in a discussion not only when it is undecided or neutral but also when its favored policy is already receiving comfortable majority support.
[35] Of course, it would be desirable to also empirically assess the certainty and convergence of the propositions that decision-makers hold. To do this, researchers would have to identify key decision-makers of state delegations involved in negotiations and repeatedly assess their views about need and feasibility of regulatory options. While desirable, such an approach is very resource-intensive, especially as international environmental negotiations often last several years (see also chapter 7). I therefore chose to operationalize and assess the roles of states rather than to measure certainty and convergence directly.
[36] Note the difference from the concept of "causal" or "technical" arguing, which refers to scientific rather than business expertise (Panke 2012, 320).

technological expertise and practices of business affect the power of proponents and opponents in technological arguing.

Microlevel Processes: The Evaluation of Competing Business Expertise in Technological Arguing

Power in argumentative contests denotes the ability of proponents and opponents to make other participants take and articulate a position that they would otherwise not take. This definition translates the classical definition of relational power into a context of arguing (Dahl 1957, 202–3). Power in arguing critically relies on the quality of the arguments and evidence presented. An argument here denotes "a set of claims in which one or more of them—the premises—are put forward so as to offer reasons for another claim, the conclusion" (Govier 2010, 1). According to my understanding, the premises or propositions contained in arguments are embedded in discursive frames. These frames "select some aspects of a perceived reality and make them more salient in a communicating text" (Entman 1993, 52). A frame thus "characterizes the issue at hand" (Krebs and Jackson 2007, 43), while premises or propositions put forward more specific factual statements and causal ideas within this characterization. Factual statements and causal ideas typically come with some supporting evidence to appear cogent. The acceptance or rejection of these propositions has implications for the acceptance of related policy conclusions. When decision-makers accept or "learn" new propositions, they may also come to prefer new policy designs or objectives (P. M. Haas 1990, 59–61).

Technological arguing specifically refers to argumentative contests about the feasibility of regulatory options. Frames possibly relevant in the context of regulatory feasibility include the availability, applicability, affordability, reliability, and safety of compliant technology or practices. A sample frame in the regulation of P could stipulate that more stringent regulation presupposes that compliant engine technology is safe. Argumentative premises or propositions in technological arguing then define the state of environmental technology or practices with respect to these frames. One premise could specify, for instance, that the use of the new engines needed for compliance with a stringent regulation does not entail any safety hazards. Supporting evidence references real-world observations that confirm the premise. For example, it could be reported that engine trials and first-mover applications on S_P did not cause any accidents. The conclusion stipulates what the supported premise implies for regulatory design. In the given example, it could suggest that a mandatory installation of low-emission engines is feasible without granting safety exemptions. According to Krebs and Jackson (2007, 44), arguing merely involves contests over frames and policy conclusions. This ignores contests over factual or causal propositions arising because of competing expertise.

Decision-makers deal with competing technological propositions according to a logic of consistency. I borrow this concept from psychological research according to which “cognitive consistency represents a core motive underlying thinking and reasoning” (Gawronski 2012, 665). Consistency is concerned with the logical relationship between “propositions about states of affairs that are regarded as true or false by the individual” (Gawronski 2012, 653). Inconsistency denotes a contradictory relationship of two or more propositions, all of which are regarded as true (Festinger 1957, 13; Gawronski 2012, 653). An example for inconsistency would be a decision-maker who holds (1) that engines which minimize emissions of P are safe and (2) that engines with low emissions of P have caused accidents in the past. Individuals with inconsistent propositional beliefs experience cognitive dissonance. According to psychologists, dissonance represents a state of disequilibrium that individuals seek to avoid or reduce (Festinger 1957, 3). For that matter, dissonance rooted in inconsistencies is different from trade-offs arising from ambivalence across decision-making dimensions. An example for cross-dimensional ambivalence is that while regulation may be needed, it may not be feasible. I assume that decision-makers can tolerate ambivalence but not inconsistencies. The pursuit of cognitive consistency thus “imposes a universal constraint on any belief system” (Gawronski 2012, 660).

Three strategies to resolve inconsistencies appear particularly relevant in political contexts. First, individuals can assign different truth values to inconsistent propositions (Gawronski 2012, 659–60). Faced with two inconsistent propositions about technology, decision-makers assess one of them to be true and the other as false. Second, individuals can specify the contexts of seemingly contradictory propositions so as to make them compatible (Gawronski 2012, 654). Decision-makers resolve the inconsistency of two technology premises by specifying that these apply to different subsets of the relevant business operations. Third, individuals can avoid information that would increase dissonance (Festinger 1957, 3). Decision-makers consider new propositions only if they are consistent with the beliefs they are already holding and ignore all others. These strategies imply that there is flexibility in how decision-makers can seek consistency. Consistency-seeking takes place on the level of state positions, but the aggregate effect of these processes plays out on the level of international negotiations.

I conceive of consistency-seeking primarily as a cognitive process but concede that motivated reasoning can play a certain role as well. Reasoning can be motivated or channeled by prior premises held by decision-makers. Policymakers of proponent and opponent states may evaluate new technology information in ways that maintain consistency with their prior goals and beliefs. However, theorists of motivated reasoning have noted that even "when one wants to draw a particular conclusion, one feels obligated to construct a justification for that conclusion that would be plausible to a dispassionate observer" (Kunda 1990, 493). In my model of technological arguing, the "dispassionate" observers are the audience states. Their decision-makers hold fewer priors and are thus more likely to engage in accurate reasoning. Although the distinction between motivated and accurate reasoning is theoretically relevant, I do not attempt to fully disentangle the two empirically.[37] In the following, I discuss how the three strategies of dealing with cognitive inconsistencies play out in technological arguing under competing business expertise.

State officials who face competing business expertise can assess the validity of inconsistent propositions based on their supporting evidence. Important evidence for the feasibility of new regulation is the demonstration of compliant technology (Reinhardt 2000, 61). I argue that such evidence is most credible when providing tangible references to existing or emerging first-mover practices. In the absence of such information, the feasibility of more stringent regulation appears questionable. This is not to argue that all credible evidence is objectively valid. I agree with the view taken by scholars of private regulation that "standards do not embody some objective truth or undisputed scientific wisdom professed by experts" (Büthe and Mattli 2011, 11). Instead, strategic business actors have an interest in producing evidence that both supports their policy preferences and appears credible to decision-makers. Recall the competing regulatory preferences and technology claims of advanced producers of emission filters for P, less advances filter suppliers, engine manufacturers, and owners of S_P that would have to shoulder the costs. Decision-makers often have insufficient knowledge of business innovation and practices to accurately judge the objective validity of technology-related evidence. Thus, it eventually matters which technological evidence decision-makers come to *perceive* as more valid.

[37] The reason is that observational data from international environmental negotiations only occasionally allows for inferring the absence or presence of directional goals in reasoning. Furthermore, reliable confessions of decision-makers are very hard to get given their tendency to rationalize behavior ex-post (Blatter and Haverland 2012, 118).

To judge the validity of competing technological evidence, decision-makers rely on common heuristics described in psychological research: representativeness, availability, and anchoring (Tversky and Kahneman 1974; cf. McDermott 2004, 59–68). In the context of technological arguing, representativeness means that decision-makers take up expertise primarily from those companies they consider to best reflect the targeted sector. Availability captures the idea that decision-makers develop their views on technological feasibility based on the most accessible evidence. Anchoring refers to the phenomenon that judgements are channeled by initial assumptions which are then insufficiently adjusted to new information. These heuristics can account for why different decision-makers assign different truth values to the same piece of evidence. However, they also hint at why existing or emerging first-mover practices are a particularly powerful form of evidence: they can be considered representative of what progressive actors are able to achieve; they provide the most tangible and visible examples for a certain technology claim; and they may establish new anchors in technological arguing, especially in the beginning of regulatory projects. Hence, first-mover evidence can lead decision-makers to evaluate the technological feasibility of a more stringent regulation positively.

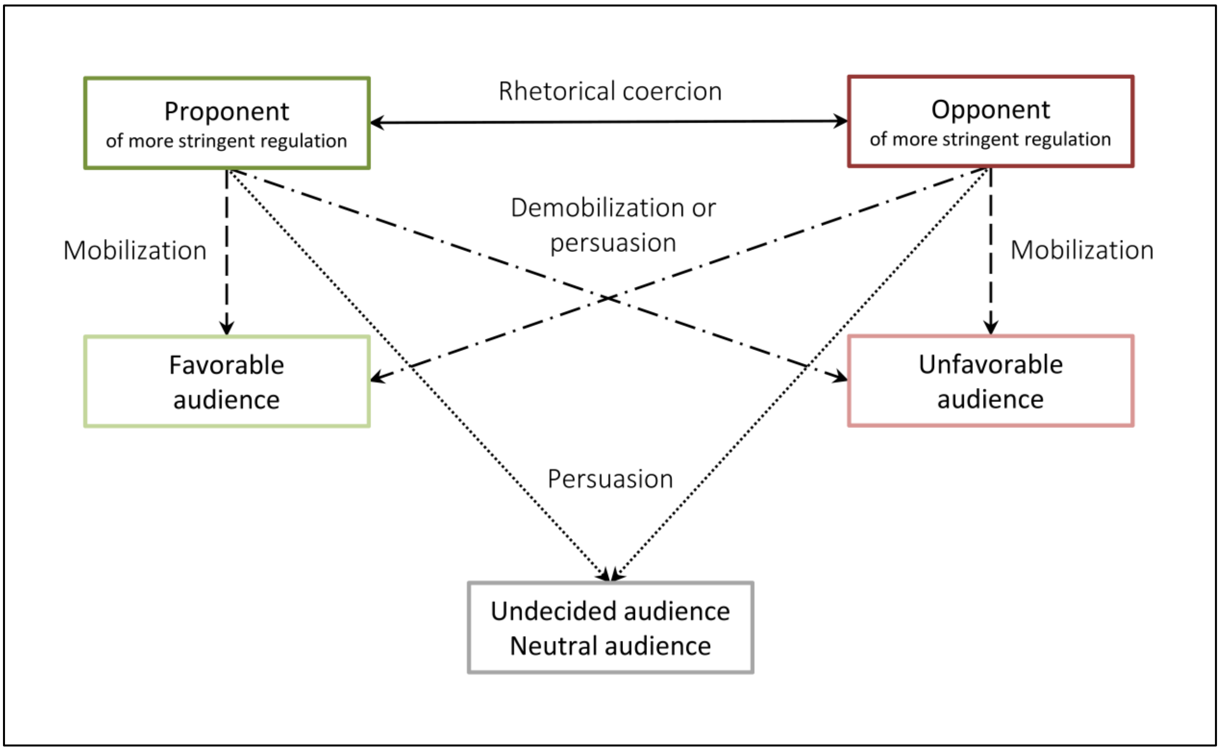
Our running example can be used to illustrate the evaluation of competing technological evidence. Imagine that two engine manufacturers claim to have developed an engine that reduces emissions of P from the source S_P by 60%. Many operators of S_P claim that these emission reductions are unrealistic, and that the new engine technology is not safe. Both engine manufacturers and operators provide technical studies and model estimates confirming their propositions. Some policymakers may anchor their views in the optimistic expertise of the engine manufacturers, which represent the targeted technology sector. Other policymakers may be inclined to follow the skeptical operators, as their studies are more readily available to them. Another group of policymakers may simply remain puzzled.

A few months later, the engine manufacturers can provide emission and operational data from new engines installed on real pollution sources S_P. Their data confirms significant emission reductions and shows no safety hazards, while the operators just reiterate the results of their earlier estimates. This newly available first-mover evidence bolsters the confidence of the optimistic decision-makers in the propositions of the engine manufacturers. At the same time, it creates pressure for skeptical decision-makers to either partially adjust their initial view or to defend it with new arguments and evidence. The first-mover evidence may also become an anchor for decision-makers that did not hold any prior views on the matter. Consequently, the number of decision-makers that consider stringent regulation to be feasible will increase. In other words, decision-makers only believe it (the feasibility of regulation) when they see it (practices in line with intended regulation).

State bureaucrats can also bring two seemingly inconsistent premises of business experts in line with each other by amending them. Amongst others, they can specify to which regions, applications, and timeframes each proposition applies. An updating of propositional beliefs can then also suggest new conclusions for regulatory design, for instance, to adjust the scope of requirements. The following variation of our example illustrates this: A first premise states that lack of space is a barrier to the installation of new low-emission engines on S_P. This suggests that regulation cannot set more demanding emission limits. A second proposition states that new sources S_P provide enough space for low-emission engines. This suggests that regulation can set more demanding limits. The inconsistencies between these propositions can be resolved by specifying that lack of space is only a barrier to the installation of new engines on *existing* sources S_P. The regulatory conclusion following from that would be to exempt existing sources S_P from more demanding emission requirements. Thus, decision-makers that seek cognitive consistency by aligning seemingly contradictory premises may come to propose new regulatory options. This can open new regulatory design paths in international negotiations.

Finally, decision-makers can simply ignore technology propositions that are not in line with those already held. Political psychologists have shown that, in the pursuit of consistency, many decision-makers "tend to see what they expect to see" (Jervis 2017a, 26). The empirical analysis of misperception has mainly focused on foreign policymakers who typically act under conditions of overload and time pressure (Davis 2013; Jervis 2017a, 135). These constraints are presumably less severe in international regulatory negotiations that last several years. However, especially proponents and opponents already holding many consistent premises may choose to ignore dissonance-increasing information. Here, consistency-seeking reinforces disagreement in international negotiations. For instance, proponents of stringent regulation of P may choose to ignore sporadic reports about safety problems that pop up as more newly developed engines are installed on S_P. Opponents may take these reports as confirmation of their concern that the new engine technology is not safe enough to issue a binding regulation. They may readily ignore though that the number of safety incidents for new engines is not significantly higher than for old ones. By contrast, audience states hold fewer propositions and are therefore more likely to resolve inconsistencies by evaluating competing premises or amending prior propositional beliefs. Thus, they are the actors that can blur, bridge, or decide argumentative disagreements in international negotiations. All three strategies of consistency-seeking—evaluation, amendment, or ignorance—matter in the different modes that technological arguing can take.

Figure 14: Modes of technological arguing



Source: Author.

Macro-level Processes: Three Modes of Technological Arguing and Changes in State Positions

International regulatory negotiations feature three modes of technological arguing. The three modes differ with respect to the states involved (see Figure 14) and in their effects on state preferences and positions. The first mode of technological arguing is mutual rhetorical coercion or entrapment by proponents and opponents. Successful coercion does not modify state preferences but rather the positions that states officially articulate and endorse (Krebs and Jackson 2007, 36, 42). The second mode of arguing over technology comprises the argumentative (de-)mobilization of favorable and unfavorable audience states by proponents and opponents. Successful mobilization amplifies states positions without changing the orientation of the underlying preferences. The third mode of arguing over regulatory feasibility refers to sincere persuasion of audience states by proponents and opponents. Successful persuasion changes or specifies state preferences. The three mechanisms are not mutually exclusive but may operate simultaneously or sequentially in regulatory negotiations. Again, they represent ideal types, with the boundaries between them being possibly blurred in practice. In the following, I explain each mode of technological arguing from a proponent perspective.[38]

Rhetorical Coercion

Proponents seek to rhetorically coerce opponents into consenting to their policy position (Krebs and Jackson 2007, 42). Rhetorical coercion is enabled by boundaries of acceptable or meaningful discourse. Discursive boundaries reflect norms and ways of reasoning that are salient in the community or institutional context in which arguing unfolds (Skovgaard 2013, 1145). Actors that violate these boundaries are likely to lose reputation and credibility, which makes it more difficult to mobilize others for their cause (Risse 1999, 551; Schimmelfennig 2001, 64–65). Rhetorical coercion works through actively pushing opponents against the boundaries of acceptable discourse (Krebs and Jackson 2007, 46–48, 55). Alternatively, opponents may entrap themselves by making commitments to specific norms or ways of reasoning (Risse 1999, 550–51; Schimmelfennig 2001, 65). When opponent arguments surpassed boundaries of acceptable discourse, the audience would side with the proponent (Krebs and Jackson 2007, 47). However, opponents anticipate this threat or intrinsically respect the discursive boundaries of the governance community. Therefore, they can be "talked into a corner, compelled to endorse a stance they would otherwise reject" (Krebs and Jackson 2007, 36). Successful rhetorical coercion leads to changes in policy positions but not necessarily in the convictions or preferences of state representatives (Krebs and Jackson 2007, 42; Schimmelfennig 2003, 202).

How could rhetorical coercion work in our example? Suppose that an opponent challenges the proposition that enough advanced filters and new engines would be available for owners of S_P to comply with a binding 60% emission reduction for P. The proponent can now attempt to agree with the opponent on the number of new filters and engines that would be required within the next ten years. Let us assume that they can agree on the number of 10,000 filters and 10,000 engines. Now suppose that experts

[38] The same logic usually applies to opponents with opposite signs. Note that I use the term "proponent" here as a synonym for "claimant" (Krebs and Jackson 2007) and "persuader" (Checkel 2001). I believe that this relatively neutral term can bridge the harder language from the theory of rhetorical coercion and the softer terminology used in sincere persuasion.

from equipment suppliers and engine manufacturing confirm that 12,000 advanced filters and 20,000 new engines can be supplied within this timeframe. Short of factual arguments against this statement, one option of the opponent would be to argue that this is too uncertain and that 15,000 filters would be better. Such an argument would be unacceptable for the regulatory community because it violates a previously agreed way of reasoning. To maintain this discursive boundary, several audience states might come to side with the proponent state. Anticipating this dynamic, the opponent would unwillingly accept the proposition that there is sufficient supply of advanced filters and new engines for a binding emission limit.

While largely following the original framework of rhetorical coercion, I deviate from it in two respects. One deviation concerns the questions of whether rhetorical coercion operates internationally and who constitutes the audience. Krebs and Jackson (2007, 55–57) are skeptical that rhetorical coercion can work on the international level outside of regional communities of states. Reasons are the lack of a global public and of internationally shared understandings of what constitutes an acceptable discourse. According to this view, domestic publics are the only relevant audience of governments in international affairs (Krebs and Lobasz 2007). I agree that the executive branch needs to justify its international policy positions domestically. However, research has shown that rhetorical coercion can also operate on the international level despite a thinner layer of common values (Petrova 2016, 397). Such common values can be underlying transnational communities in which state and nonstate actors pursue a common project (Djelic and Quack 2010, 25) or can emerge from dense, nonhierarchical interactions in international institutions (Risse 2000, 19). International organizations are likely to approximate such conditions as they enable states (and nonstate actors) to govern together, which means "to address common problems and work towards common goals in the future" (Mitzen 2015, 120). Audience states wishing to maintain the normative foundations of this governance community will intervene when its discursive boundaries are violated by proponent or opponent arguments. Thus, in international negotiations, audience states replace a missing global public.

Another deviation concerns the outcome of rhetorical coercion. The original theory conceptualizes this outcome as a dichotomy. It assumes that, if rhetorical coercion occurs, either proponents or opponents win (Krebs and Jackson 2007, 44–47). I hold that this is oversimplifying given the complexity of regulatory negotiations. In complex negotiations across multiple design dimensions, both proponents and opponents may argue each other away from their initial policy positions. In our example from above, the opponent could attempt to shift the discussion by introducing a new frame. One option is to call into question whether the owners of S_P can afford 10,000 new filters and 10,000 new engines within 10 years. The two states will then attempt to agree on what level of equipment costs would still be affordable and collect data to assess the actual cost level. In the ensuing argumentation, both proponents and opponents may find it difficult to sustain their respective premises in light of agreed ways of reasoning and new evidence advanced by the other side. Let us assume that this process forces them to recognize that whereas the new engines reducing emissions of P by 60% are affordable for owners of S_P, the advanced filters achieving a 70% reduction are not (for instance, because the more efficient engines reduce fuel costs, while the filters increase operational costs). Hence, both proponents and opponents have been directed towards new premises that have implications for regulatory design. As they follow this route rather unwillingly, this still qualifies as rhetorical coercion rather than truth-seeking (cf. Risse 2000, 12).

Argumentative Mobilization

Proponents seek to mobilize favorable audience states and demobilize unfavorable ones. Favorable audience states share some views of proponents about the need for regulation or its feasibility but are not certain about them. Argumentative mobilization denotes efforts of proponents to reduce these uncertainties. Reduced uncertainty activates favorable audience states and turns them into active supporters of stringent regulation. By contrast, unfavorable audience states do not share claims of proponents about regulatory need or feasibility. Argumentative demobilization increases the uncertainty of decision-makers in these states. Increased uncertainty attenuates their skepticism, preventing them from articulating opposition. Opponents pursue the reverse strategy with a view to mobilizing skeptics and demobilizing potential supporters of the proponent position.

Proponents and opponents can influence the level of certainty about regulatory feasibility by advocating new premises about the state of technology. They form and communicate these premises together with experts from the business sector. Proponents and their business allies seek to dispel doubts about the feasibility of more stringent regulation, while opponents and their allies spread them. Put differently, both proponents and opponents provide propositions that resonate with those audience state positions initially closest to them. Going back to our running example, proponents take up the expertise of innovative filter and engine manufacturers supporting a binding and demanding emission reduction of P by 60-70%. Opponents use the expertise that the less advanced filter producers and the owners of S_P provide against such a stringent regulation. Favorable and unfavorable audience states consequently face competing arguments that entail inconsistent propositions about aspects of regulatory feasibility. In their pursuit of consistency, decision-makers of audience states assign different truth values to these propositions or explore ways of aligning them. The quality of evidence presented by proponents and opponents to support their arguments determines whose mobilization and demobilization efforts eventually succeed. For instance, a strong piece of proponent's evidence for the feasibility of a binding emission limit would be reports about the installation of new engines by first-moving owners of S_P that have reduced P by 60%.

Argumentative mobilization is different from rhetorical coercion. Rhetorical coercion relies on some minimum normative consensus about the boundaries of acceptable discourse in an international community. Audience states seek to maintain discursive boundaries that define the community with which they affiliate themselves. Independent of their preferences on the object under negotiation, audience states lend support to proponents when opponents violate these boundaries. In contrast to this, argumentative mobilization does not rely on common values about what constitutes an acceptable argument. Rather, it works by reinforcing or attenuating substantive views that decision-makers of audience states have already been holding about the issue under negotiation. Proponents can mobilize favorable audience states by increasing their certainty that stringent regulation is indeed both needed and feasible. Here, evidence that strengthens the validity of previously held propositions over that of competing propositions put forward by opponents is decisive.

Argumentative mobilization can also be contrasted with authentic persuasion or truth-seeking. Truth-seeking denotes preference formation or change in ideal speech situations (Deitelhoff 2009, 43; Risse 2000, 10–11). Truth-seeking arguments are persuasive when presented by speakers who are perceived as neutral and when resonating with prior knowledge, norms, principles, and worldviews of the audience (Ulbert and Risse 2005, 361–64). Resonance of arguments in the audience is important in the context of argumentative mobilization, too; a neutral perception of speakers less so. Proponents of truth-seeking themselves have recognized that ideal deliberation and ensuing preference change are quite rare—world politics only exhibit "islands of persuasion" (Deitelhoff 2009, 62; Risse 2013, 344). I suspect this is because audience states in international negotiations vary in their openness towards proponent and opponent arguments. For proponents, audience states already favorable to their position are the most accessible pool for additional support. Unfavorable audience states are likely sources of additional opposition. The reinforcement or attenuation of these preferences form the core of argumentative mobilization.

Sincere Persuasion

Proponents launch efforts at sincere persuasion of neutral, undecided, or unfavorable audience states. Sincere persuasion refers to preference change resulting from the adoption of new ideas about cause-and-effect relationships (Checkel 2001, 562; 2003, 212). Causal ideas may form part of premises about the state of technology and its implications for regulatory feasibility. Psychological assumptions and empirical evidence suggest that sincere persuasion is most likely when issues are little politicized; when persuadees hold few cognitive priors and have to cope with uncertainty due to newness of the issue, crisis, or policy failure; and when persuaders possess in-group authority (Checkel 2001, 562–63; 2003). According to my interpretation, in-group authority can relate to regional groups of states, such as the EU, or functional groups, such as major polluters. The conditions of high uncertainty and low politicization are clearly met in neutral audience states, where decision-makers do not hold any cognitive priors. Some degree of uncertainty and a limited politicization may also be present in the other types of audience states, where policymakers hold some prior beliefs about regulatory need and feasibility.

The operation of sincere persuasion in technological arguing depends on the targeted audience state. Proponents can attempt to persuade neutral audience states of a favorable stance on stringent regulation. Communicating propositions that confirm the feasibility of more stringent regulation is one element in this attempt. Recall, however, that the reason for an initially neutral stance of states is that their decision-makers do not hold any distinct views on the need and the feasibility of regulation. It follows that arguing over regulatory feasibility alone does not suffice to change the policy preferences of neutral audience states. Gaining support from neutral audience states presupposes that their decision-makers also come to acknowledge a need for regulation. To return to our example, neutral audience states would have to be convinced that the health and environmental impacts of P are so severe that a large emission reduction is needed. Amongst other things, proponents here can resort to science diplomacy (cf. Legrand and Stone 2018). They can try to produce and disseminate scientific information fueling domestic voices in neutral audience states that consider more stringent regulation necessary.

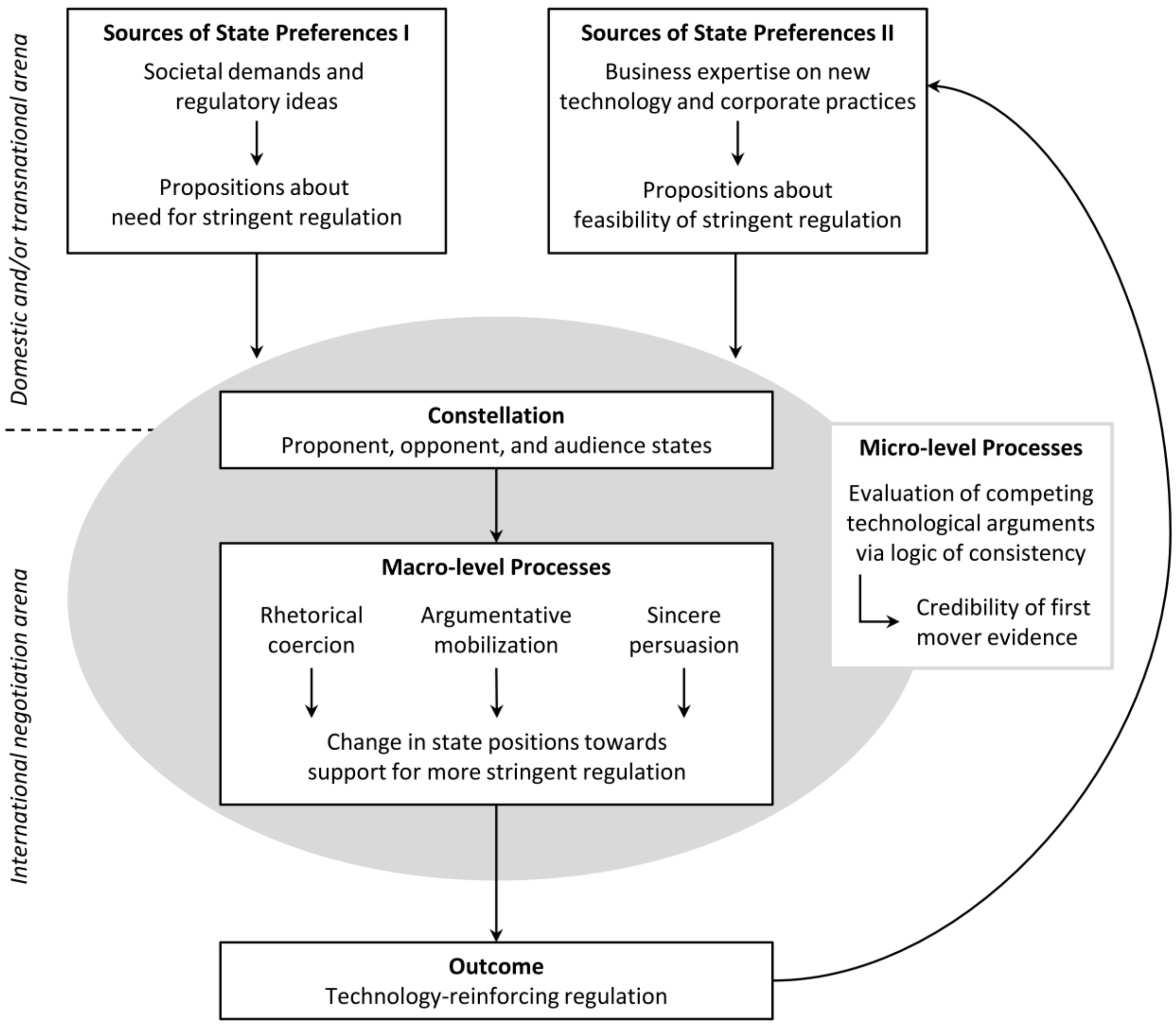
Proponents can also attempt to persuade audience states whose decision-makers hold cognitive priors. On the one hand, proponents can try to make undecided audience states support stringent regulation. The starting point of undecided decision-makers is that regulation is needed but not feasible, or vice versa. Proponents can eliminate this ambivalence by challenging the validity of premises that speak against stringent regulation. This requires strong evidence that can prove some previously held propositions wrong. For instance, proponents would have to show that the skeptical views of owners of S_P about the feasibility of stringent regulation of P are based on false assumptions about technology development. Amongst others, they could attempt to demonstrate that the emission reductions achieved by new engines go well beyond initial estimates presented by the owners of S_P.

On the other hand, proponents can attempt to turn unfavorable audience states into undecided or neutral ones. Unfavorable decision-makers tend to consider that stringent regulation is superfluous and infeasible but are not certain about this. By providing arguments that call into question most of the premises underlying this initial view, proponents can increase the uncertainty and ambivalence of these decision-makers. For instance, they could show that the expertise on which these audience states based themselves came from an equipment producer that was technologically far less advanced than previously thought. Successful persuasion presupposes that the newly advocated premises are supported with particularly compelling evidence. These reflections suggest that persuasion is easiest with respect to neutral audience states and most difficult for unfavorable ones. The main differences of sincere persuasion to argumentative mobilization is that it does not merely change the intensity but rather the orientation of the preferences of targeted states.

Outcome: Technology-Reinforcing Regulation

The relationship between business practices and international regulation is one of argumentative coproduction. Feasibility considerations in international environmental policymaking make business expertise a source of regulatory ideas. Business expertise on more environmental-friendly technologies or industry practices can inspire state proposals for more stringent regulation (Braithwaite and Drahos 2000, 559–62). Anticipation of more stringent regulation by early adopters can then lead to a moderate spread of first-mover practices (Vormedal 2011, 4). In our running example, new engines with lower emissions of P are installed by several owners of S_P. These first-mover practices—intentionally or unintentionally—provide credible evidence for the feasibility of more stringent regulation. They can demonstrate that emission reductions of at least 60% are technically feasible, that the required engines do not increase safety hazards, that these engines are commercially available, and that owners of S_P can afford them. Such evidence is an essential source of argumentative power and potentially pivotal in all three modes of technological arguing. It helps proponents and their business allies to rhetorically coerce opponents and to mobilize, demobilize, or persuade audience states. Evidence from first-mover business practices can thus tip the balance in favor of design choices pointing towards more stringent international environmental regulation. In the example, the first-moving owners of S_P provide argumentative ammunition for making a 60% reduction in emissions of P a binding regulatory requirement.

Figure 15: The model of argumentative coproduction



Source: Author.

New regulation then shapes business behavior more broadly by diffusing and reinforcing the same first-mover practices that once inspired it (see Figure 15).[39] After the adoption of a binding and ambitious emission limit for P, the uptake of new engine and emission control technology will accelerate. Initial first-mover practices become the new normal. As this diffusion or normalization progresses, new first movers appear that reduce P by more than 60%, use new devices for real-time emission measurement, or the like. These developments set in motion yet another regulatory process that may result in even more stringent policy. In the long term, this brings the industry ever closer to the 80% emission reduction of P that scientists consider necessary. In short, argumentative coproduction captures the dynamic relationship of regulation and business practices, which is often dialectic rather than one-directional.

The notion of coproduction connects to different lines of research in the field of science and technology studies. The interaction of private innovation and public policy development figures prominently in works on transition management. This literature describes sustainability transitions as vision-guided processes in which new technology and supporting policies coevolve (Kemp, Loorbach, and Rotmans 2007; Loorbach 2010; cf. Ekins 2010). Coevolution modifies socio-technical systems comprising markets, corporate practices, knowledge, and regulation (Geels 2005). My approach agrees with the coevolutionary view that niche innovation can inspire transition processes (Geels 2005, 450–51; Kemp, Schot, and Hoogma 1998, 183–84). However, while transition management describes or even prescribes national policy, my model focuses on explaining international regulation. Another line of research in science and technology studies has developed an interpretivist understanding of coproduction. It highlights that "knowledge and its material embodiments are at once products of social work and constitutive of forms of social life" (Jasanoff 2006, 2). Translated to the context of environmental regulation, this means that expertise on regulatory feasibility is both a source and a product of political processes. My explanatory model captures these dynamics.

The dialectic view on the nexus between business practices and public regulation differs from the rather one-directional perspectives of ideational interventionism and material evolutionism. Ideational interventionism posits that regulation, driven by activists and scientists, is forced upon business actors (D. L. Levy and Newell 2005). I agree that societal actors shape ideas of decision-makers about the need for more stringent regulation. The important question of whether such regulation is also feasible often calls

[39] The extent and speed of these effects depends on the specific design of regulation, regulatory enforcement, as well as various contextual factors.

for evidence of first-mover practices from the targeted sector though. Material evolutionism suggests that regulation reflects the technologies and practices of large firms with instrumental or structural power resources (Falkner 2005b; 2008; Maxwell and Briscoe 1997, 284). My model holds that business influence mainly operates through the discursive channel of expertise. I agree that the technologies and practices of large firms may be important because of their high visibility. However, my model does not preclude the possibility that niche innovation by smaller firms comes to shape international regulatory proposals. Referring to the stylized example, it would not necessarily change the outcome if the innovative filter producers were small and medium-sized enterprises and the less innovative ones were large multinationals. Material evolutionism further notes the importance of tipping points in business support for new regulation (Vormedal 2012). Indeed, evidence of first-mover practices may appear more compelling when referencing many firms. However, my model suggests that corporate expertise does not necessarily need very broad business support to be effective. Overall, argumentative coproduction thus corrects several propositions of ideational interventionism and material evolutionism.

Scope Conditions and Intervening Factors

The preceding description suggests five scope conditions under which argumentative coproduction operates. First, argumentative coproduction of regulatory decisions takes place in the context of negotiations within international organizations. Arguing is less relevant in the non-negotiated diffusion of standards, which appears to be driven by market power (Drezner 2008; Simmons 2001). Second, technological arguing applies to environmental problems that can be addressed through enhanced business practices or technology. Discussions about banning certain industrial activities altogether, as in the case of whaling, may coincide with more fundamental norm conflicts and clashing identities (C. Epstein 2008). Third, the argumentative influence of business actors presupposes that they have access to decision-making debates (Cortell and Davis 2005, 23; Skjærseth and Skodvin 2003, 36). Both domestic and international regulators may act as gatekeepers in granting institutional access to corporate experts. Fourth, business expertise shapes regulatory positions most strongly for issues that are not very salient for voters. State preferences on salient issues, like climate change in some countries, are more likely to be subject to electoral pressures (Harrison and Sundstrom 2007, 6–7). Fifth, the model of technological arguing fully operates only if audience states exist that can tip the balance. The number of audience states is highest for issues that are little politicized, have asymmetrical effects on states, and are discussed in large global institutions. The empirical case selection pays attention to these scope conditions.

Several factors may intervene into technological arguing. On the one hand, issue framing and linkages shape the rhetorical arena within which technological arguing unfolds. Issue framing can be a gateway for NGO influence (Andresen and Skodvin 2008, 144; Keck and Sikkink 1998, 16–20; Humphreys 2004, 71). Activists and scientists can notably play a role in setting the "anchor" from which policymakers adjust to new information communicated by business experts. This is particularly important when activists and scientists team up with pro-regulation business experts. Moreover, issue linkages can structure the arguing space. Issue linkages are forged by policy entrepreneurs from national delegations as well as secretariats of international organizations (O. R. Young 1991, 293–98). Activists and scientists can also establish issue linkages, for instance, by showing that a regulatory proposal for reducing P also has implications on another environmental externality, say discharge D. Such linkages undoubtedly increase the complexity of negotiations. They imply that technological arguing on one issue can affect the course of negotiations on linked issues.

On the other hand, institutional factors can have an impact on technological arguing and its implications for contentious regulatory design choices. International institutions are likely to differ in the sense of community that has emerged among their members. Older institutions with regular and frequent interactions among state delegates presumably feature a stronger sense of community than younger ones with sparse interaction. A stronger sense of community based on common values is a more conducive environment for rhetorical coercion. Moreover, international institutions differ in their mandates and degrees of technicality. Technological arguing is presumably more likely to be found in institutions that exclusively focus on low politics with strong technical components. The membership of international organizations, including the access they grant to different business actors, determines who can take part in technological arguing. Furthermore, institutional path dependencies can limit the range of design options considered in negotiations (R. E. Kim and Mackey 2014, 13). For instance, international organizations pursuing a soft-law approach are more likely to maximize the substantive ambition rather than the formal tightness of regulations. Additionally, decision rules and voting rights define how much support is needed for the adoption of a regulatory proposal (Koremenos, Lipson, and Snidal 2001, 772). This has implication for how much effort proponents must put into rhetorically coercing opponents as well as mobilizing and persuading audience states. While I do not attempt to fully determine the influence of these intervening factors, the empirical analysis will acknowledge their presence where appropriate.

Summary

This chapter reviewed existing ideational and material models of international regulatory politics and formulated the alternative model of argumentative coproduction. This new model posits that business practices and international environmental regulation coproduce each other. Coproduction means that business practices inspire public regulation which then reinforces these practices in turn. At the core of this relationship is the role of business expertise in informing policymakers about the technological leeway for more stringent regulation. Business expertise is not necessarily consensual as firms may pursue different interests with respect to environmental protection and regulation. In case of competing business expertise, the credibility of supporting evidence becomes crucial. The credibility of evidence hinges on tangible references to existing or emerging innovations and first-mover practices. Such evidence is a major source of power in arguing over the technological basis for regulation. Technological arguing is driven by states with strong and stable policy preferences that seek to garner support among states with weaker and less stable preferences. Changes in state positions can occur through rhetorical coercion, argumentative mobilization, and sincere persuasion. Underlying these specific mechanisms is the logic of consistency that guides policymakers in the formulation and articulation of state positions.

The proposed model complements existing ways of thinking about international regulatory politics in at least three ways. First, argumentative coproduction integrates a theory of business influence into a larger model of technological arguing in international negotiations. This is an improvement compared to ideational-interventionist and material-evolutionist approaches, which either downplay the relevance of business conflict or underrate the discursive dimension of corporate practices and technological power. Second, argumentative coproduction opens new theoretical space in between the constructivist and rationalist underpinnings of ideational interventionism and material evolutionism, respectively. With respect to competing business expertise, the model stresses its material sources as well as its ideational influence on state positions. With respect to the evaluation of competing expertise by regulatory decision-makers, the model introduces consistency-seeking as a new logic of action. Third, argumentative coproduction corrects some of the more specific propositions of existing explanations. By identifying business expertise as an argumentative driver of international regulatory change, my model goes beyond the ideational-interventionist focus on activists and scientists. Furthermore, positing that even first movers with limited material resources can inspire international regulation, my model challenges the materialist-evolutionist focus on large firms from powerful states.

Having outlined different models of business influence in international environmental regulation, I now turn to probing their explanatory power. Especially, I want to show that argumentative coproduction can shed light on empirical processes and outcomes of regulatory negotiations that ideational interventionism and material evolutionism neglect. How can this be done best? In the next chapter, I illustrate the application of the three theoretical models against the backdrop of the empirical puzzles identified in chapter 2. Based on that, I argue that a case-based congruence analysis with embedded process tracing is an adequate method for initially assessing the added explanatory value of the theory of argumentative coproduction. I outline key elements of this method and justify the selection of two empirical cases as serious probes of the theory. The empirical case studies examine negotiations on limiting environmental impacts of shipping which have mainly taken place in the International Maritime Organization (IMO) in London. One of the cases focuses on shipping regulation for the Baltic Sea, the other on regulation for the Arctic. The case studies show that the decisions made by regulators in London were decisively shaped by what companies did in these distant regions and by what was said about these deeds in the meeting halls of the IMO.

4 Method: Designing a Pragmatic Probe of the Three Models

This chapter lays the foundations for moving from empirical description and theory to causal inquiry. The preceding chapters described the empirical variance in the design of international maritime environmental regulations and outlined three theoretical models that draw different causal links between business practices and contentious regulatory design choices. Existing explanations were summarized in the two clusters of ideational interventionism and material evolutionism. The former portrays a discursive war of position between reluctant business interests and progressive regulatory ideas of environmental NGOs and scientists. The latter stresses the dependence of regulatory decisions on innovation and interests of materially powerful companies. As a theoretical innovation, I proposed the model of argumentative coproduction. The model posits that business practices can influence or shape regulatory decisions through their reflection in expertise on the feasibility of different policy options. According to the underlying causal mechanism, progressive environmental practices of corporate first movers strengthen the argumentative power of those political actors which claim that stringent regulation is feasible. The resulting regulation then forces broader changes in business practices beyond first movers.

Subsequently, I explain the method used for probing the explanatory power of my model against that of the alternatives of ideational interventionism and material evolutionism. To begin with, I apply the three models to the empirical puzzles in international maritime environmental regulation presented in chapter 2 to demonstrate their distinctiveness but also their partial overlap. Based on that, I establish that an appropriate way to probe their explanatory power is to adopt a case study approach consisting of a congruence analysis with embedded causal process tracing. Next, I outline the three elements that form the core of this analysis, namely comprehensive storylines, pattern matching, and smoking gun and hoop evidence. After that, I describe the diverse empirical material used for the analysis. I then set forth the criteria for the selection of the two empirical cases that shall help to assess the explanatory value of argumentative coproduction. As a basis for the case studies, I move on to formulating theoretical expectations of the three models of international environmental regulation. Finally, I summarize the key points and outline the structure of the case studies.

Linking Theory and Empirics: Implications for Research Strategy

Before deciding on a research method, it is useful to consider to what extent the models of ideational interventionism, material evolutionism, and argumentative coproduction are distinctive or overlapping. For that purpose, I reflect on how these theories would approach the empirical patterns of international maritime environmental regulation identified in chapter 2. These patterns relate to the variance of regulatory stringency across industries, environmental impacts, regions, and international organizations, as well as to the prevalence of different design combinations over time. I do not attempt here to provide full-fledged explanations and hypotheses ready for empirical testing. Instead, my aim is to compare the different lines of thinking in an illustrative way and to draw conclusions for an appropriate research strategy.

Five puzzles in the variance of the design of international maritime environmental regulations have been identified from the IMER Database. The first puzzle was the greater abundance of stringent regulation in shipping as opposed to offshore oil and gas. Ideational interventionism would suppose that industry, standing in natural opposition to stringent regulation, has built a more solid material, organizational, and discursive hegemony in the regulation of offshore oil and gas. The discursive means of NGOs and scientists suffice to challenge that hegemony only occasionally, for instance, when existing policies fail in a big way. By contrast, material evolutionism would suspect that incentives for business conflict are larger in shipping, so that pro-regulation coalitions with instrumental and structural power resources are more numerous. These coalitions are built around influential technology leaders, multinational companies, or suppliers of environmental technology that economically benefit from regulation. Argumentative coproduction would approach cross-industry variance by asking whether the incentives for firms to improve their environmental conduct and become first movers differ in the two industries. Amongst others, it would explore whether shipping companies face greater and more direct consumer pressure to go green than oil and gas companies. A larger number of first movers could explain why pro-regulation arguments have presumably been more assertive.

The second puzzle asked why oil- and other water-related externalities have been regulated earlier and often also more stringently than other impacts. Ideational interventionists would examine the discursive properties of these impacts. For instance, they would argue that activists and scientists can challenge business hegemony most readily when externalities have highly visible and dramatic environmental consequences, such as oil spills. Material evolutionists would take a different perspective. For them, one possibility is that the more stringently regulated externalities are those where innovation in environmental technology has progressed faster. Another possibility is that, for issues with early stringent regulation, the mutual benefits of international cooperation for states were largest. The model of argumentative coproduction would inquire whether the most stringently regulated externalities are those that have been subject to previous improvements in corporate environmental practices. For instance, these impacts may have threatened the social license of business, or their abatement may have promised new market opportunities for firms. Again, enhanced business practices could have supported arguments for stringent regulation. The dynamic repetition of this process may even explain why regulation of all impacts has grown more stringent over time.

The third puzzle consisted of the observation that the most regulated regions have very different levels of industrial activity. Ideational interventionists would be concerned with the symbolic value of the regulated regions and the societal values in rim states. Sea regions that are perceived as highly vulnerable, such as polar areas, and those bordering states with strong environmental discourses stand a better chance of overcoming the dominance of business hegemony. Material evolutionists would probably point to the fact that all highly regulated sea regions are located (at least partly) in economically developed world regions. The level of innovation in these regions is generally high, and thus also the interest of firms and states in stringent regulation that shields them from low-cost competitors with less developed technology. Argumentative coproduction would give credit to the starting points of both theories. In addition, it would explore whether corporate overcompliance is more common in vulnerable or particularly affected regions where NGOs exert high pressure on businesses. Argumentative coproduction would also speculate whether countries in highly regulated regions are better at bringing progressive business expertise into international negotiations.

The fourth puzzle identified international organizations with strong business participation as hubs of regulation. Ideational interventionism would find the observed pattern surprising as business is not expected to be a constructive partner in global environmental governance. It could resolve this puzzle in two ways though. One option is to challenge the empirical diagnosis by arguing that the seemingly stringent regulations do not require radical eco-innovation as they only codify incremental innovation of dominant business actors. Another option is to accept the empirical description and explore whether stringent international regulators also grant activists and scientists access to deliberative processes. By contrast, material evolutionism would count the observed pattern as indirect evidence for their view that business can contribute constructively to environmental governance. The presumption would be that coalitions of large innovative firms and their materially powerful host countries bargain most forcefully and can thus capture regulation for their benefit. My theory of argumentative coproduction would also be optimistic about the role of business in international organizations. It would conjecture that international organizations with a high output of stringent regulations provide an institutional environment that encourages technological arguing based on progressive business expertise.

The fifth puzzle focused on why states rather frequently agree on regulations that are both tight in form and ambitious in substance. Ideational interventionists would once again doubt the extent of truly progressive regulation. However, they would acknowledge that particularly strong environmental norms or processes of arguing about less politicized issues can make states pursue regulation that is both tight and ambitious. Material evolutionists would be rather surprised by the observed empirical pattern. They would assume that diverse business and state interests often result in bargains that trade off formal tightness against substantive ambition, or vice versa. Argumentative coproduction would be less surprised. It assumes that stringent regulation emerges when regulators feel confident that it is both needed and feasible. These views of regulators rest on domestic calls for regulation and on compelling expertise of innovative business actors for its feasibility. The dialectic and highly dynamic relationship between innovation and regulation may account for why the number of stringent shipping regulations has increased over time.

What implications do the different theoretical approaches have for the choice of a research strategy? Many researchers from the positivist tradition might find a large-n quantitative analysis most desirable for resolving the observed empirical puzzles. At present, such a large-n analysis is difficult for three reasons. First, the list of potentially relevant variables is still long and will likely require a major data collection effort. The IMER database covers the “dependent variable,” but data availability seems more complicated for the various “independent” and “control variables.” Second, even if all necessary data could be obtained, the partial overlap of the three explanatory models is a challenge for quantitative analysis. I suspect that the empirically observable differences between the models will often be found on the level of process rather than variable observations. Third, and related to that, the mechanisms proposed by the three models are not necessarily mutually exclusive. It is conceivable that the models operate to different extents at the same time depending on contextual conditions. These arguments are not meant to dispute the possibility of an insightful large(r)-n assessment of the three theorical models. Rather, they suggest that, before scholars make such a great effort, the expectations and scope conditions of these theories should be probed and, if necessary, specified further. Qualitative case studies are an appropriate tool for this purpose and therefore form the empirical part of my dissertation.

Congruence Analysis and Causal Process Tracing

The empirical case studies are intended to assess the usefulness of the three theories for capturing the processes and outcomes of international environmental regulation of business. My methodological starting point is the pragmatic position outlined in the introductory chapter. It holds that the gap between positivist "truth-seeking" and interpretivist "sense-making" can be bridged by a set of coherent methods (Blatter 2017). The main purpose of the causal inquiry is to probe the explanatory power of the newly proposed model of argumentative coproduction against that of ideational interventionism and material evolutionism. All three models theorize when and how business and its environmental practices influence or shape the design of international environmental regulations. Besides probing argumentative coproduction, the case studies also seek to further explore the scope conditions of this novel theory. A challenge for the causal inquiry is equifinality: the different mechanisms proposed by the three theoretical models can, at times, lead to the same outcome (e.g., stringent regulation). Another potential challenge is reverse causality: stringent regulation may not be the result of new business practices and expertise but rather their cause. These challenges and the purpose of the empirical case studies are reflected in the selection of methods.

The empirical probe consists of a within-case analysis combining congruence analysis and causal process tracing. Blatter (2017, 2–3) has argued that this pragmatic combination of methods comes "close to balancing the epistemological principles and ontological presuppositions of truth-seekers and sensemakers." The essence of a congruence analysis is to systematically assess the expectations of different theoretical explanations against the empirical evidence. I adopt the "complementary theories approach" which assumes that new theories can provide new or neglected causal insights without necessarily leading to the rejection of existing explanations (Blatter and Haverland 2012, 145). In this understanding, a congruence analysis is useful for "bolstering the aspiration of new theories to be recognized in a field of research" (Blatter and Haverland 2012, 150). By formulating propositions about expected process observations, I embed process tracing into the congruence analysis (cf. Checkel 2014, 90). This is a fruitful combination as theoretical expectations about processes create a broader basis for evaluating different theories against empirical observations (Blatter and Haverland 2012, 218; cf. George and Bennett 2005, 181).

Process tracing examines "intermediate steps in a process to make inferences about hypotheses on how that process took place and whether and how it generated the outcome of interest" (A. Bennett and Checkel 2015, 6). It is central to my research design for several reasons. To begin with, its focus on causal mechanisms fits my ambition to explain "streams of behavior" rather than just outcomes (Blatter and Haverland 2012, 85; Davis 2005, 177). Put differently, I trace the consecutive stages on the pathways that led to certain regulatory design choices. Furthermore, because of the attention it devotes to causal sequences, process tracing addresses the challenges of equifinality and reverse causality (George and Bennett 2005, 223–24). Additionally, thanks to its inductive qualities, process tracing allows for clarifying scope conditions of theoretical propositions (A. Bennett and Checkel 2015, 13). Finally, process tracing has proven useful for examining the role of nonstate actors—like business—as both causes of environmental problems and drivers of policy responses (Vanhala 2017, 89, 96). With respect to its practical implementation, I present the process tracing in the form of an "analytic explanation." This variant of process tracing "converts a historical narrative into an *analytical* casual explanation couched in explicit theoretical forms" (George and Bennett 2005, 211, emphasis in the original). I build this analytical causal explanation on three core elements, which I outline next.

Three Core Elements of the Analysis

The first core element of my analytical explanation are comprehensive storylines that capture regulatory processes in terms of sequences and key moments (Blatter and Haverland 2012, 111–13).[40] Comprehensive storylines are an important element in causal process tracing (Blatter and Haverland 2012, 111). Their time horizon should be relatively long as many environmental problems and the responses to them unfold slowly (Vanhala 2017, 98). Furthermore, an "expansive empirical scope" allows for examining continuity and change as well as for tracing flows of information and actors (Jacobs 2015, 41). This is particularly important for probing my theory of argumentative coproduction, which posits that business expertise may travel from niches to broader sets of actors in

[40] I use the terms regulatory process, policy process, and negotiations interchangeably throughout the empirical analyses. My focus is on the international level, so that the domestic side of the process may not be fully captured.

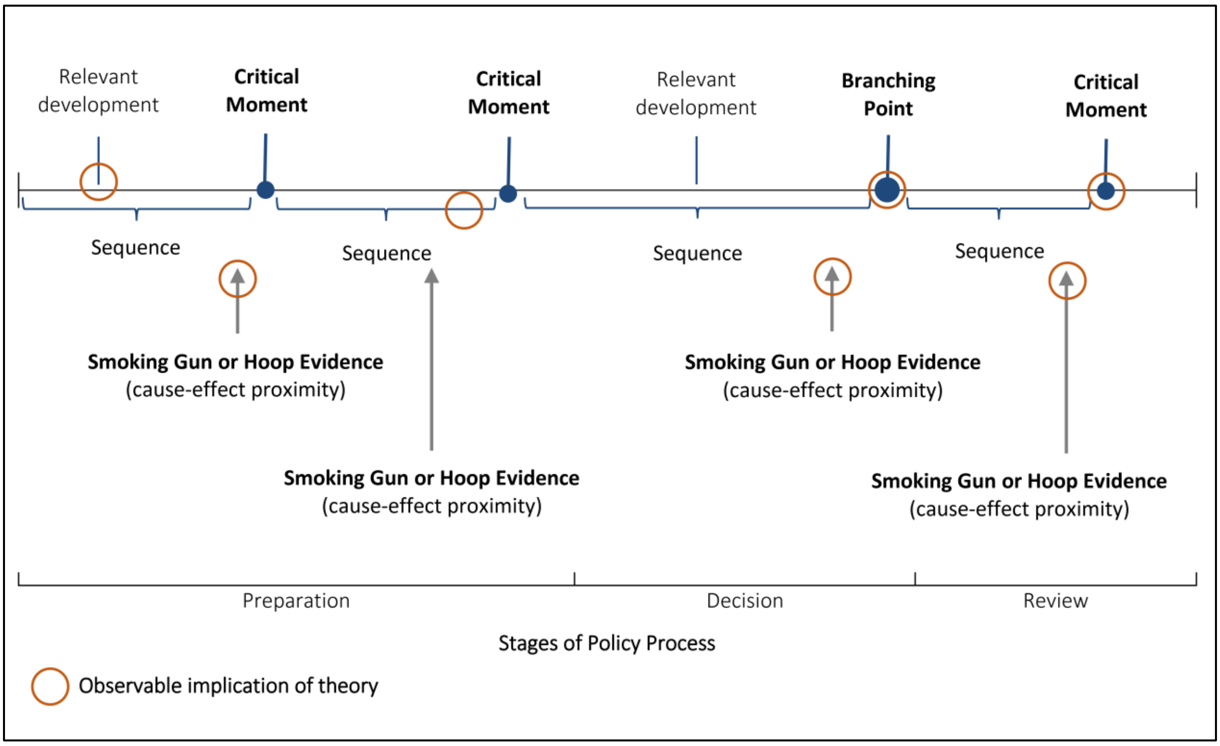
international environmental negotiations. Accordingly, the empirical analysis covers all stages of the policy process from agenda-setting and preparation to decision-making and review.

To give the storyline more profile, I distinguish two degrees of key moments (cf. Bengtsson and Ruonavaara 2017, 50–53). *Critical moments* are decisive moments or focal points that confirm, reinforce, or specify prevailing directions in regulatory design or prepare branching points. *Branching points* represent junctions that can be understood as "phases of transformation" which strongly affect causal pathways (Blatter and Haverland 2012, 111–12; cf. George and Bennett 2005, 212–13). A joint characteristic of both key moments is that they refer to situations where alternative futures were possible. An example for a critical moment would be the formulation of a new regulatory option, say a precise equipment requirement, in a situation where other options, say a less precise requirement, were conceivable, too. A branching point would then be the decision to codify this option in a new regulation even though some actors advocated maintaining the status quo. A subsequent critical moment may be the decision not to review the new regulation despite some vocal calls for this. The example illustrates that, to identify these key moments, I need to consider both observable decisions and non-decisions. I make cautious use of counterfactuals to support this task, while acknowledging the difficulties that their formulation is fraught with (George and Bennett 2005, 231). The sequences and key moments of a comprehensive storyline provide the basis for the other two core elements of the within-case analysis. A stylized comprehensive storyline with sequences and key moments as well as the other core elements of my analytical explanation is visualized in Figure 16.

The second element of the analysis is the matching of observable implications of the three theoretical models of international regulatory politics with actual empirical observations. My starting point lies in between principled interpretivist and positivist thinking about causal mechanisms. I agree that causal mechanisms are analytical constructs which are not just "out there" (Pouliot 2015, 238). At the same time, I assume that, even though causal mechanisms themselves are unobservable, proper theorizing allows for deducing *observable implications of causal mechanisms* (A. Bennett and Checkel 2015, 12). These theoretical expectations may relate to key moments, sequences, specific pieces of evidence for cause-effect relationships, or other relevant developments.

The case studies examine whether empirical manifestations of theoretical expectations can be found (Beach and Pedersen 2013, 15). This activity is also referred to as “pattern matching” (Yin 2009, 136). A major concern with this kind of inquiry is a potential confirmation bias in the selection of empirical material (George and Bennett 2005, 217). I address this concern by providing separate empirical accounts for each theoretical model. As material, ideational, and argumentative theories make use of different kinds of empirical evidence, I do not expect though to demonstrate that their explanatory power is mutually exclusive. To the extent that the formulation of expected patterns takes the form of precise propositions rather than concrete predictions, the empirical accounts involve a certain degree of interpretation (Blatter and Haverland 2012, 165–67). Ideally, matching expected and actual empirical observations would allow for tracing the elements and outcomes of the political process back to a single theory. Practically, however, evidence may often be consistent with more than one theory, especially where theoretical propositions are complementary (George and Bennett 2005, 222). Again, careful use of counterfactual reasoning which assumes away only a few factors or steps ahead of or at branching points can help establish which explanation is more plausible (Davis 2005, 168–75).

Figure 16: Stylized comprehensive storyline with core elements of analytical explanation



Note: For reasons of simplification, the application of this template to the case studies will not visualize the sequences and observable manifestations of theory. These elements are explained in the case study text.

Source: Author.

The third core element of the analytical explanation in the case studies is the collection of empirical observations that demonstrate a temporal, spatial, and social proximity of causes and effects (Blatter and Haverland 2012, 115–17). Such observations are particularly powerful for making causal inferences about theorized mechanisms. This approach relaxes some positivist rigidities, especially the understanding of process tracing as a series of "tests" (Beach and Pedersen 2013, 100–105; A. Bennett and Checkel 2015, 17; Van Evera 1997, 31–32). I agree though that empirical observations are particularly important when allowing us to judge the explanatory power of a theorized mechanism (Beach and Pedersen 2013, 123–24). Most relevant in this respect is the metaphorical "smoking gun"—a "central piece of evidence within a cluster of observations, which together provide a high level of certainty for a causal inference" (Blatter and Haverland 2012, 115). Ideally, I would also gain direct insights into actors' perceptions, motivations, and anticipations through "confessions" (Blatter and Haverland 2012, 111, 117–19). However, I am skeptical that many useful confessions can be obtained, especially as actors may conceal or misrepresent their real motivations.

The unavoidable gaps in obtaining smoking gun evidence can be filled by detecting where theoretical propositions do not manifest themselves empirically. Evidence not passing through the "hoop" of a theoretical model undermines the explanatory power of that model (Beach and Pedersen 2013, 102–5; A. Bennett and Checkel 2015, 17). For example, if I observed decision-makers to not act in line with the material incentives of a given political and institutional context, this would undermine the material-evolutionist model (cf. Jacobs 2015, 42). Of course, hoop and smoking gun evidence is to be searched for with the same intensity for all three theories of international environmental regulation. For ideational interventionism, I focus on how new ideas about the environmental problem and a sense of crisis have produced shifts in state positions. For material evolutionism, I pay attention to how issue linkages, side payments, and lowest common denominator solutions have enabled political agreement. For argumentative coproduction, I trace arguments about technological feasibility, including their origin, transmission, and effect on state positions (cf. Jacobs 2015, 65–69).

Empirical Material

The development of comprehensive storylines, pattern matching, and collection of smoking gun and hoop observations relies on a diverse set of empirical material. The compilation of the material is guided by two goals: to maximize "exposure" to different perspectives on the regulatory process at hand and to ensure a good degree of intertextuality (Schwartz-Shea and Yanow 2012, 84–89). Exposure means that I tried to consider the various understandings that different actors have of the same regulatory negotiation and outcome. For example, to avoid a one-sided depiction of the process, material from its "winners" and "losers" as well as from policymakers, industry, and civil society actors need to be considered. Intertextuality means that I interpreted an empirical source in the context of other types of sources. For instance, the centrality of different arguments put forward in a written submission to an international organization can be assessed with the help of an audio-record of the related discussions. As to my knowledge the selected cases have not been analyzed in international relations literature yet, relevant secondary sources were relatively scarce. The case studies therefore rely on a rich collection of primary sources.

The main type of empirical material used in my case studies are documents from the archives of international organizations. In general, archival sources can provide various kinds of evidence, including patterns of interaction, sequences of events, and traces of causal factors (Beach and Pedersen 2013, 136). Meeting reports and regulatory output documents form the backbone for the development of the comprehensive storylines. They typically document the choices made with respect to regulatory outcomes and the principal topics of the underlying discussions. Usually, they also contain information on the policy positions taken by key participants and on majority patterns in the negotiation and decision-making process. A more detailed source regarding participant views are documents that member states and nonstate actors submitted to international organizations. I drew on these documents for tracing arguments about technological feasibility, ideas about the need for regulatory interventions, and the presence of material constraints. As some documents recapitulate previous discussions and decisions, they also reveal different understandings of the regulatory process. Yet, in a process that involves oral negotiations, archival documents can only tell part of the story. For that reason, I triangulate them with other types of material.[41]

Another important type of material covering the formal side of negotiations are audio-records of international regulatory meetings. My ambition was to capture as comprehensively as possible the contents of these meetings, where "policy-making processes […] unfold in time-condensed settings" (Corson, Campbell, and MacDonald

[41] I use the term triangulation not in its strict meaning which originates from its use in navigation. This meaning suggests—falsely, as interpretivists argue—that combining different points of evidence in empirical analysis is a precise process that can reveal "truth" (Schwartz-Shea and Yanow 2012, 88). Instead, I use the term triangulation to capture the idea that a combination of different empirical sources enhances intertextuality and provides a richer understanding of the process.

2014, 33). Audio records typically provide greater detail on the oral interventions of actors in negotiations and on majority patterns than written sources. I protocolled all available audio records and used them to complement the comprehensive storylines with respect to key actors and their policy positions at different stages in the negotiations. These protocols were also extremely useful for tracing the articulation and responses to different technological arguments and regulatory ideas. In collecting both audio records and written documents, I considered all institutional levels. The reason is that existing research is inconclusive as to whether arguing is more prevalent in open plenaries or closed working group settings (Orsini and Compagnon 2013, 284–85; Risse 2000, 11). Unfortunately, however, the availability of audio records was more limited than that of written sources.

An empirical entry point into the more informal elements of regulatory negotiations was participant observation. Interpersonal interactions in side meetings, in the hallways, or elsewhere are often-neglected aspects of international meetings (O'Neill and Haas 2019, 6). This is unfortunate as such meetings are "active political spaces" where "researchers can observe the processes that produce (or fail to produce) outcomes, as well as the particular politics […] employed in such processes" (Campbell et al. 2014, 4). I addressed this shortcoming by participating in four week-long meetings of the IMO's Marine Environment Protection Committee (MEPC) between 2017 and 2019. I was formally affiliated with the Swiss delegation but tried to adopt a researcher-only role with a low degree of actual participation (Schwartz-Shea and Yanow 2012, 64). As a member of the Swiss delegation, I was placed in the middle of the plenary of the committee. The delegations are seated quite close to each other, so that I was even able to listen to conversations within other delegations. While not making direct use of such accidental insights for ethical reasons, this comprehensive immersion gave me a sense of how delegates perceive the negotiations. For instance, it allowed me to judge which observations represented institutional routines and which ones were more unusual. In addition to the plenary, I was able to observe and take notes on interactions in unrecorded side events and presentations. My participation also provided opportunities for discussing some of my theory-guided observations with practitioners and gaining access to certain key actors.

Additional sources contributed to casting the net widely for diverse empirical observations. A useful source for detecting changes in business practices and expertise and their linkages with the political process were news reports of specialized media. Occasional reports by general newspapers and information released by companies and nongovernmental organizations complemented these specialized reports. A source covering political dynamics were semi-structured formal interviews with actors directly or indirectly involved in the policy process. Semi-structured interviews strike a balance between gathering insights into the empirical process in a systematic way and giving interviewees leeway in answering the mostly open-ended questions (Leech et al. 2013, 210–11; Martin 2013, 117–19). Interviews are a standard research technique in the repertoire of process tracing. However, my experience confirmed the view of many interpretivists that interviews are often less valuable than participant observation or in-depth study of archival sources (Campbell et al. 2014, 12; Eckl 2018, 170). The reasons are manifold and include lack of access to some key actors, gaps in memory of interview partners, a tendency of interviewees to misrepresent motivations and past interactions, or their inability to reconstruct perspectives they ceased to hold (cf. Beach and Pedersen 2013, 135; Becker and Geer 1957; Jacobs 2015, 46).

Compared to interviews, direct participant observation and indirect observation through audio records of meetings have several distinct advantages. They increase empirical accuracy with respect to the sequence of events not recorded in written sources. They enable researchers to learn "native" meanings and to observe actual changes in behavior (Becker and Geer 1957, 29, 31–32). They also provide "a rich experiential context" which facilitates researchers' interpretation of other empirical material and increases awareness for unexplained facts and possible connections between observations (Becker and Geer 1957, 32). Because of these considerations, and in line with the flexibility that empirical research projects should maintain (Schwartz-Shea and Yanow 2012, 74–77), I decided to maximize participant observation rather than the number of formal interviews. Yet, in the context of participant observation, I conducted a series of short informal conversations to collect different "native" views on the process under study and on the context in which they unfolded.[42] In line with the pragmatic approach underlying my dissertation, the use of such ethnographic techniques also clearly transcends the theory/practice boundary in political science (cf. Eckl 2008).

[42] Conversations are considered informal when I approached interlocutors without a previously arranged interview appointment. At the beginning of these conversations, I always introduced myself as a researcher and explained my research interest. These types of conversations were often useful to get a brief insight into the main standpoints and perceptions of actors, especially when they were not available for longer interviews. However, given that these conversations were not formal interviews, I do not directly quote or reference them in the text but rather use them as background information.

Case Selection and Overview

The research methods outlined above are applied to two within-case studies. The selection of cases is guided by the aim to probe the explanatory power of the causal model of argumentative coproduction and to explore its scope conditions. A good way to establish basic confidence in a new theory is to examine a typical case. A typical case is one where both causes and effects as well as the scope conditions of the proposed casual mechanism are (hypothetically) present (Beach and Pedersen 2013, 150). I also tried to approximate contextual conditions that characterize many other processes in international shipping regulation (cf. Yin 2009, 48). While assuming that the study of such a typical case can be informative about some other regulatory projects, I do not claim any representativeness in statistical terms (cf. Gerring 2007, 91–93). The reason is that my case selection has to rely on prior knowledge about the suspected presence of causes and effects without full information on the location of the case in relation to many others. This is different from case selection based on a large-n analysis which has established a correlation of independent and dependent variables and shows the location of the case in a larger population (cf. Beach and Pedersen 2013, 147–50). Case selection on positive outcomes is possible for process tracing studies as they gain inferential leverage from examining manifestations of causal mechanisms rather than from covariation (A. Bennett and Elman 2006, 461–62; Blatter and Haverland 2012, 101). In addition to these theory-related selection criteria, accessibility as well as practical and social relevance matter for choosing cases for process tracing (Blatter and Haverland 2012, 102–7). Considering the empirical material I chose to collect, access to archival material, meetings, and actors was a crucial criterion (Schwartz-Shea and Yanow 2012, 70–71).

The first case study analyzes the making of an international regulation of nutrient inputs via sewage from passenger ships in the Baltic Sea between 2005 and 2016. Nutrients contained in sewage contribute to the eutrophication of the Baltic Sea, which leads to the spread of so-called "dead zones" on the sea bottom. The Baltic Sea is the first sea region which has been designated a "special area" by the IMO to restrict nutrient inputs from ships. As of 2019, the regulation had an intermediate level of stringency. A particularly contentious issue in the negotiations of this regulation was the required externality reduction, namely the nutrient limit value for discharges of sewage from ships. Among the two options that figured most prominently in the negotiations, the more demanding option was chosen. I trace the discussions and choices on this and other design elements from the first documented mention of the issue in international negotiations to the adoption of the regulatory output. The case study considers negotiations in two institutions: the IMO as the global shipping regulator and the Helsinki Commission (HELCOM) as the regional governance body for the Baltic Sea.

This first case approximates the conditions of a typical case. In a pre-screening of the case, I observed some innovation in environmental technology and the choice of a relatively demanding regulatory requirement. While the causal linkages between the two were initially not clear, the centrality of an emission limit in the regulation suggested a possible role of argumentative coproduction. For such performance standards to work, they need to reflect what technology can achieve (Jaffe, Newell, and Stavins 2002, 50). Accordingly, their choice should represent a typical situation for the consideration of business expertise on technological feasibility.

Beyond that, the contextual conditions of this case are in many ways typical for the regulatory politics of maritime shipping. First, underlying the case is a recurring pattern of conflicting interests: flag states and shipowners face additional costs from regulation, whereas coastal states benefit environmentally and some equipment suppliers gain economically (Tan 2006, 24, 166). Second, the case exemplifies the increasing regionalization of global shipping regulation, which has given rise to ever more special areas for oil discharges, noxious liquid substances, garbage, and air pollution (van Leeuwen 2015). Third, the case features a regional actor (HELCOM) that prepared and pushed for actions of the global regulator (IMO). This resembles in part the present situation in air pollution and greenhouse gas emission regulation where the EU advocates more ambitious measures (Roe 2013, 20–27; Tan 2006, 83–89). Finally, it is important to bear in mind that the new sewage regulations developed for the Baltic Sea could become a model for other sea areas affected by eutrophication.

After basic confidence in the new theory of argumentative coproduction has been established, its recognition can be further increased by examining a least-likely case.[43] Method scholars have developed different views on what characterizes a least-likely case. Some highlight contextual conditions that make the operation of a theory unlikely (Blatter and Haverland 2012, 177, 199). Others stressed that cases are least-likely when the theorized causes and effects are present but with a low degree (Beach and Pedersen 2013, 151–53). Again, there is no large-n analysis based on which I could select such a

[43] Even greater theoretical leverage would be gained by selecting a crucial case, but such cases are rare in reality (cf. Blatter and Haverland 2012, 204; Eckstein 1975; George and Bennett 2005, 120–23). In the context of the complementary theories approach adopted here, I would even argue that ideal-typical crucial cases probably do not exist. Assuming that the three theoretical models of international environmental regulation are at least partly complementary, it is hard to imagine a single case in which one model is least-likely while the other two models are most-likely.

case. I used prior case knowledge about potential causes and effects as well as contextual factors to approximate the conditions of a least-likely case, which is therefore more accurately labeled a *less-likely* case. Moreover, it is desirable that the second case study varies some contextual factors as well as the regulatory outcome compared to the first case (Yin 2009, 61).[44] Accessibility and societal relevance were once again additional selection criteria.

The second empirical case study examines the international regulation of the use of heavy fuel oil (HFO) as fuel by ships in Arctic waters from 2009 to February 2020. The use of HFO by ships has two environmental implications: it leads to operational emissions of climate-forcing black carbon and can cause large environmental damages if the fuel oil is accidentally spilled. The international regulation of HFO use by ships has been undergoing two transitions: first, from nonregulation in 2009 to guidance with an intermediate stringency in 2014/15; and second, from this nonbinding guidance towards the ongoing development of a stringent HFO ban. The key question in these transitions was whether the IMO should adopt a legally binding ban. Thus, in contrast to the substantive side that dominates in the first case, the critical design choice here is on the formal side of stringency. With respect to this formal and related design choices, the longitudinal character of the case study creates a chance for observing directional shifts in causal pressures (Yin 2009, 49). As the case has been ongoing during my research, I had very good access to recent empirical material, including participant observation and audio records of meetings. The price for this is a pending definite outcome. The resulting uncertainty about the durability of my findings is mitigated though by the analytical focus on process rather than just outcomes.

Based on prior case knowledge, the operation of argumentative coproduction in HFO regulation in Arctic shipping seems quite unlikely. Alternatives to HFO have been used in shipping for a long time and the technical complexities of a fuel substitution seem limited. Furthermore, the Arctic region is subject to growing interests by shipping and other economic sectors, while the symbolic value of the Arctic environment remains high (Hough 2013, 7; Keil 2019). All this does not lead to expect that technological

[44] There is an emerging view which challenges the idea of generalizing findings about causal mechanisms based on most- and least-likely case logic (cf. Beach and Pedersen 2019, 106–10). In brief, the argument is that causal mechanisms may be heterogeneous, i.e., different mechanisms may link the same cause to the same outcome in different contexts (Beach 2019). The suggested solution of "snowballing-outwards" consists of varying an increasing number of contextual conditions in subsequent case studies. While not systematically applying this approach via a mapping of the full population of potential cases, I still try to approximate its rationale by varying contextual conditions between cases.

arguments of business will have more explanatory power than the ideational influence of environmental NGOs or the material interests and power resources of economic actors.

The case also varies three important contextual factors. First, the Arctic HFO case features more complex material interests because stringent regulation may create substantial costs for both distant flag states and shipping within Arctic coastal states. Second, compared to the Baltic Sea, the Arctic is a peripheral sea region but has a large potential for maritime growth. Third, its regional governance framework under the Arctic Council is softer in legal terms and more fragmented than that of HELCOM (Koivurova and Vanderzwaag 2007). Finally, the Arctic HFO case showcases the politics of mitigating increasing anthropogenic pressures on some of the planet's most vulnerable marine ecosystems. This speaks to pragmatists' call for research with practical and societal relevance.

Table 6: Overview of regulatory design outputs in the two case studies

<table>
<tr><th rowspan="2"></th><th colspan="4">Case 1: Regulation of nutrients, Baltic Sea</th><th colspan="4">Case 2: Regulation of HFO use, Arctic</th></tr>
<tr><th>Year</th><th>Tightness</th><th>Ambition</th><th>In effect</th><th>Year</th><th>Tightness</th><th>Ambition</th><th>In effect</th></tr>
<tr><td>Begin of case study</td><td>2005</td><td>-</td><td>-</td><td>-</td><td>2009</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Regulatory outcome 1</td><td>2016</td><td>High</td><td>Medium</td><td>2019</td><td>2015</td><td>Low</td><td>High</td><td>2017</td></tr>
<tr><td rowspan="2">Regulatory outcome 2</td><td rowspan="2" colspan="4"></td><td rowspan="2">2021?</td><td>High</td><td>Medium</td><td>2024?</td></tr>
<tr><td>High</td><td>High</td><td>2029?</td></tr>
</table>

Source: Author.

The two selected cases vary to some extent on their regulatory outcomes (see Table 6). In the case of nutrients in sewage discharges in the Baltic Sea, a rather direct transition from nonregulation to a regulation with high formal tightness took place.[45] The substantive ambition of the regulation is on an intermediate level. By contrast, for the use of HFO as ship fuel in the Arctic, the first transition was from nonregulation to a regulation with low formal tightness but high substantive ambition. The second and still ongoing transition is clearly directed towards increasing the formal tightness of the regulation.

[45] As an intermediate step, the IMO adopted a voluntary scheme encouraging cruise ships not to discharge wastewater in closed and semi-closed sea areas at risk of eutrophication (IMO 2009e, para. 1.2). I do not count this as regulation because it leaves undefined the areas of application. The provision was issued in the beginning of IMO negotiations and did not serve as an alternative to regulatory options.

The current state of play suggests that this is likely to come with a weakening on the substantive side, notably in terms of scope (IMO 2020g, annex 12; 2020i, para. 14.24). The different regulatory trajectories of the two cases (see also Figure 24 in Appendix II) should be conducive to probing different facets of the model of argumentative coproduction. It is important to note though that the case studies will not content themselves with examining decisions reflected in high, medium, or low design element scores. In fact, investigating design choices that do not pass any of my coding thresholds can be equally relevant and informative. The most important example here is the choice between two sets of nutrient limits in the Baltic Sea case. While both options corresponded to a medium level of required externality reductions, they differed greatly in their technological, environmental, and economic implications.

The regulatory outcomes of these cases can be put in relation to the entire population of international environmental regulations in shipping (see chapter 2). All regulatory outcomes in the case studies have intermediate or high levels of stringency. These stringency levels were the most abundant ones in the full population of shipping regulations in 2019. In terms of design composition, most regulatory outcomes in the case studies fall into the two dominant clusters observed in shipping regulation (high tightness and high ambition; high tightness and intermediate ambition). An exception to this is the HFO case, where the first outcome pertains to the smaller cluster of regulations with low tightness and high ambition. Furthermore, the selected cases are examples for the growing stringency of regulations addressing water and air pollution impacts. It is noteworthy though that the selected externalities were unregulated at the beginning of the study period. While this sets the selected cases apart from many other regulatory projects, it also reduces path dependencies from previous decisions. This circumstance maximizes the number of moving parts to be observed in the case studies.

Finally, the case selection also reflects a specific geographic and institutional focus. Geographically, both cases are instances of regulatory regionalization, taking place in two regions with above-average levels of regulation. The Baltic Sea and the Arctic are among those regions with the highest numbers of regulated externalities and stringent regulations. Institutionally, both cases center on the IMO, which issues almost all international shipping regulations. The inclusion of HELCOM and the Arctic Council brings in two regional forums that differ in their previous roles in shipping regulation. Whereas the former has been active in shipping regulation beforehand, the latter has been almost entirely absent from it. Hence, the cases provide an opportunity for studying argumentative coproduction in two regional hotspots of shipping regulation with partly different institutional contexts.

Theoretical Expectations

Before I move to the case studies, the matching of theoretical expectations and empirical observations—which is one of their core elements—needs further elaboration. I translate the rather broad propositions of the three models of international environmental regulation outlined in the previous chapter into somewhat more specific theoretical expectations. These expectations make clearer where and how the three theoretical models differ (see Table 7).

Ideational interventionism generates six expectations highlighting the causal impact of ideas and norms that may occasionally trump business power. First, the actor constellation in regulatory politics constitutes a war of position between a dominant historical bloc and outside challengers. The analysis should typically find business actors on the reluctant side, and activists and scientists on the progressive side. Second, state interests and preferences are a function of the causal ideas that states hold and the norms they have internalized. Where the analysis observes diverging state positions, it should also observe competing causal ideas or norms. Third, knowledge- and norm-based leadership by activists and scientists plays a major role in persuading states to support more stringent regulation. Decision-makers should change their positions following exposure to new ideas or norms, but not in response to shifts in material factors. Fourth, reluctant business actors have various discursive strategies at their disposal to contain ideational and normative leadership of outside challengers. Business actors should be able to attenuate regulatory pressures by means of lobbying strategies that involve counter-expertise and accommodation. Fifth, activists and scientists succeed in overcoming business opposition if decision-makers perceive an environmental crisis. Accordingly, state support for more stringent regulation should be widely justified in terms of policy failure and urgency. Sixth, only stringent regulation that is inspired by activists and scientists eventually leads to major improvements in corporate environmental practices. Therefore, the analysis should not detect any major improvements in corporate environmental behavior prior to regulatory pressures.

Table 7: Theoretical expectations of the three models of international environmental regulation

	Ideational interventionism	**Material evolutionism**	**Argumentative coproduction**
Actor constellation	War of position between hegemonic business bloc and outside challengers (activists, scientists)	Business conflict or cooperation	Argumentative contest between proponents and opponents, presumably based on business conflict
Roots of different state preferences	Different norms and ideas held by decision-makers about the problem at hand	Different material interests of dominant domestic business actors	Different propositions held by decision-makers about need for and feasibility of regulation
Driver of change in state positions	Idea- and norm-based leadership by activists and scientists	Interest- and power-based leadership by business and states	Argument- and evidence-based leadership by competing business experts and proponents/opponents
Role of business in regulation	Reluctant: counter-expertise, accommodation, and technology lobbying by hegemonic bloc.	Constructive role possible: technological power of business can shape policy options	Constructive role possible: arguments and evidence on regulatory feasibility from progressive business expertise
Conditions for emergence of more stringent regulation	Crisis, urgency: outside challengers gain greater discursive power than hegemonic bloc	Companies that would benefit from regulation have largest instrumental and structural power	Arguments in support of regulation come with evidence that references tangible first-mover practices
Character of regulatory outcome	Technology-forcing: innovation occurs as a response to regulation	Technology-following: regulation codifies practices of influential firms	Technology-reinforcing: regulation reinforces innovation, possibly from niches, that inspired it

Source: Author.

The material-evolutionist model suggests expectations that differ markedly from those of ideational interventionism. Its six expectations stress the importance of exogenously given interests and the distribution of material power resources. First, the actor constellation can be understood in terms of business conflict or cooperation in relation to international regulation. I expect that, depending on distributional effects of regulation, conflicting or harmonious business interests are observable at key moments in the regulatory process. Second, state preferences in international regulatory negotiations reflect dominant domestic business interests. The appropriation of causal ideas is a function of these interests, so state preferences should not change without prior shifts in material factors. Third, interest- and power-based leadership can lead to changes in state coalitions. Changes in state positions should occur either in response to new issue linkages or following pressure from more powerful states and their business actors. Fourth, the regulatory options that states consider in the negotiations can be shaped by firms through the development or uptake of new technologies. I should not see decision-makers adopting regulations that go beyond what is technically feasible. Fifth, business actors influence state preferences and regulatory outputs mostly through their instrumental and structural power. Thus, in case of business conflict, the corporations with higher material power resources should prevail. Sixth, regulations then merely codify environmental technologies and corporate practices previously adopted by influential business actors. Accordingly, I should not see international regulation that is inspired by niche innovation in smaller firms.

The model of argumentative coproduction suggests another distinct set of empirical expectations for how stringent international environmental regulation evolves. These expectations emphasize the role of business expertise and processes of arguing. First, international negotiations are argumentative contests involving proponents, opponents, and audience states. The empirical analysis should observe extensive exchanges of arguments among states, some of which are early argumentative leaders while others only take a position later in the process. Second, the policy positions of states are based on propositions held about regulatory need and feasibility. States should thus be observed to justify their policy positions in these terms, which may involve both material and ideational aspects. Third, competing propositions of states about regulatory feasibility are rooted in competing business expertise. I should be able to observe that arguments of state representatives for more stringent regulation are built around information previously communicated by progressive business actors. Fourth, new technological arguments can lead to changes in state coalitions, especially by mobilizing or demobilizing audience states. Thus, support for stringent regulation or opposition to it should build up or deteriorate as new arguments are being made. In justifying their policy positions, mobilized states should echo the arguments of proponents or opponents and of their respective business allies. Fifth, in very tense argumentative contests, credible evidence of first-mover practices may tip the balance. Decisive changes in state positions should occur in response to such new evidence that cannot be invalidated effectively.[46] Ideally, this should happen in the absence of any simultaneous emergence of new norms, issue

[46] Recall that I do not attempt to probe the propositions of my theoretical model on the level of cognitive processes but rather on the level of the political behavior resulting from these processes.

linkages, or pressures from powerful states. Sixth, the regulation emerging from this process reinforces and diffuses technologies or practices that some firms have developed beforehand. It would strengthen my argument if I found that some of these technologies or practices emerged in niches rather than in materially powerful companies.

Summary

This chapter outlined the method that allows me to probe the explanatory power of argumentative coproduction, taking into account the alternative models of ideational interventionism and material evolutionism. I explained that a congruence analysis with embedded process tracing is ideal for assessing the explanatory power of these partly complementary theories. Drawing on qualitative methods literature, I identified three elements that will constitute the core of the analytical explanation: comprehensive storylines map sequences as well as key moments in the regulatory process; pattern matching looks for empirical manifestations of the causal mechanisms theorized in the different models; and smoking gun and hoop observations can demonstrate the proximity of causes and effects. I develop these core elements by drawing on a rich set of empirical material. Materials include archival documents, audio records of negotiations, participant observation in international meetings, complementary interviews, and some other primary sources.

I collected and analyzed this material for two cases. The regulation of nutrients contained in discharges of sewage in Baltic Sea shipping represents a typical case. A successful theory probe in this case can demonstrate the basic tenability of argumentative coproduction. The regulation of HFO use in Arctic shipping is a less-likely case. A successful probe in this case can further increase confidence in the explanatory power of my theoretical model. A partly successful or unsuccessful probe can help specifying the scope conditions of argumentative coproduction. The presentation of these case studies follows an identical structure. In the beginning, I provide overviews of the environmental externality and its regulation, the defining case properties and presence of scope conditions, and the empirical material used. I then outline the comprehensive storyline which structures the regulatory process. Next, I present analytical explanations that empirically assess the predictions of ideational interventionism, material evolutionism, and argumentative coproduction. In the end, I draw an interim conclusion on the explanatory power of the three theoretical models.

The next chapter examines the development of international regulation of nutrient inputs from ships in the Baltic Sea. The case has everything that makes for an interesting theory probe: the important environmental problem of an increasing eutrophication of the Baltic Sea which is caused by nutrient inputs; the conflicting economic interests of the shipping industry and of the producers of equipment for nutrient reduction; and competing arguments about the feasibility of more or less demanding regulatory requirements for nutrient removal. I am going to show that argumentative coproduction can explain the observed outcome very well. Progressive environmental practices of some business actors and the related expertise made the IMO adopt a regulation with relatively demanding nutrient requirements for passenger ships. What began as an innovation in sewage treatment technology in the offices of a medium-sized company on the Finnish coast has by now become the new normal for an entire shipping segment in the Baltic Sea.

5 Case Study: Nutrient Inputs from Ships to the Baltic Sea

In 2019, the Baltic Sea became the world's first special area for discharges of sewage from ships. The special area regulation limits the input of nutrients from passenger ships, which contribute to eutrophication and the spread of dead zones in the Baltic Sea. In the development of this regulation, the limit values for nutrients were a highly contentious design choice. Some states preferred a rather demanding limit value requiring the installation of new sewage treatment technology on passenger ships. Others preferred a less demanding standard that could have been met with already installed treatment equipment. The coalition in favor of the more demanding requirement prevailed. In this case study, I am going to show that this is a surprising outcome from the perspectives of ideational interventionism and material evolutionism. Firstly, the contribution of shipping to the eutrophication of the Baltic Sea has only seen limited public mobilization by environmental activists and scientists. Secondly, the beneficiaries of the new regulation are a few advanced treatment manufacturers with limited lobbying resources, while the costs are put on the larger and better organized companies of the cruise sector. This chapter is going to demonstrate that the model of argumentative coproduction can account for this outcome and the preceding process.

The chapter is structured as follows: First, I provide an overview of the problem of nutrient inputs from ships in the Baltic Sea and of the regulation adopted by the IMO. Second, I note the defining properties of the case as well as the empirical material used for the within-case analysis. Third, I present a storyline of the regulatory negotiations and identify the key moments on which the analysis is focused. Fourth, I assess to what extent ideational-interventionist and material-evolutionist models can explain the process and its outcome. Fifth, I examine the case from the perspective of argumentative coproduction. I show that technological arguing played a key role in the negotiations of the new nutrient limits. Underlying these negotiations was a business conflict between a few small, progressive manufacturers of wastewater treatment systems and the much larger, reluctant cruise industry. I find that arguments referring to existing or emerging business practices successfully mobilized states to support demanding effluent standards. Strikingly, the argumentative power of the cruise line association was undermined by progressive environmental practices of some member companies. Sixth, I discuss the explanatory power of argumentative coproduction in comparison to that of the other two models. I conclude that my model can fill the explanatory gaps left by ideational interventionism and material evolutionism.

Combatting Eutrophication: The Regulation of Sewage Discharges from Ships

The regulation examined in this case study addresses the nutrient content of sewage that ships discharge into the Baltic Sea. Sewage from ship toilets contains nitrogen and phosphorus. Both substances are nutrients that contribute to marine eutrophication. Eutrophication causes noxious cyanobacteria blooms and leads to the expansion of so-called "dead zones" where most marine life in bottom waters can no longer be sustained due to oxygen depletion. Eutrophication and spreading dead zones affect many sea basins and coastal oceans (Diaz and Rosenberg 2008). In the Baltic Sea, dead zones have increased tenfold during the last century to an area almost equaling the size of Lithuania (Carstensen et al. 2014). The main drivers are atmospheric and waterborne inputs of nutrient from anthropogenic sources (Svendsen et al. 2015). Sewage from ships accounts for only a small share of these inputs but can have significant local impacts along busy shipping routes (Hänninen and Sassi 2009, 58).

On June 1, 2019, a new IMO regulation establishing the first international standards for the nutrient content of sewage discharged by ships took effect in the Baltic Sea. This regulation has a high level of formal tightness. The requirements are laid down in the binding MARPOL Annex IV and in the nonbinding 2012 Guidelines on implementation of effluent standards and performance tests for sewage treatment plants. Passenger ships shall either have in operation a sewage treatment plant that meets precise numerical nutrient removal standards or discharge all untreated sewage into port reception facilities (IMO 2011a). Compliance of the sewage treatment plants is forced through their mandatory type approval by administrations. The discharge of sewage into port reception facilities is incentivized by the no-special fee system in Baltic Sea ports. This system ensures that all ships pay the costs for waste reception via port fees, irrespective of actual delivery. Thus, the provisions of the nutrient regulation are partly binding, precise, and subject to formally strong monitoring and enforcement.[47]

The substantive ambition of the new regulation is intermediate. Within its scope are passenger ships, like ferries and cruise ships, which produce most sewage (Hänninen

[47] The current monitoring and enforcement system which relies on type approval under laboratory has been criticized for allowing large deviations from the required standards in real-life operation. The reasons are manifold and include unrealistic conditions in the type approval process, lack of maintenance, lack of training of seafarers, lack of proper wastewater management onboard ships, and occasionally also the certification of equipment with questionable performance parameters (Netherlands 2017; Interview 4; Interview 8). While there is thus ample room for improvement, the incentives of the no-special fee system lead me to classify the overall monitoring and enforcement system as strong.

and Sassi 2009, 45). The regulation applies to new passenger ships in the Baltic Sea from 2019 and to existing passenger ships from June 2021. It requires sewage treatment plants to produce an effluent with maximum 20 milligram nitrogen per liter (or at least 70% reduction) and 1 milligram phosphorus per liter (or at least 80% reduction) (IMO 2012a). These requirements will bring major reductions in the previously unregulated nutrient input from passenger ships. They also stand out in international comparison as no comparable nutrient limits exist for any other sea region. In short, the regulation has a narrow to medium scope; its requirements are medium in relation to the externality and high in international comparison. The overall stringency of the nutrient regulation in the Baltic Sea is thus on an intermediate level. It may become a precursor to similar regulation in other sea regions affected by eutrophication.

The new regulation was negotiated in the Helsinki Commission (HELCOM) and in the IMO between 2005 and 2016. HELCOM is a regional organization with the mandate to protect the Baltic Sea marine environment from pollution (Helsinki Convention 1992, art. 20). Its membership comprises the nine coastal states of the Baltic Sea (of which all but Russia are EU members) and the EU. The intergovernmental organization is composed of different bodies which take decisions by consensus (HELCOM 2013; 2020a). Ministerial meetings set the strategic priorities of the organization. The Baltic Marine Environment Protection Commission adopts recommendations and amendments to the Helsinki Convention. Meetings of the heads of delegation also take policy decisions. These decisions are prepared by working groups, supported by expert groups and platforms. The work of these bodies is coordinated by a medium-sized permanent secretariat in Helsinki. More than 40 nonstate observers, including various sectoral associations representing the shipping and port industry as well as environmental NGOs like the World Wide Fund For Nature (WWF), can take part in meetings of the commission and its subsidiary bodies (HELCOM 2020b). Observers can submit written documents and make oral interventions but do not have voting rights (HELCOM 2015a, para. 3).

The IMO is a specialized agency of the United Nations responsible for creating and maintaining the regulatory framework for global shipping (IMO Convention 1948, art. 1). The organization has 174 member states, three associated members, and 80 nonstate organizations with consultative status (IMO 2020b). It is governed by an Assembly and a Council, but all environmental regulations are adopted by the Marine Environment Protection Committee (MEPC) (IMO 2020d). The formal decision-making rule is majority-voting with one vote for each member state.[48] However, the IMO strives for consensus decisions, so that formal votes are very rare (Psaraftis and Kontovas 2020). The regulations adopted by MEPC are typically prepared by sub-committees, formal working groups that mostly take place in parallel to (sub-)committee meetings, and correspondence groups that operate in between meetings. Within the large permanent secretariat of the IMO in London, one division supports the work of these bodies (Campe 2009, 158–59). The range of nonstate consultative organizations at the IMO is broad and includes industry associations, environmental NGOs, and professional organizations. Their rights are similar to those of observers in HELCOM (cf. IMO 2019c, rules 7-8).

A contentious issue in the negotiations in HELCOM and especially in the IMO were the effluent limits for nitrogen and phosphorus. The relatively demanding limits that were eventually adopted encountered considerable opposition throughout the process. Some states pushed for more permissive limits, and others even opposed the idea of regulating nutrient inputs from ships altogether. Underlying these discussions was a business conflict between equipment manufacturers selling innovative wastewater treatment systems and reluctant cruise lines which would have to buy and operate the new equipment. The equipment manufacturers contributed to the development of the more demanding nutrient limits, whereas the cruise industry challenged them. Hence, the IMO seems to have followed a handful of medium-sized equipment manufacturers rather than the multi-billion-dollar cruise industry. In the following, I focus on the regulatory process up until the adoption and confirmation of the new nutrient limits for shipboard wastewater treatment plants by the IMO in 2012 and 2014.

Case Properties and Material

The case approximates the conditions of a typical case for argumentative coproduction: manufacturers of sewage treatment plants innovated on nutrient removal; limits for nutrient input were hotly debated in the negotiations; and states eventually adopted relatively demanding requirements. Moreover, all scope conditions of my model are present. Eutrophication has received public attention in Baltic Sea states, but the contribution of shipping to this problem has not been the main focus (Jönsson 2011; Lyytimäki 2012). Nutrient inputs can be reduced through enhanced technology (advanced sewage

[48] Decisions of MEPC only require a simple majority of states present and voting (IMO 2010a, rule 27). However, for amendments to the MARPOL Convention, a two-thirds majority of parties present and voting is needed (MARPOL 1973, art. 16(2)(d)).

treatment plants removing nitrogen and phosphorus) or business practices (discharge of sewage into port reception facilities). Their regulation was negotiated in international organizations to which business actors had access. The presence of many audience states is to be expected because regulation for the Baltic Sea only affects a limited number of IMO member states. Its effects concentrate on coastal states in the region and on some major flag states outside the region. Apart from these scope conditions for argumentative coproduction, the process unfolded in a typical setting of international shipping regulation. Economic interests of flag states were pitched against environmental concerns of coastal states; and there was a strong element of regionalization.

The within-case study is a congruence analysis with embedded process tracing. First, I develop a comprehensive storyline that consists of sequences separated by two types of key moments. Branching points clearly discriminate between different pathways in regulatory negotiations and thereby leave a major imprint on regulatory design. Critical moments are focal points that either prepare these branching points or confirm, reinforce, or specify an existing direction in regulatory design considerations. Second, I formulate theoretical predictions about the regulatory process and its outcome that should be empirically observable. These predictions build on the propositions outlined in the previous chapter and adapt them to the comprehensive storyline of the case. For each explanatory model, I examine the presence (or absence) of evidence for empirical manifestations of these predictions. Third, in this endeavor, I search for smoking gun and hoop evidence which demonstrates a proximity of causes and effects. This proximity can be temporal, spatial, or social.

The analytical explanation that I build from these three core elements draws on a rich set of primary sources (see Appendix I). I obtained over 200 meeting documents from the archives of HELCOM and IMO, including meetings reports as well as all relevant submissions by member states and nonstate observers. In addition, I had access to audio-records of three sessions of MEPC between 2014 and 2016, one of which captures a critical moment in the negotiations. The analysis considers negotiations on all institutional levels of HELCOM and IMO, including relevant committees, working groups, as well as correspondence and expert groups. I complement these comprehensive sources with punctual evidence from nine semi-structured interviews with state and private sector representatives who were involved in the policy process. I contextualize the case-specific analysis with general insights into the operation of MEPC obtained through participatory observation during four committee meetings between 2017 and 2019.[49]

Despite these comprehensive materials, some data gaps persist. For non-recorded meetings, it is often impossible to fully reconstruct the positions taken by all the delegations. The reason is that the meetings reports of the IMO often summarize the support for different policy options in an aggregate way, and interviewees were often uncertain about when exactly a certain delegation took which position. Therefore, while I am confident that my reconstructions consider the positions of all the major actors, they may not be exhaustive. Another problem is that interviewees occasionally made mistakes in the factual recollection of events, especially when long ago. In case of conflict, I privileged written sources over interview evidence.

Next, I summarize the storyline of the international negotiations of nutrient regulation for ships in the Baltic Sea and identify key moments in this process. The focus is on the nutrient removal standards as the most contentious design choice, but I point out interactions with other design choices where relevant.

Storyline: Key Moments in the HELCOM and IMO Negotiations

The document analysis reveals five key moments in the development and choice of the nutrient removal requirements. Three moments of interest are observed in the preparation of regulatory action by HELCOM between 2005 and 2009. They shaped the proposal for a new regulation which was then negotiated and decided within the IMO between 2010 and 2012. The decision-making process at the IMO culminated in a branching point where the responsible committee favored more demanding nutrient removal requirements over less demanding ones. Before the entry into effect of the new regulation, the IMO reviewed some of its elements between 2013 and 2016. A critical moment in this review phase was the confirmation of the previously adopted nutrient standards. I now turn to a more detailed description of these key moments.

The policy process began in late 2005 when Finland initiated deliberations in HELCOM on nutrient inputs caused by discharges of sewage from ships into the Baltic Sea. The organization commissioned a study which assessed the amount and impacts of

[49] Note that the period of participatory observation was after the conclusion of the regulatory process examined here. Accordingly, the purpose of the observation was to better understand the inner workings of IMO MEPC in general rather than to collect case-specific evidence. Some insights on matters related to sewage discharges were gained from ongoing discussions about a revision of the current monitoring and enforcement system.

these discharges. In 2006, the HELCOM Maritime Working Group decided that the IMO was the most appropriate forum for addressing the issue. At this point, however, the group was still unable to agree on preparing specific regulatory measures (HELCOM 2006, para. 7.16).

A first key moment was the commitment of the Baltic Sea states to preparing regulatory action. In 2007, their initial disagreements were overcome when future regulatory action was considered in the development of the Baltic Sea Action Plan (HELCOM 2007a, para. 3.10). The Baltic Sea Action Plan is the political instrument guiding the work of HELCOM. Member state ministers adopted the action plan after negotiations at various levels of the organization. They agreed on preparing, within two years, a joint submission to the IMO on regulatory measures "including further consideration of designation of the Baltic Sea as a special area, with the aim to eliminate the discharge of sewage from ships, especially from passenger ships and ferries" (HELCOM 2007e, 26). This agreement was critical because it is unlikely that, without such a regional initiative, the IMO would have considered the designation of a special area. Any designation of a new special area involves prior consultation of the adjacent states as, according to IMO guidelines, it can only be implemented "when adequate reception facilities are provided for ships" (IMO 2002, annex I, para. 2.7; cf. 2014d; Sainlos 2011, 330–31). Indeed, the basic idea of the HELCOM states for the new regulation was to require ships to either operate a sewage treatment plant with nutrient removal or deliver all sewage to port reception facilities.

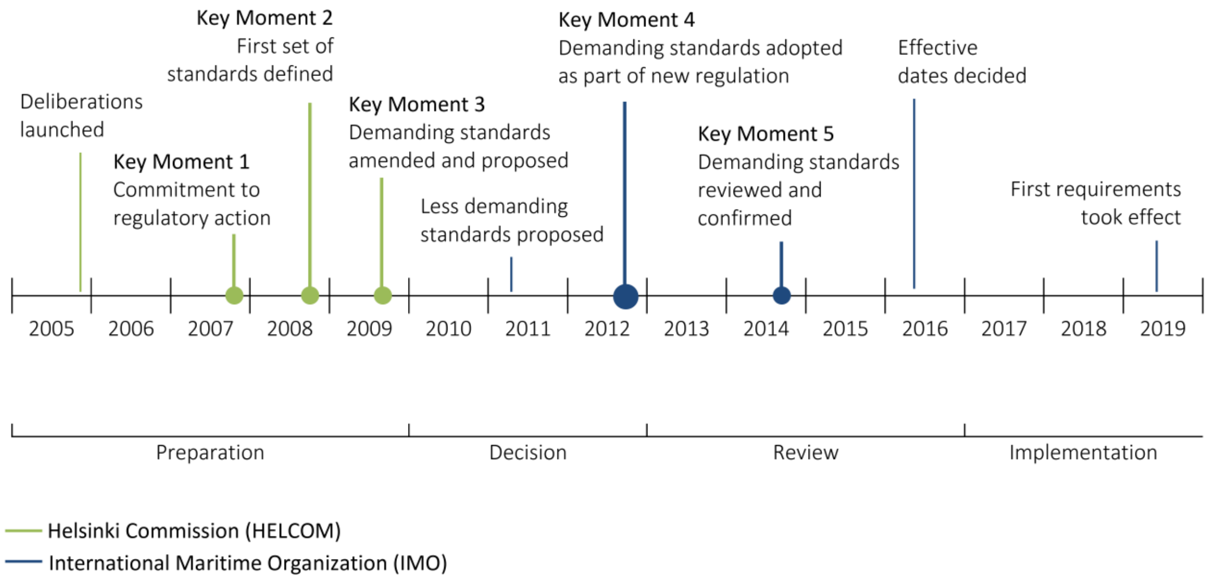
A second key moment was the choice of a first set of requirements in the proposal for a new regulation. In 2008, the HELCOM countries developed their regulatory proposal, especially the future nutrient limits for sewage treatment plants. A correspondence group consulted with manufacturers of treatment plants and with the cruise industry on potential standards and implementation issues. As a result, it envisaged effluent limit concentrations of maximum 10 milligram nitrogen per liter and 0.5 milligram phosphorus per liter. This was critical because it set the path for precise numerical discharge requirements that were going to exceed the standards for passenger ships in all other sea areas (Finland 2008a, 3). Absent this proposal, the regulatory instrument and its level of precision would have remained open for discussion. At the same time, the exact level of the nutrient limits as well as some other issues remained subject to uncertainties. Consequently, the HELCOM delegations were unable to adopt their regulatory proposal in the first half of 2009.

A third key moment was the decision of the HELCOM countries to amend and adopt the nutrient removal requirements contained in their proposal for a new regulation. Following the previous standstill, the responsible correspondence group once again discussed the nutrient standards with equipment manufacturers and the cruise industry. In the second half of 2009, it came up with a new set of nutrient limits for sewage treatment plants: maximum 20 milligram nitrogen per liter or a reduction of at least 70%, and 1 milligram phosphorus per liter or a reduction of at least 80%. Although less demanding than the original figures, the new standards still required substantial externality reductions compared to the status quo. In addition, maximum effluent contents were now complemented with minimum reduction levels as an alternative requirement. The cruise industry questioned the feasibility of these standards without success. At the end of 2009, the Baltic Sea states adopted their finalized proposal for new regulation of discharges of sewage from ships in the Baltic Sea and submitted it to the IMO (HELCOM 2009, para. 3.10; Denmark et al. 2009b). The choices reflected in this proposal were critical because they defined what would become the more ambitious policy option in the negotiations at the IMO.

The fourth key moment in the regulatory process was the adoption of demanding nutrient standards by the IMO. The design of the new regulation was discussed in MEPC, the Sub-Committee on Ship Design and Equipment (DE), and related correspondence and working groups. In these deliberations, the level of the future nutrient removal standards was particularly controversial. The Baltic Sea coastal states, building on information obtained from manufacturers of sewage treatment plants, had proposed rather demanding standards for nitrogen (max. 20 mg/l or at least 70% reduction) and phosphorus (max. 1 mg/l or at least 80% reduction). The cruise industry and some large flag states put forward more permissive limit for nitrogen (max. 35 mg/l or at least 30% reduction) and phosphorus (max. 2 mg/l or at least 70% reduction). With the correspondence group and the sub-committee unable to arrive at a consensus, MEPC had to decide on the requirement levels at its 64th session (MEPC 64). In the second half of 2012, MEPC 64 adopted the more demanding standards based on “a very slight majority of the delegations who took the floor” (IMO 2012f, para. 11.16). This was a branching point because the more demanding standards were formally adopted at a time when a less demanding outcome was very much conceivable. The pivotal nature of this decision is underscored by the agreement reached in MEPC to undertake a review of the standards before their entry into effect.

A fifth key moment was the review of the demanding nutrient requirements and their confirmation by the IMO. The review, which considered the availability of adequate equipment, was undertaken by MEPC 67 in 2014. The discussions at this meeting largely reproduced earlier lines of conflict. The Baltic Sea coastal states together with Norway held the view that a sufficient number of treatment systems compliant with the demanding standards were available. Several flag states followed the argumentation of the cruise industry that this was not the case. In the end, a clear majority of (European) delegations supported the demanding standards. This was a critical moment because the regulatory review presented an opportunity for relaxing the required nutrient reductions. A different majority could have weakened the central part of the new regulation. After this review, it took another two years until MEPC 69 decided that the Baltic Sea special area requirements would take effect from June 2019. This delay mainly related to controversies around the availability of adequate port reception facilities for ships that choose to retain all sewage onboard while at sea.[50]

Figure 17: Key moments in the development of nutrient regulation for ships in the Baltic Sea



Source: Author.

[50] The issue of port reception facilities centered on the question of whether it was feasible for ships to comply with the new regulation by delivering their sewage to onshore facilities (cf. Wilewska-Bien and Anderberg 2018). Expertise on this question was mainly provided by the port authorities providing reception facilities. However, I do not examine these discussions in detail here as they mainly affected the entry into force of the regulation rather than elements of its stringency.

Below, I examine the five key moments shown in Figure 17 and the sequences in between them from the perspectives of ideational interventionism, material evolutionism, and argumentative coproduction. Each section begins with theoretical predictions about the causal mechanism at work. These relatively specific expectations prepare the ground for the empirical analysis. Through the three analytical spotlights, I am going to show that argumentative coproduction can account better for most process and outcome observations than the other two models.

Ideational-Interventionist Spotlight: Business Hegemony and its Unexpected Disruption

This section examines the regulatory negotiations and outcome from the perspective of ideational interventionism. As a basis, I formulate theoretical predictions that operationalize the broader expectations outlined in chapter 4 for the specific storyline of the case. The empirical analysis of these predictions shows that activists and scientists played a supportive role in regulating nutrient inputs from passenger ships. Their efforts encountered opposition from the cruise and ferry industries. However, unlike predicted by ideational interventionism, the disruption of business hegemony and successful imposition of demanding nutrient requirements on passenger shipping cannot be fully explained in terms of environmental crisis.

Theoretical Predictions

What observable implications does ideational interventionism suggest? To begin with, ideational interventionism conceives of regulatory politics as a war of position between reluctant business interests and outside challengers. By implication, it expects that business sought to avoid the regulation of nutrient inputs, while environmental NGOs and scientists pushed for stringent regulation. Business support for the more demanding nutrient standards would contradict this expectation. The ideational-interventionist model further assumes that state preferences reflect causal ideas and normative understandings of decision-makers. It expects that decision-makers which had different positions on the nutrient limits also differed in their ideas and norms regarding the problem of eutrophication. This expectation would be contradicted by observing states that opposed the more demanding standards despite agreeing on the need to address the problem, or vice versa. Related to this, the ideational-interventionist approach stresses the role of knowledge- and norm-based leadership in changing state positions. It predicts that the growing support for demanding nutrient limits can be traced back to new ideas and norms introduced by environmental NGOs or scientific findings. If such attempts of leadership were observed without subsequent changes in state preferences, the plausibility of the model could be called into question.

With respect to business, ideational interventionism posits that it can use various strategies to fend off discursive challenges to its hegemony. The prediction is that reluctant business actors used counter-expertise, accommodation strategies, and lobbying resources to prevent stringent nutrient regulation. This prediction would be disconfirmed if targeted business actors readily subordinated themselves to demanding nutrient standards. Furthermore, the model sees crisis and urgency as necessary conditions for activists and scientists to break business hegemony. Support for more ambitious regulation is thus expected to have been rooted in a sense of crisis and urgency regarding shipping's contribution to eutrophication. This expectation would not be fulfilled if the supporting states did not refer to the magnitude of the problem or time pressures. In the end, ideational interventionism views stringent regulation as the only means to force improvements in corporate environmental practices. It expects that the industry had not met the new nutrient standards before the new regulation entered into force. Voluntary improvements in the treatment of sewage from ships in the Baltic Sea would not be in line with this expectation.

Analysis

To what extent do these theoretical predictions empirically manifest themselves in the process of regulating nutrient inputs from ships in the Baltic Sea? In line with ideational-interventionist predictions, the observed negotiation process can be broadly understood as a war of position between competing economic and environmental interests. On the one hand, a historical bloc formed by the cruise industry and major flag states sought to safeguard its economic interests. The cruise industry was represented by its global sector association, Cruise Lines International Association (CLIA), and its regional sister organization, the European Cruise Council (ECC). The historical bloc defended the present regulation and opposed demanding standards that would require the installation and operation of more costly treatment systems. On the other hand, a loose coalition of some coastal states, environmental NGOs, and manufacturers of sewage treatment plants challenged the status quo. This coalition proposed demanding nutrient limits that would enhance the protection of the marine environment and create a new market segment for the supply industry, while putting the costs on the shipping industry.[51] While the overall situation thus resembled a war of position, it was more complex than the classic tale of environmental NGOs versus business interests.

This war of position was apparent around most key moments in the regulatory process. In response to a growing regulatory momentum in the preparation phase, the global cruise industry began to stress several operational aspects to be considered in the policy development (CLIA in Finland 2008, 17–20). Towards the end of the preparation phase, it openly criticized the regulatory proposal developed by the Baltic Sea states (ECC/CLIA 2009a; 2009b). In the decision and review phases, a coalition of CLIA, other shipping industry associations, and several major non-European flag states like the Bahamas, Liberia, Marshall Islands, and Panama repeatedly questioned the envisaged regulation (Bahamas et al. 2010b, para. 28; IMO 2012d, para. 11.18; 2014b). In particular, they objected to the demanding nutrient removal standards proposed by the Baltic Sea coastal states. Joint opposition to stringent regulation from targeted shipping sectors and the economies dependent on them is a common pattern in the IMO (Interview 7). Ideational interventionists would consider the destabilization of this bloc an instance of successful outside challenge which gave rise to a new dominant formation of coastal states, environmental NGOs, and equipment suppliers.

The expectation of ideational interventionism that different state positions can be traced back to different causal ideas and norms partly manifested itself in the process. Early in the negotiations, ideas about the contribution of shipping to eutrophication were underlying conflicting positions among the Baltic Sea states. The leading roles of Finland and Sweden were in line with concerns of their domestic public about the eutrophication of the Baltic Sea (Jönsson 2011; Lyytimäki 2012). By contrast, Denmark, Estonia, and Russia doubted the need for regulation given the small contribution of shipping to total nutrient inputs (Denmark and Estonia in Finland 2007c, 6–8; HELCOM 2007a, para. 3.6). Ideas about eutrophication also mattered in the negotiations at the IMO. Some states from outside the Baltic Sea region, such as Cyprus, supported the more demanding standards noting that they also faced eutrophication in their sea regions (IMO 2014b). Decision-makers from these states may have seen regulation in the Baltic Sea as a possible precursor to similar regulation in their region. An observation raising doubts about an independent effect of ideas though is the Finnish position in HELCOM at the

[51] One could argue that, for the Baltic Sea states, the proposed requirement of more advanced treatment equipment was a way to reduce the need for upgrading wastewater reception facilities in often publicly owned ports (Interview 9).

beginning of the policy process. Back then, Finland (2005) already proposed considering regulatory measures even though the extent of nutrient inputs from ships was still "not fully known." This may be counted as a manifestation of a (very) precautionary approach; or it may suggest that predefined preferences mattered more than knowledge about the problem.

In paving the way towards nutrient regulation, idea- and norm-based leadership by activists has played a limited role. The most active environmental NGO on the international level was the WWF. Before the Baltic States presented their regulatory proposal, the WWF had put nutrient inputs from shipping in the Baltic Sea on the agenda of MEPC 59 in 2009. Its main achievement was the adoption of an MEPC circular which encouraged cruise ships "navigating in semi-closed and closed sea areas which are threatened by eutrophication, to refrain from discharging their waste water into the sea" (IMO 2009e, para. 1.2; cf. 2009b, para. 14.1-14.6). Adopted at the outset of IMO negotiations on this issue, the circular also announced the intention of the Baltic Sea states to submit a regulatory proposal to the IMO (IMO 2009e, para. 1.1). Considering that the circular itself did not name any specific sea areas to which it should apply, it represented a political signal to the sector rather than a real regulation.

Science also fueled the momentum for regulation. The HELCOM activities on eutrophication have encouraged scientific research to define and understand the problem, its sources, and effects (Linke et al. 2014, 514–18; Interview 1). Regarding the specific contribution of shipping to eutrophication, the key piece of research was a study commissioned by HELCOM and conducted by VTT Technical Research Centre of Finland. It found that shipping only contributed 0.5% of the total nutrient inputs into the Baltic Sea. These inputs were not considered negligible though because of their concentration along shipping routes and their direct uptake by blue green algae (Huhta, Rytkönen, and Sassi 2007, 7). Although this argument was used by Finland (2007b), it is unlikely to have convinced many states to support demanding regulatory requirements. For example, when the goal of developing a joint regulatory proposal was incorporated into the Baltic Sea Action Plan, Denmark and Russia were still arguing that the contribution of shipping to eutrophication was overestimated (HELCOM 2007a, para. 3.6; 2007b, para. 6.3). Ideational leadership cannot explain why these countries came to support regulation.

Confronted with the threat of regulation, and in line with ideational-interventionist predictions, the hegemonic business actors used various tools to prevent or preempt ambitious regulation. First, the cruise industry mobilized expertise that called into question scientific findings both in the preparation and decision-making phases. In 2008, a study by ECC attempted to show that the nutrient load of sewage from cruise ships in the Baltic Sea amounted to only two thirds or half of what VTT had calculated (CLIA 2010a, annex 1). In 2010, a consultant engaged by CLIA similarly noted "critical omissions and errors in the assessment and methodology used by VTT" (CLIA 2010a, para. 3.1; see also 2010b, para. 11). He further pointed to technological challenges as the "removal of nutrients from passenger ship waste waters is in its early stages of investigation" (CLIA 2010a, para. 23). However, neither of the two studies mobilized a majority of delegations within HELCOM or the IMO against the demanding nutrient standards, let alone regulation in general. This is consistent with my observation that, among the over one hundred documents submitted to each session of MEPC, information documents by consultative organizations often receive only limited attention.

Second, the ferry and cruise industries sought to accommodate demands for regulation through their corporate environmental management practices. The public disapproval of discharges of untreated sewage (Huhta, Rytkönen, and Sassi 2007, 9) increased the threat of regulation for these industries. Until 2007, a dozen ferry and cruise companies responded to an initiative of the WWF to implement voluntary improvements. They committed to refraining from the discharge of untreated sewage and to delivering all sewage to port reception facilities or reducing phosphorus in treated sewage (HELCOM 2007d, para. 2.18; WWF 2007). Despite this "window dressing" (Interview 9), the HELCOM member states decided to prepare regulatory measures. In 2009, the European cruise industry adopted an agreement to voluntarily deliver all sewage to port reception facilities if certain infrastructural conditions were fulfilled (ECC 2009). The HELCOM delegations were informed about this agreement but still adopted their proposal for a new regulation and submitted it to the IMO (HELCOM Secretariat 2009). In 2012, a document prepared by CLIA and supporting flag states stated that "a strong voluntary code already in place and adhered to by the vast majority of ships identified by the Baltic Sea states in their submission is likely to deliver as strong an environmental improvement as that which would arise from the proposed regulations" (Bahamas et al. 2010b, para. 28). Yet, this voluntary scheme was unable to prevent MEPC 64 from adopting a regulation with demanding nutrient limits (Interview 6).

Third, the cruise industry lobbied vocally for requirements consistent with its technology strategies. In the preparation phase in 2008, CLIA (in Finland 2008, 19) noted the ongoing innovation process in nutrient removal technology. In 2009, when confronted with the demanding nutrient limits proposed by the Baltic Sea states, the cruise industry criticized these standards as "unrealistic" (ECC/CLIA 2009b, 6). In the decision-making in 2011 and 2012, it advocated more permissive standards that could be met by advanced wastewater treatment systems already installed onboard several very large passenger ships (CLIA 2011, paras. 5, 10; 2012, paras. 10, 21). In the review in 2014, CLIA challenged claims by Finland and Norway that an installation of equipment compliant with the demanding standards was planned for several new cruise ships (CLIA 2014b, para. 6; Finland and Norway 2014, annex 2). However, the recurring lobbying of CLIA for permissive nutrient limits proved mostly unsuccessful. This means that all powerful tools of the hegemonic bloc—counter-expertise, accommodation through corporate environmental management, and lobbying—failed to preempt or prevent demanding regulatory requirements. How was this possible?

Ideational interventionism would predict that hegemonic blocs can be challenged successfully under exceptional circumstances. Environmental crises can provide outside challengers with additional political leverage and windows of opportunity for reshaping regulation (Braithwaite and Drahos 2000, 561). Crisis-like circumstances indeed triggered the regulatory process on nutrient inputs from ships. In 2005, Finland raised the issue in HELCOM as a response to media reports and public concerns about legal discharges of untreated sewage by ferries sailing between Helsinki and Tallinn (Huhta, Rytkönen, and Sassi 2007, 9). The VTT study served to establish the link between such discharges and the eutrophication of the Baltic Sea. Eutrophication was already recognized as a major problem. It was addressed in the strategic goals of HELCOM and became a main pillar of the Baltic Sea Action Plan (HELCOM 2007e; Backer and Leppänen 2008, 325). To justify their proposal on nutrient regulation in the IMO, the HELCOM states referred to eutrophication as "the most serious environmental challenge of the Baltic Sea" (Denmark et al. 2009a, para. 4.15). These observations suggest that, assuming away concerns about eutrophication and nutrient inputs from ships raised by environmentalists and scientists, it is unlikely that any regulatory movement would have occurred.

While a sense of crisis can explain some of the movement, it insufficiently accounts for the disruption of the hegemonic coalition. The impression of immediate crisis weakened throughout the long regulatory process despite repeated efforts of the WWF to stress the relevance of the problem (WWF 2009; 2010a; 2010b). Moreover, the contribution of shipping to overall nutrient inputs was very small. During the review of the nutrient standards in 2014, only three out of the eleven member state delegations that supported the more demanding standards explicitly mentioned eutrophication in their oral interventions (IMO 2014b). Even more surprisingly, neither of the two environmental nongovernmental observers that took the floor referred to the magnitude of the environmental problem (IMO 2014b). Thus, in contrast to ideational-interventionist predictions, a sense of crisis cannot fully account for the choice and confirmation of the more demanding nutrient limits.

Finally, the regulatory outcome does not neatly fit into the ideational-interventionist focus on technology-forcing regulation. In the negotiations, some critical state and industry delegations claimed that the demanding nutrient limits represented a technology-forcing or aspirational approach (CLIA 2011, para. 8; 2012, para. 15; IMO 2014b). As will be shown later, however, this assessment does not hold at closer inspection. Innovative equipment manufacturers had developed the basic technology approach for meeting demanding nutrient limits already before their adoption. The technology uptake by the shipping industry began around the initial adoption of the nutrient limits in 2012 but still before their review in 2014. This suggests that the link between regulation and business practice was more complex than a simple top-down intervention.

Summary

The foregoing analysis suggests that, in a war of position over nutrient inputs from ships in the Baltic Sea, the engagement of activists and scientists was conducive to the emergence of regulation. Science and applied research mattered in raising awareness of the problem of eutrophication and assessing the contribution of shipping. Environmental NGOs contributed to keeping the issue on the agenda and put pressure on shipping companies to improve their environmental practices. However, the ideas and norms that scientists and activists brought into the process alone cannot account for the choice of the more demanding nutrient standards. From an ideational-interventionist point of view, it remains unclear why the counter-expertise mobilized by the cruise industry and enhanced environmental practices of shipping companies did not prevent regulation. Even more importantly, it is puzzling that the hegemony of reluctant business actors got disrupted in the absence of a truly urgent sense of environmental crisis.

Material-Evolutionist Spotlight: Business Conflict and the Puzzling Victory of the Davids

This section analyzes the regulatory negotiations and outcome through the lenses of material evolutionism. To prepare the ground for this analysis, I deduce theoretical predictions from the theory's general expectations, taking into account the storyline of the negotiations on nutrient regulation. The empirical assessment of these predictions finds that a business conflict between progressive equipment manufacturers and reluctant shipping interests was underlying the regulatory negotiations. To the surprise of the material-evolutionist model, however, the choice of the more demanding nutrient limits reflected the position of the materially less powerful equipment manufacturers.

Theoretical Expectations

The material-evolutionist model posits that the actor constellation can be captured in terms of business conflict or cooperation. Conflicts between winners and losers of nutrient regulation should be observable to the extent that the regulation has had distributional effects. Nutrient regulation is expected to benefit the suppliers of advanced sewage treatment plants at the expense of shipping companies that use the equipment. An absence of business conflict between suppliers and users would be surprising. Material evolutionism also posits that conflicting state preferences reflect competing interests of their domestic businesses. States with treatment plant manufacturers and industries that suffer from marine pollution should have supported stringent regulation, while those with a large cruise industry should have opposed it. If preferences of states and dominant domestic businesses were found to not have been in agreement with each other, the explanatory power of the model would be weakened. This would also be the case if decision-makers came to adopt and advocate ideas that do not serve material state interests. The model further stipulates that interest- and power-based leadership can produce changes in state preferences and coalitions. The growing support for demanding nutrient requirements should have resulted from issue linkages forged or pressures exerted by powerful states in maritime regulation. The observation of changing state positions absent prior issue linkages or pressures would undermine the plausibility of the model.

According to material evolutionism, business can shape options for international regulation through its technological power. Thus, the demanding nutrient standards are predicted to reflect innovations in sewage treatment technology. Regulatory proposals that went beyond available technology would contradict this prediction. In case of business conflict, the model expects that those business actors with larger instrumental, structural, and discursive power resources win state support. Large firms with well-endowed interest associations and good access to the regulatory negotiations should have had more influence on nutrient regulation than smaller firms without dedicated interest groups and limited access to international organizations. If, however, business Davids won against the Goliaths, this would puzzle material-evolutionist analysts. Lastly, material evolutionism expects that regulation codifies the technologies and practice of these influential firms. This means that the nutrient regulation should reflect what business Goliaths from powerful states already did beforehand. If I found that the regulation exceeds their sewage treatment technology and practices, the explanatory power of the model would be weakened.

Analysis

Can empirical manifestations of these predictions be found in the negotiations of nutrient regulation? From a material-evolutionist perspective, the struggle over nutrient standards was driven by a business conflict between equipment manufacturers and parts of the shipping industry. The conflict was rooted in different economic interests along the supply chain. At its one end, innovative manufacturers of sewage treatment plants informed decision-makers about the expected nutrient removal performance of their new systems. These manufacturers would economically benefit from ambitious regulation which creates demand for more advanced and thus also more expensive treatment systems (Interview 8). At the other end of the supply chain, the cruise industry opposed "potentially enterprise-threatening" nutrient limits requiring the installation and operation of new equipment at additional costs (Interview 6). The demanding requirements proposed by innovative suppliers would increase the investment costs of a treatment plant by up to € 700,000 or 23% (Denmark et al. 2009a, para. 7.13). The increase in total annual costs for the installation, operation, and maintenance of the wastewater treatment plant would amount to € 100,000 or 18% for a medium-sized cruise ship (Denmark et al. 2009a, para. 7.18). In addition to the cruise industry, less innovative equipment manufacturers also had an interest in avoiding overly restrictive standards that could undermine their competitive position.

The business conflict between equipment manufacturers and the cruise industry was underlying most key moments in the process. Early in the preparation phase, several HELCOM countries broached the issue of economic implications of new regulation for the shipping industry (HELCOM 2006, para. 7.15). The first set of nutrient standards entering into the regulatory proposal reflected the expected performance of a new treatment system from one manufacturer (Finland 2008, 5). This manufacturer also provided estimates of investment and operation costs for new equipment, but no comprehensive impact assessment was conducted (Finland 2008, 8). Business conflict intensified when HELCOM was finalizing its regulatory proposal. Two manufacturers declared that their equipment would meet the amended standards (Evac Oy 2009; Hamann AG 2009). The cruise industry questioned the viability of its Baltic Sea operations under the new standards and stated that, in its experience, "most manufacturers claims are significantly exaggerated" (ECC/CLIA 2009b, 3, 9). Another equipment manufacturer reported that trials had not proven the feasibility of the proposed standards (Hamworthy Water Systems 2009, 16). Neither these critical business voices nor the lack of a comprehensive impact assessment prevented the HELCOM countries from submitting their proposal to the IMO.

In the decision and review phases at the IMO, disagreements largely continued to follow the divide between equipment manufacturers and the cruise industry. Submissions by delegations supporting demanding nutrient removal standards mentioned environmental considerations but heavily relied on technical information from equipment manufacturers (Denmark et al. 2009a, para. 7; 2010b, para. 7, annex 2; 2010a, para. 10; Finland and Norway 2014). The cruise industry repeatedly expressed its commitment to improving its environment performance (CLIA 2009, paras. 5–6; 2010b, para. 15; ECC 2009). At the same time, it fiercely opposed the demanding requirements, challenged the technical rationale behind them, and proposed less demanding standards instead (CLIA 2011; 2012; 2014a; IMO 2014b). These lower standards could have been met with already established and less costly treatment equipment (CLIA 2011, paras. 4–5). This option was also supported by parts of the shipping and shipbuilding industries represented by the International Chamber of Shipping (ICS) and the Committee of EU Shipbuilders' Associations (CESA) (IMO 2014b).

The empirical evidence only partly supports the material-evolutionist prediction that state preferences for demanding regulation reflected the interests of dominant domestic business actors. Indeed, countries with domestic equipment manufacturers that were able to develop advanced nutrient removal technology supported the demanding standards (Denmark et al. 2010b, para. 7; Finland 2010, 4, 8; IMO 2014b). This includes Finland (Evac), Germany (Hamann), Norway (Scanship), and France (Veolia). However, it is not obvious that the material interests of these countries would be maximized by simply following the preferences of their equipment manufacturers. Several, if not all, supporting countries also had strong economic ties with passenger shipping by hosting major shipbuilders, ferry or cruise operators, or cruise destinations (Interview 1; Interview 9).[52] For Finland and Sweden, one could argue that their pro-regulatory position reflected the high willingness of their population to pay for measures mitigating the eutrophication of the Baltic Sea (Ahtiainen et al. 2014, 14). The potential benefits of reduced eutrophication for their domestic fishing and tourism industries may have played a role, too. The material-evolutionist model cannot precisely predict though how decision-makers make such complex calculations. Moreover, industries suffering from eutrophication were not visible in the regulatory process and decision-makers arguably did not have complete information on public preferences.

The same mixed picture is found for states that opposed regulation in general or the demanding nutrient limits in particular. Several major flag states took a position that was in line with economic shipping interests. Among them were the Bahamas and Panama which accounted for 36% and 12% of all registered cruise ships in 2008 (Boy 2011, 64). Other major flag states like Liberia and the Marshall Islands were less closely attached to the cruise industry at the time. They probably feared that demanding regulation for passenger ships might spill-over to cargo ships in the future. However, in contradiction to material-evolutionist predictions, other major cruise flags like Italy (8% of all cruise ships), the Netherlands (5%), Cyprus (2%), and Greece (2%) did not oppose the demanding nutrient limits (Boy 2011, 64).[53] Strikingly, Italy, Cyprus, and Greece even supported the more demanding nutrient standards in the review in 2014.

Material evolutionism expects that, through its technological power, business can create new possibilities for regulation. Indeed, the manufacturers possessed significant technological power as they controlled innovation in treatment technology. In the preparation phase, the Finnish manufacturer Evac operated an onshore pilot system for nutrient removal from sewage. The German treatment system supplier Hamann confirmed the feasibility of demanding performance values based on experiences with land-based treatment plants (Interview 8). These were important preconditions for the nutrient limits eventually adopted as part of the HELCOM proposal (Interview 2). Technology

[52] Another specific material calculation of Germany concerned the potentially distortive competition effects of different regulations applying to its Baltic Sea and North Sea ports (Interview 3).
[53] Two other major flag states were Bermuda and the US (both 6%). However, the former is not a member of the IMO and the latter is not a party to MARPOL Annex IV which addresses discharges of sewage from ships. The UK, which accounted for 4% of all cruise ships, wanted to postpone the review decision of the IMO in 2014 until more knowledge on compliant treatment plants would become available (IMO 2014b).

availability then became a major concern in the decision and review phases. The adoption of demanding nutrient standards in 2012 was based on information from five manufacturers on the *anticipated* availability of compliant treatment technology (Denmark et al. 2010b, para. 7). The cruise industry, which had own experiences with innovation in shipboard equipment, did not share this outlook. The confirmation of the demanding standards in 2014 was then grounded in information on the *actual* availability of new treatment technology from two suppliers (Finland and Norway 2014). Without the technological power of equipment manufacturers, the road towards the more demanding standards would have been blocked. Still, in 2014, several delegations claimed that two manufacturers were not enough for concluding that a sufficient amount of equipment was available on the market (IMO 2014b). Thus, while technological power created possibilities for demanding regulatory requirements, it does not explain why a majority of IMO delegations actually endorsed them.

There is some evidence here for the existence of exogenous interests that guide the uptake of competing ideas by states. Major flag states adopted ideas in line with the economic interests of the shipping industry. The cruise industry association challenged scientific findings on the severity of the sewage problem (CLIA 2010a; 2010b). It also called into question the proportionality of the proposed measures (HELCOM 2015b, 4.10; ICS, CLIA, and Interferry 2010, para. 9). Furthermore, the cruise industry disputed the feasibility of the demanding standards and the availability of compliant equipment (CLIA 2011, paras. 6–8; 2012, paras. 12–15; 2014a; 2014b). Representatives of the cruise industry also raised procedural concerns relevant well beyond the Baltic Sea context (CLIA 2009, para. 2; 2010b; IMO 2010e, para. 6.15-6.17). Many of these ideas were taken up by flag state delegations opposing the demanding standards (IMO 2012d, para. 11.18; 2014b). It should be recalled though that the link between material interests and policy positions taken was less straightforward for European flag states and the Baltic Sea coastal states.

Throughout the negotiations, some instances of interest-based leadership can be observed as predicted by material evolutionism. One major instance was the agreement of the HELCOM states to only aim for a regulation of passenger ships. Addressing these 6% of all ships in the Baltic Sea promised to reduce nutrient inputs from ship sewage by two-thirds (Denmark et al. 2010a, para. 12; IMO 2010g, para. 7.28). Yet, it also left one third of the nutrient inputs from shipping unregulated (Hänninen and Sassi 2009, 45). This choice was instrumental in dampening potential economic impacts of regulation and avoiding opposition from owners of cargo ships and their flag states (Interview 1;

Interview 2; Interview 7). Another instance of interest-based cooperation was the agreement on preparing regulatory action in the context of the Baltic Sea Action Plan. Denmark had initially taken a skeptical position on the need for nutrient regulation, which also reflected the interests of its large domestic shipping industry. One reason why Denmark consented to regulatory action was that it wanted to see the package deal of the Baltic Sea Action Plan adopted (Interview 4). Without this linkage, continued disputes about the need for nutrient regulation would most likely have prevented swift action by HELCOM.

Yet another instance of interest-based leadership concerned the entry into effect of the new regulation. Until 2016, Russia blocked a decision on the effective date of the new regulatory requirements. It had not notified the adequacy of its port reception facilities yet and voiced concerns about the economic implications of the regulation for shipowners and ports (HELCOM 2015c, para. 2.38; Russian Federation 2016b; 2016a, para. 11). However, the other Baltic Sea states reached a consensus with Russia which let the regulation take effect by temporarily exempting ships in direct transit to Russia from the requirements (IMO 2016c, para. 10.18; Russian Federation and Sweden 2016). As cruise ships usually do not directly transit to St. Petersburg from outside the Baltic Sea, the practical relevance of this side payment seems very limited though (Interview 1).

Material-evolutionist theory expects that regulatory outcomes reflect the interests of business actors with strong instrumental, structural, and discursive power. On the instrumental level, the manufacturing and cruise industries had different degrees of access to the negotiations. The interests of the cruise industry were vocally represented by sector associations with observer status in HELCOM and the IMO. CLIA managed to coordinate some of its positions with major flag states (Bahamas et al. 2010b; 2011). Interventions of flag states usually have substantial weight in discussions at the IMO because amendments to MARPOL require tacit acceptance by two-thirds of the contracting parties representing at least 50% of the world's tonnage (MARPOL 1973, art. 16(2)(f)(ii)). Some positions of CLIA were also supported by associations of the ferry, shipping, and shipyard industries (Bahamas et al. 2010b; ICS, CLIA, and Interferry 2010; IMO 2014b). The manufacturers did not have a comparable, centralized interest representation with access to the negotiations. Some manufacturers were in contact with the delegation of their home country and a few occasionally joined them as observers at relevant IMO meetings (IMO 2010c; 2010f; Interview 8). While business observers can speak to their national delegates during meetings, they may usually not take the floor on behalf of their delegation.

On the level of structural power, again the cruise industry seemed predominant. The multi-billion-dollar cruise sector features large, transnational companies. In 2013, they created a total economic impact of 117 billion US dollars per year, including significant expenditures at cruise destinations (Business Research & Economic Advisors 2014, 3–4). The Baltic Sea states are home to popular cruise ports, including Copenhagen, Helsinki, Rostock, Stockholm, and Tallinn. Regulatory measures that curtailed the viability of cruise operations would thus entail economic losses for the coastal states. The economic and political resources of the cruise sector contrast with the limited structural leverage of a dozen medium-sized equipment manufacturers. Furthermore, even the business prospects of the manufacturers depended in part on the economic situation of the cruise industry. Due to space constraints for equipment retrofitting, existing cruise ships are expected to comply with the new regulation mostly by delivering sewage to port reception facilities (Interview 6). Therefore, only continued growth in the number of new cruise ships would secure long-term demand for new sewage treatment plants.

On the discursive level, the equipment manufacturers faced disadvantages, too. Unlike the cruise industry, they lacked an industry association speaking with a single voice. In the preparation phase, only few manufacturers contributed information on feasible performance standards to the development of the regulatory proposal (Finland 2008, 5). The number of manufacturers providing information increased only slowly as technological developments progressed (Denmark et al. 2010b, para. 7). In other words, the supply industry does not seem to have had any discursive strategy and mainly took a reactive position in technical consultations. By contrast, as explained earlier, the cruise industry used an entire set of discursive strategies to oppose demanding nutrient standards. Overall, the cruise industry thus possessed superior instrumental, structural, and discursive power resources in comparison to the equipment manufacturers. Despite this, the IMO adopted and confirmed demanding nutrient standards that mostly reflected the preferences of the innovative equipment suppliers. This is a puzzling outcome for material evolutionism.

Lastly, the demanding nutrient requirements of the new regulation are not purely technology-following as material evolutionists would expect. When the requirements were adopted in 2012, the compliant nutrient removal technology was not in use onboard any ships yet. When the requirements were reviewed in 2014, however, new technology was installed on two new cruise ships and plans for more installations existed (Finland and Norway 2014). Interestingly, all cruise companies that had planned for a possible installation of new equipment continued to oppose the demanding nutrient limits through CLIA. Hence, the relationship between technology development and regulation was apparently more complex than a clear bottom-up dynamic from already dominant industry practice to legal codification.

Summary

A material-evolutionist spotlight on the regulatory process usefully captures the competing business interests that were underlying the negotiations. Aspects of material bargaining are reflected in the choice to only regulate passenger ships and in the compromise reached for its entry into effect. As concerns the regulatory requirements, the analysis suggests that the technological power of equipment manufacturers greatly contributed to the adoption of demanding nutrient standards. It remains unclear, however, how these business Davids with limited traditional power resources came to successfully influence such a contentious design choice. This question becomes even more puzzling when considering that the business Goliaths from the cruise industry actively challenged the technology claims of the manufacturers.

Argumentative Coproduction: Innovators and Involuntary First Movers Tip the Scales

The analyses through ideational-interventionist and material-evolutionist lenses have provided valuable insights into the lines of conflict between actors, competing ideas and interests, and the distribution of traditional power resources. Moreover, they suggest that technological innovation in wastewater treatment played a role in enabling nutrient regulation with demanding requirements. However, the two approaches have not yet fully elucidated three important empirical questions: How did the regulatory status quo become disrupted in the absence of a strong sense of urgent environmental crisis? How were medium-sized manufacturers of sewage treatment plants able to influence the new regulation more profoundly than the economically and politically much more potent cruise industry? And why did a majority of delegations follow the optimistic technological claims of the equipment manufacturers rather than the skepticism of the shipping industry? In the following, I show that the development of nutrient regulation involved extensive arguing over technology. Expertise provided by innovative equipment manufacturers and involuntary first movers from the cruise sector together tipped the scales in favor of those that argued for more demanding nutrient limits.

Theoretical Expectations

Argumentative coproduction understands international negotiations as argumentative contests among proponent, opponent, and audience states. It expects that some states acted as argumentative leaders in the discussions about nutrient regulation, while others adopted more reactive or passive stances. An absence of written and oral exchanges of arguments between states with different positions in HELCOM or the IMO would raise doubts about this depiction. The model further argues that policy preferences of states are based on propositions held about regulatory need and feasibility. Proponents of stringent regulation should have referenced both the environmental need to reduce nutrient inputs and the technological possibilities for doing so. Missing references to the eutrophication problem or the state of sewage treatment technology would weaken that part of the model. Moreover, argumentative coproduction posits that new technological arguments and evidence can change state positions. When reactive or passive states came to support proponent or opponent positions, they should have endorsed their arguments about the feasibility of demanding nutrient limits. If states changed their position on nutrient regulation in the absence of new arguments about technological feasibility, this would raise doubts about the model.

The model of argumentative coproduction theorizes competing business expertise as the source of proponent and opponent arguments about the feasibility of regulatory options. I expect to find the major arguments of states for and against demanding nutrient limits to reflect information received from equipment manufacturers and the cruise industry, respectively. The centrality of business expertise would be called into question if feasibility aspects were mainly discussed based on scientific, administrative, and civil society expertise. The model suggests that first-mover practices are particularly credible evidence with respect to technology arguments and may therefore be able tip the balance in tense argumentative contests. Thus, the more demanding nutrient limits adopted by the IMO should have been rooted in some frontrunner practice demonstrating their feasibility. It would be puzzling if the standards were adopted without tangible proof of their feasibility. Finally, the regulation resulting from this process is expected to be technology-reinforcing. This means that nutrient regulation should require the broader adoption of new treatment technology that has emerged in a limited segment or niche. I should not see that the regulation codifies technology that was already widely used or that did not exist before its adoption.

Business Actors, Corporate Expertise, and State Roles

Argumentative coproduction understands regulatory negotiations as a series of articulations and evaluations of competing arguments about the technological leeway for regulatory action. Indeed, as the previous narratives have shown, the technological feasibility of the proposed nutrient standards and the availability of compliant equipment were *the* central issues in the preparation, decision, and review of the regulatory requirements. The competing arguments in favor or against the demanding standards reflected different business interests. Innovative producers of sewage treatment plants would benefit from ambitious regulation through increased demand for advanced equipment and an improved competitive position. The information they provided consistently demonstrated possibilities for demanding nutrient limits. These limits create additional costs for cruise companies, which have to install and operate more advanced systems offered by a limited number of suppliers. Accordingly, the skeptical arguments put forward by the cruise industry sought to challenge the information provided by the manufacturers (see Table 8).

Table 8: Main actors in the negotiation of nutrient regulation for the Baltic Sea

	Progressive position	**Reluctant position**
Main state actors	Finland Norway	Bahamas Liberia Marshall Islands
Important audience states	Baltic Sea coastal states, EU member states	Non-European flag states, incl. Panama
Main business interests	Innovative manufacturers of sewage treatments systems	Cruise industry Other manufacturers of sewage treatment systems
Business actors	Individual companies: Evac, Hamann, Scanship, and others	Industry association: CLIA/ECC Individual company: Hamworthy
Other nonstate actors	Environmental NGO: WWF	-

Source: Author.

The equipment manufacturers and the cruise industry assumed central roles in the discussions not only because they had the highest stakes in the regulation. They also had the most extensive first-hand knowledge of innovation in treatment technology and its uptake. On behalf of the cruise industry, CLIA submitted numerous documents and made oral interventions. The role of the equipment manufacturers was mostly limited to providing information which became included in documents and statements of some state delegations. Written documents can play a major role in technological arguing as many IMO delegations prepare their statements ahead of international meetings. In contrast to equipment suppliers and the cruise industry, other industry and nongovernmental actors with lower stakes and/or less practical knowledge remained on the sidelines. For instance, the ferry operator association Interferry did not engage in discussions on nutrient limits because it considered that ferries typically use port reception facilities rather than onboard sewage treatment plants (Interview 9).[54] The participation of the WWF in the negotiations is noteworthy as it provided information on the voluntary discharge of sewage into port reception facilities by certain companies.

Argumentative coproduction posits that decision-makers strongly rely on business expertise to form their policy preferences. Finland and later also Norway acted as proponents that strongly supported demanding nutrient requirements. Both delegations were in close contact with their domestic equipment manufacturers Evac and Scanship, respectively. Their interventions usually built upon information from these manufacturers, even up to the point of explaining technical specifications of certain treatment systems (Finland and Norway 2014; IMO 2014b). The Bahamas, Liberia, and the Marshall Islands repeatedly acted as opponents of demanding nutrient standards in the IMO. As major flag states, they have close contacts with shipowners and operators. Accordingly, their interventions usually echoed the arguments against demanding standards put forward by CLIA (Bahamas et al. 2010b; 2011; IMO 2014b). At the request of CLIA, the British equipment manufacturer Hamworthy also provided occasional technical arguments and evidence backing the opponent view (Interview 4). Altogether only few delegations seem to have had rather fixed preferences though.

Argumentative coproduction expects that audience states with less stable or undetermined preferences are open to being mobilized or persuaded. The theory posits that, to garner support among audience states, proponents and opponents attempt to challenge competing propositions about the availability, affordability, reliability, and safety of technology. Indeed, technological arguing occurred at all key moments in the development of nutrient regulation. The proponents managed to gather support for relatively demanding nutrient regulation from the Baltic Sea coastal states, especially Estonia, Germany, and Sweden, as well as from several EU member states, including Cyprus, France, Greece, and Ireland. The opponents received support from other non-European

[54] This consideration may have been not entirely correct as also ferry operators are now interested in new sewage treatment plants with nutrient removal technology (Interview 8).

flag states like Dominica and Panama, but this did not prevent the adoption of relatively demanding requirements. As predicted by the theory, the argumentative power of the successful coalition often resided in the ability to reference existing and emerging business practices as tangible and credible evidence for its claims.

The First Key Moment

At the critical moment in 2007, sincere persuasion helped building support for regulatory action. Finland had kick-started the negotiations at HELCOM and pushed for more stringent regulation of nutrient inputs from ships' sewage. The Maritime Working Group early agreed that regulation by the IMO would be most appropriate as this would also bind ships flying the flags from outside the region (Finland 2006; HELCOM 2006, para. 7.16). The states supportive of the Finnish proposal for IMO regulation were Sweden and, to a lesser extent, Latvia and Poland (Finland 2007a, 7–9). By contrast, Denmark, Estonia, Germany, Russia were initially skeptical about taking regulatory action (Finland 2007a, 5–10; HELCOM 2007a, para. 3.10). One source of doubt was the technological possibility of nutrient removal onboard ships. For instance, Estonia (in Finland 2007a, 5–6) reported that a treatment system of the Finnish company Evac installed on a modern passenger ship in the Gulf of Finland was unable to effectively remove nutrients. Germany (in Finland 2007a, 7) had similar doubts about the availability of required technology. Another issue of concern was the availability of port reception facilities for ships that would be unable to comply with future nutrient removal standards (Finland 2007a). In short, several delegations were not convinced that shipping companies would be able to comply with more stringent regulation of sewage discharges in the Baltic Sea. These beliefs manifested themselves in split views on the possibility of a joint submission to the IMO (see Table 9).

Table 9: Initial positions of Baltic Sea states on nutrient regulation, February 2007

	Supported regulation	**No position taken**	**Skeptical position**	**Opposed regulation**
Proponents	**Finland**	-	-	-
Opponents	-	-	-	-
Audience	Latvia Poland Sweden	Lithuania	Estonia Germany	Denmark Russia

Source: Author. Positions according to Finland (2007a) and HELCOM (2007a).

A consensus around regulatory action only emerged after delegates had adopted the proposition that less harmful practices in discharges of sewage were feasible. In early August 2007, the final report of the study conducted by VTT was circulated (Finland 2007b). It reported nutrient removal rates achieved in municipal wastewater treatment and noted the existence of marine treatment systems capable of removing phosphorus (Huhta, Rytkönen, and Sassi 2007, 27, 43). By the end of August, an expert meeting of HELCOM could still only agree on a loose commitment to working on the nutrient issue in the IMO (HELCOM 2007d, 13). At the same meeting, the WWF informed the delegations of voluntary agreements concluded with a dozen ferry and cruise companies on ceasing discharges of untreated sewage (HELCOM 2007d, para. 2.18). This included well-known ferry lines from Denmark, Estonia, Finland, and Sweden (WWF 2007). A meeting report of the HELCOM Maritime Working Group suggests that the delegations quickly came to see these voluntary practices as an interim measure on the way to regulation (HELCOM 2007b, para. 6.7). The corporate initiatives were also important because they raised awareness in the shipping and port sector that new regulation was likely to emerge (Interview 2).

Table 10: Growing support of HELCOM member states for nutrient regulation, February-November 2007

	Continued support for more stringent regulation	**Increasing support for / less opposition to more stringent regulation**	
Proponents	**Finland**	-	
Opponents	-	-	
Audience	Latvia Poland Sweden	Estonia Germany Lithuania	Denmark Russia

Source: Author.

Another element that supported consensus-building around nutrient regulation within HELCOM was the adoption of a two-step approach. According to this approach, passenger ships would be regulated first and cargo ships later (HELCOM 2007d, para. 2.17). The focus on relatively few ships with high amounts of sewage generation markedly reduced the technological and operational challenges of nutrient regulation. For several audience states, this was an important precondition for supporting a regulatory initiative (Finland 2007c, 6–9). Only a few weeks after this decision and the reports about voluntary first-mover practices, the HELCOM countries agreed on taking concrete steps towards a joint submission for a new regulation by the IMO. Now also Denmark, Estonia, Germany, Lithuania, and Russia formally supported regulation (see Table 10). Thus, improvements in corporate environmental practices and the focus on passenger ships were a push for cooperation, in addition to the issue linkages that the Baltic Sea Action Plan entailed.

The agreement of the Baltic Sea states on the development of a joint regulatory proposal meant that the basic design choices were to be discussed within HELCOM first. In this preparation phase, the nonhierarchical and consensus-oriented culture of the organization (Interview 1) was going to prove conducive to argument- and evidence-based discussions. This created an ideal entry point for the influence of business expertise. By the end of the preparation phase in 2009, the HELCOM states had built a consensus around a proposal for nutrient regulation with relatively demanding requirements. The next two critical moments shed light on how these requirements were rooted in the expertise of equipment manufacturers.

The Second Key Moment

At the critical moment in 2008, corporate expertise translated into the first set of nutrient standards in the HELCOM proposal. When the responsible correspondence group wanted to develop the future nutrient standards, it faced several knowledge gaps. No model regulation on the nutrient load of sewage from ships existed internationally, not even in Alaska with its demanding local discharge standards. In the Baltic Sea, the German cruise company Aida was among the first to use membrane technology that was able to reduce nutrients (Interview 3). Although members of the HELCOM correspondence group were aware of advanced treatment technologies installed on modern cruise ships, they did not know their nutrient reduction capacity (Denmark and Germany in Finland 2008, 13–14). The group also had knowledge of onshore treatment plants capable of reducing nutrients but was uncertain whether and how such systems could be applied in marine contexts (Germany in Finland 2008, 13). Because of this uncertainty, the group was unable to come up with possible nutrient standards on its own.

To close the knowledge gaps, the correspondence group consulted with CLIA and several equipment manufacturers. CLIA gave a surprisingly optimistic outlook stating that “the technology is coming, but not yet here, to practically remove all nitrogen and phosphorus” (CLIA in Finland 2008, 19). It also indicated that it wished wastewater treatment manufacturers to further develop such systems for nutrient removal (CLIA in

Finland 2008, 19). This statement signaled a willingness to adopt more environmentally friendly technology, while shifting responsibility onto the manufacturers. Among the responses from the manufacturers, only the information submitted by the Finnish company Evac was considered adequate (Finland 2008, 5). Evac expected its new system to achieve effluent concentrations of less than 10 milligram nitrogen and less than 0.5 milligram phosphorus per liter. In the absence of competing information from other companies, the correspondence group inserted these values as a first set of standards into the proposed regulation (Finland 2008, 5). This is a very clear example of how state delegations turn propositions from business experts into policy proposals.

The Third Key Moment

At the critical moment in 2009, additional corporate expertise made the HELCOM delegations amend the nutrient standards in their regulatory proposal. Although a first set of standards had been defined in 2008 based on information from Evac, the proposed limit values remained in square brackets. Most delegations did not consider it sufficient to base future requirements solely on evidence from one manufacturer (HELCOM Secretariat 2008, para. 3.36). This issue was only resolved once additional corporate expertise became available after renewed discussions with Evac and input from two other manufacturers. Following these consultations, the group proposed amended nutrient limits: maximum 20 milligram nitrogen per liter or at least 70 % reduction and maximum 1.0 milligram phosphorus per liter or at least 80 % reduction (Finland 2009, Appendix 3, Annex 3).

These standards were somewhat less demanding than before but still went well beyond the status quo. The companies Evac (2009) and Hamann (2009) confirmed that their future equipment would be able to meet these requirements. By contrast, the British manufacturer Hamworthy (2009, 16) reported that its trials had not proven the feasibility of the proposed standards. Especially, it noted the challenges in applying advanced onshore wastewater treatment technologies onboard ships (HELCOM 2015b, para. 4.8). As a consequence, the HELCOM countries stuck to the original performance data provided by Evac but built a safety margin into the standards (Interview 2). This was a pragmatic choice which was guided by the idea that the best internationally feasible standard should be adopted (Interview 3). The cruise industry strongly objected to the amended standards by stressing the total lack of advanced technology tested on large cruise ships (HELCOM 2015b, 4.11). Interferry was not directly involved in the question of nutrient standards but held the general view that discharges of sewage from ships should be addressed by an upgrading of port reception facilities rather than ship-side regulation (Interview 9) (see Table 11).

Table 11: Business practices and expertise in sewage treatment, 2007-2009

Progressive	**2 equipment manufacturers, partly referenced in VTT research report** Evac (Finland), Hamann (Germany) **15 shipping lines, under voluntary program of WWF** Bornholmstrafiken, Molslinien (Denmark); Lindaliini, Tallink (Estonia); Birka Line, Eckerö Line, Nordic Jetline, Silja Line, Seawind Line, Viking Line (Finland); Aida, Peter Deilmann Reederei (Germany); Colorline, Hurtigruten (Norway); Rederi AB Gotland and Destination Gotland (Sweden)
Unprogressive	**2 business associations** Cruise Lines International Association (CLIA) / European Cruise Council (ECC), Interferry **1 equipment manufacturer** Hamworthy (UK)

Source: Author. Information on progressive shipping lines from WWF (2007; 2008).

Policymakers largely followed the expertise provided by the progressive equipment manufacturers for several reasons. First, Evac had demonstrated that a pilot plant installed in its offices met the proposed standards (Interview 2). The negative assessment provided by Hamworthy was less tangible and mainly seemed to reflect differences in innovation across firms (Interview 2). Second, Hamann announced plans to scale up its new system for ships carrying up to 1,200 passengers (HELCOM 2015b, para. 4.6). This was consistent with CLIA's earlier estimate that nutrient removal technology for cruise ships was within reach. Third, the two manufacturers did not conceal that their systems needed further design improvements, scaling up, and shipboard testing (HELCOM 2015b, para. 4.6-4.7). This remaining uncertainty was addressed through the addition of a safety margin and other amendments to the standards. For example, as proposed by the manufacturers, the requirements came to feature both maximum effluent concentrations and reduction limits in order to account for variable sewage characteristics (Evac Oy 2009, 5; HELCOM 2015b, para. 4.7).

Other regulatory design decisions facilitated the agreement on the relatively demanding standards. The draft proposal for the new regulation still left enough time for testing the new technology on ships. Prior to the decision on nutrient standards, the proposed application dates for new and existing ships had been moved to 2013 and 2018, respectively (Finland and Russia 2009 Appendix 1, Annex 1). Moreover, contentious monitoring aspects were not discussed. The existing type approval system allows for the use of equipment that meets effluent limits under laboratory conditions but not necessarily in real life (Netherlands 2017; Interview 4; Interview 8). Yet, the issue of tightening the type approval system for sewage treatment plants or even replacing it by continuous compliance monitoring was left out of the negotiations. These aspects may have made it easier for states to agree on demanding requirements.

Still, the decisive push for the nutrient limits came from the tangible evidence presented by innovative equipment manufacturers. Together with the progressive practices voluntarily adopted by many shipping companies, this greatly supported the move towards regulation. At the end of the preparation phase in 2009, the member states of HELCOM jointly submitted their proposal for nutrient regulation to the IMO. In meetings of the global shipping regulator, technological arguing intensified from 2010 onwards.

The Fourth Key Moment

At the branching point in 2012, technological arguing contributed to building a narrow majority of IMO delegations in support of the demanding standards. The initial situation in the IMO was as follows: Finland, supported by the Baltic Sea states, proposed a regulation with relatively demanding nutrient limits (max. 20 milligram nitrogen per liter or at least 70 % reduction and max. 1.0 milligram phosphorus per liter or at least 80 % reduction) (Denmark et al. 2010a, para. 7; 2010b, para. 8). Together with CLIA, the Bahamas, Liberia, and the Marshall Islands opposed this proposal and pushed for less demanding nutrient limits (max. 35 milligram nitrogen per liter or at least 30 % reduction and max. 2.0 milligram phosphorus per liter or at least 70 % reduction) (Bahamas et al. 2010a; 2010c; 2011, para. 3; Germany 2011, para. 10.1; Interview 3). Major non-European flag states, like Panama, and shipowners represented by ICS shared this view (Interview 3; Interview 7). The persuasion and mobilization of audience states by means of technology-related arguments and evidence were important elements in the decision-making on these two options.

Throughout the negotiations in the IMO, reluctant flag states and the cruise industry repeatedly raised concerns about the availability of compliant treatment technology. This led to the drafting and adoption of an MEPC resolution which called “for the development, without delay, of proven, adequate and cost-effective technical onboard equipment to make it possible to meet the discharge standards under regulation 11.3 of

MARPOL Annex IV" (IMO 2012c; 2011d, para. 6.37.8). The opponent coalition continued to argue that the demanding standards proposed by the Baltic Sea states were aspirational and therefore not necessarily achievable and practicable (IMO 2012d, para. 11.18). The cruise industry noted that some already available advanced wastewater treatments systems might be able to comply with the less demanding standards but not with the more demanding ones (CLIA 2012, paras. 10–11).

These arguments were contradicted by equipment manufacturers in control of innovation. The proponent delegations behind the more demanding requirements "stressed that a number of the companies (at least six) had indicated that the proposed standards were achievable, and that onshore equipment could be designed for marine use and made available before the application date for those standards" (IMO 2012d, para. 11.17). The cruise industry attempted to question the credibility of this information by stressing various weaknesses and uncertainties (CLIA 2012, para. 14): that only three out of the six manufacturers had conducted partial testing of new equipment; and that it was still uncertain whether, once in operation, this equipment would really meet the new standards. It suggested that, in the type approval tests, the "use of geometric mean was essential to achieving the proposed discharge standard for nutrients" (CLIA 2012, para. 14). At the same time, it had to concede that "one manufacturer has accepted an order to deliver an AWTS [advanced wastewater treatment system] to meet the more stringent of the two proposed nutrient standards" (CLIA 2012, para. 14). Precisely this order was going to seriously compromise the argumentative power of the cruise sector.

The cruise industry failed to prevent the more demanding standards because its concerns were partly accommodated in the regulatory provisions and because some of its arguments were at odds with emerging business practices. The delegations effectively responded to the observations on trial results by deciding to use the geometric mean for determining compliance (IMO 2012d, para. 11.60.1). This meant that test results now confirmed the feasibility of the more demanding standards. Moreover, information about an order of compliant equipment contradicted CLIA's claim that such equipment was not yet available. Concerns about the equipment's actual performance were effectively addressed by the decision to review the standards in 2014. The purpose of this review was "to determine that the required removal standards for Nitrogen and Phosphorus are met by type approved sewage treatment plants" (IMO 2012d, para. 11.60.3). This arrangement promised that regulation would only require what was technically achievable. Finally, a previous decision to relax the application dates for new ships by two years provided additional leeway for technology testing and implementation (IMO 2011d, para. 6.9-6.11).

The arguments and accommodating moves of the proponents were important factors for the adoption of the more demanding nutrient limits. Although the IMO formally strives for consensus, de-facto majority decision-making without formal voting is a frequent practice in MEPC. The chairman of the committee informally counts the interventions made for or against a policy proposal to determine the outcome. This approach is typically applied when policy positions are clearly opposed on a specific question like the nutrient limits. One decision-maker confessed that, for the mobilization of the narrow majority in support of the more demanding standards, "it was important that technology was not only available in theory but also in practice" (Interview 2).[55] By implication, failure to demonstrate the availability of compliant technology would have weakened the argumentative power of proponents and might thus have tipped the scales in favor of the less demanding standards. This aspect becomes even more visible when examining the review of the nutrient limits in 2014.

The Fifth Key Moment

At the critical moment in 2014, different modes of technological arguing increased the number of IMO delegations that supported retaining the demanding nutrient limits. The majority in favor of demanding limits was much more solid at MEPC 67 than at MEPC 64: eleven states supported the demanding standards; only four opposed them (IMO 2014b). The supporters were several European delegations inside and outside of the Baltic Sea region (see Table 12). The Marshall Islands, a former opponent, stopped objecting the more demanding standards. Some skeptical delegations, such as China and the UK, proposed to delay the decision rather than to amend the standards. The increased support for and reduced opposition to the demanding requirements is not self-evident considering that the IMO has a strong representation of shipping interests. Observed shifts in state positions cannot be traced back to material interests as these are unlikely to have changed in between the decision and review of the nutrient standards. Instead, preferences mainly seem to have been amplified (or attenuated) by argumentative (de-) mobilization in conjunction with new first-mover business practices. Moreover, skillful

[55] Note that no written or recorded information exists on the complete list of states which supported the more and the less demanding standard options at that time. Interviewees also did not reliably remember this information. Accordingly, I focus my analysis on those states that took a position in the 2014 review.

argumentation by proponents made it more difficult for opponents to sustain their position and partly coerced them into accepting the more demanding standards.

Table 12: Growing support of IMO member states for demanding nutrient standards, 2010-2014

	Continued support for more stringent regulation	**Increasing support for / less opposition to more stringent regulation**	
Proponents	**Finland**	**Norway**	
Opponents	-		**Marshall Islands**
Audience	Denmark Estonia Germany Sweden	Cyprus France Greece Ireland Italy	China UK

Source: Author.

The review of the nitrogen and phosphorus removal standards built upon previous technological arguments. In a document submitted to MEPC 67, CLIA again claimed that compliant equipment was not available. The association was "not aware of any sewage treatment plant currently fitted to a CLIA member line ship in service having been issued a Type Approval Certificate by the ship's Administration to meet the more stringent standards for nitrogen and phosphorus" (CLIA 2014a, para. 7). However, it conceded that certain systems had "undergone a preliminary evaluation to assess whether it could be possible to seek future type approval" (CLIA 2014a, para. 8). It also admitted that it had knowledge "of certain sewage treatment plants currently fitted to CLIA member ships in service having potential for enhanced nitrogen and phosphorus removal, which have not undergone any onboard testing" (CLIA 2014a, para. 9). In essence, CLIA argued that, despite some progress made, one could not be sure that available equipment would meet the current standards. It therefore suggested adopting the less demanding standards proposed earlier (CLIA 2014a, para. 10).

These arguments were challenged by evidence provided by Finland and Norway. Their submission explained that systems from two suppliers met the demanding nutrient standards and had obtained type approval in accordance with the revised guidelines (Finland and Norway 2014, para. 5). The system of the Finnish company Evac had been tested and the system of the Norwegian company Scanship was already in operation at two large new cruise ships. Both systems were reported to fulfill the standards with a "good margin" (Finland and Norway 2014, para. 8). In addition, the document listed 11 additional cruise ships launched between 2013 and 2017 for which the installation of the Scanship system was planned (Finland and Norway 2014, annex 2, 3). These ships were being built by shipyards in Germany, Italy, and Finland, which are responsible for the subcontracting and installation of the sewage treatment plant. The ship projects belonged to five leading cruise lines (see Table 13). These companies were largely acting in anticipation of new regulation as to avoid difficult retrofitting of brand-new ships and partly also to retain their "green" image (Interview 6; Interview 7). To the policymakers, however, information on these projects proved that compliant equipment was available and taken up by the industry (Interview 3).

Table 13: Business practices and expertise in sewage treatment, 2014

Progressive	**6 equipment suppliers** Evac (Finland), Hamann (Germany), Scanship (Norway), Veolia (France), 2 unknown suppliers (Europe/US)
	5 cruise lines Carnival Cruise Line, Norwegian Cruise Lines, Royal Caribbean International (US); TUI Cruises (Germany); Viking Ocean Cruises (Switzerland)
	3 shipyards Fincantieri (Italy), Meyer Werft (Germany), STX Finland (Finland)
Unprogressive	**3 business associations** CLIA/ECC, International Chamber of Shipping (ICS), Community of European Shipyards' Associations (CESA)
	1 equipment manufacturer Hamworthy (UK)

Source: Author. Information on cruise lines and shipyards from Finland and Norway (2014, annex 2, 3).

The relevance of this information is illustrated by the fact that CLIA quickly responded by preparing another commenting document. CLIA now argued that the available equipment did not match industry needs. This argument had two legs: the lack of equipment with suitable treatment capacity and the lack of type approval. With respect to the Evac system, CLIA argued that this system "is suitable for approximately 20 persons, well below the typical number of persons on passenger ships in the Baltic Sea" (CLIA 2014b, para. 3.3). It reported that, according to its information, the system had not yet been certified to the new nutrient standards (CLIA 2014b, para. 3.1). With respect to the

Scanship system, CLIA observed that the system was "suitable for more than 5,000 persons, well above the typical number of persons on passenger ships in the Baltic Sea" (CLIA 2014b, para. 4.3). It contended that the system had not been certified to the new guidelines either and that available test results did not conform to type approval procedures (CLIA 2014b, para. 4.4, 5).

Both legs of the cruise industry's argumentation broke down during MEPC 67 because of the role of first-mover practices. The first leg—absence of type-approved equipment—already collapsed before deliberations took off. In the lunch break of the first meeting day, the manufacturers Scanship and Evac gave presentations on their treatment systems. These kinds of presentations are attended by interested members of delegations and may thereby come to influence regulatory discussions. In the presentation, Scanship informed about the type approval of its system by a classification society on behalf of the Norwegian administration. When CLIA was introducing its documents later in the deliberations, it had to concede that type-approved equipment *may* indeed exist. Norway quickly clarified that type approval had been granted based on a system installed onboard a ship of Norwegian Cruise Lines, which is a member line of CLIA. The fact that one of its member lines had in operation compliant equipment severely undermined the doubts expressed by CLIA on the availability of such equipment. Norway also clarified that the test procedures employed in the type approval were in line with the guidelines. In the ensuing discussions, no delegation challenged any of these specific points. Instead, several supporters of the demanding nutrient standards referred to the information provided by Finland and Norway to justify their position (Finland and Norway 2014; IMO 2014b).

The second leg of CLIA's argument—lack of suitable equipment—was also undermined by first-mover practices. Norway noted that it had type-approved not a single system but rather a series of systems which, according to Scanship, were suitable for ships with 150 to 10,000 passengers. This covered all sizes of cruise ships typically sailing in the Baltic Sea. Neither CLIA nor any state delegation critically commented on this specific point. The shipbuilding industry raised some doubts on available capacities but did not call for revising the agreed standards. Again, several supporters referred to the information that suitable equipment was available to justify their position (IMO 2014b). The table provided by Finland and Norway on new cruise ships that were going to use the new systems was a powerful tool in this respect. CLIA seemed to realize this; it called the table "misleading" and invited Finland and Norway to consider withdrawing it (CLIA 2014b, para. 6.1). Despite this highly unusual request, CLIA only showed for a single ship that the information provided was probably misleading. This was insufficient for calling into question the accuracy of information on all other ship projects.

Table 14: IMO member state positions in the review of the nutrient standards, 2014

	Supported demanding standards	**No position taken**	**Skeptical position: post-pone decision**	**Opposed demanding standards**
Proponents	**Finland** **Norway**	-	-	-
Opponents	-	**Marshall Isl.**	-	**Bahamas** **Liberia**
Audience	Cyprus Denmark Estonia France Germany Greece Ireland Italy Sweden	Latvia Lithuania Poland Russia +all other IMO member states	China UK	Dominica Panama

Source: Author. Positions according to IMO (2014b).

That some of CLIA member lines seemed to already be doing what CLIA representatives argued was infeasible greatly weakened the latter's argumentative power. Put differently, the corporate environmental strategies of individual cruise lines which were anticipating potential future regulation clashed with the political strategy of their sectoral interest group. The technology uptake by major first-mover cruise lines represented strong evidence that tipped the scales in technological arguing towards support for the demanding nutrient standards. As a result, the proponents of the demanding nutrient limits were able to mobilize support by Cyprus, France, Greece, Ireland, and Italy (see Table 14). The opponent coalition eroded, and potentially unfavorable audience states were demobilized.[56] Of course, the mobilization of other EU countries could also be interpreted as a successful interest-based alliance (Interview 6). However, cross-issue trades explaining this support are not obvious and the limited number of supporting EU

[56] Although Russia did not articulate a position in MEPC 67, it later expressed a skeptical view in HELCOM regarding the availability and affordability of compliant treatment plants (HELCOM 2015b, para. 5.3; 2015c, para. 2.38). However, this position did not directly relate to the question of nutrient limits, but rather to the entry into effect of the Baltic Sea special area (see also fn. below).

countries suggests that this was not a fully coordinated exercise of EU power.[57] In my interpretation, these countries were generally favorable to the position of the Baltic Sea states. The reasons are a shared awareness for the problem of eutrophication and regular exchanges in the context of EU coordination meetings (Interview 1). Yet, one interviewee claimed that for the mobilization of these favorable audience states, "[information on type-approved equipment of] Scanship was the decisive impetus" (Interview 3).

Careful counterfactual reasoning supports the importance of the argumentative power that arose from progressive first-mover practices. Without information on type-approved equipment, the discussion at MEPC 67 would have taken place under a different frame. Notably, the key question would have been whether the IMO should confirm a standard for which no compliant equipment was available yet. The outcome of such a discussion cannot be predicted with certainty. However, it would have most likely drawn in other non-European flag states that are generally skeptical of aspirational standards. The reason is that such standards create high regulatory uncertainty for shipowners which are dependent on compliant equipment from suppliers. The more principled nature of such a discussion would have had the potential to turn the tide back to the less demanding nutrient requirements.

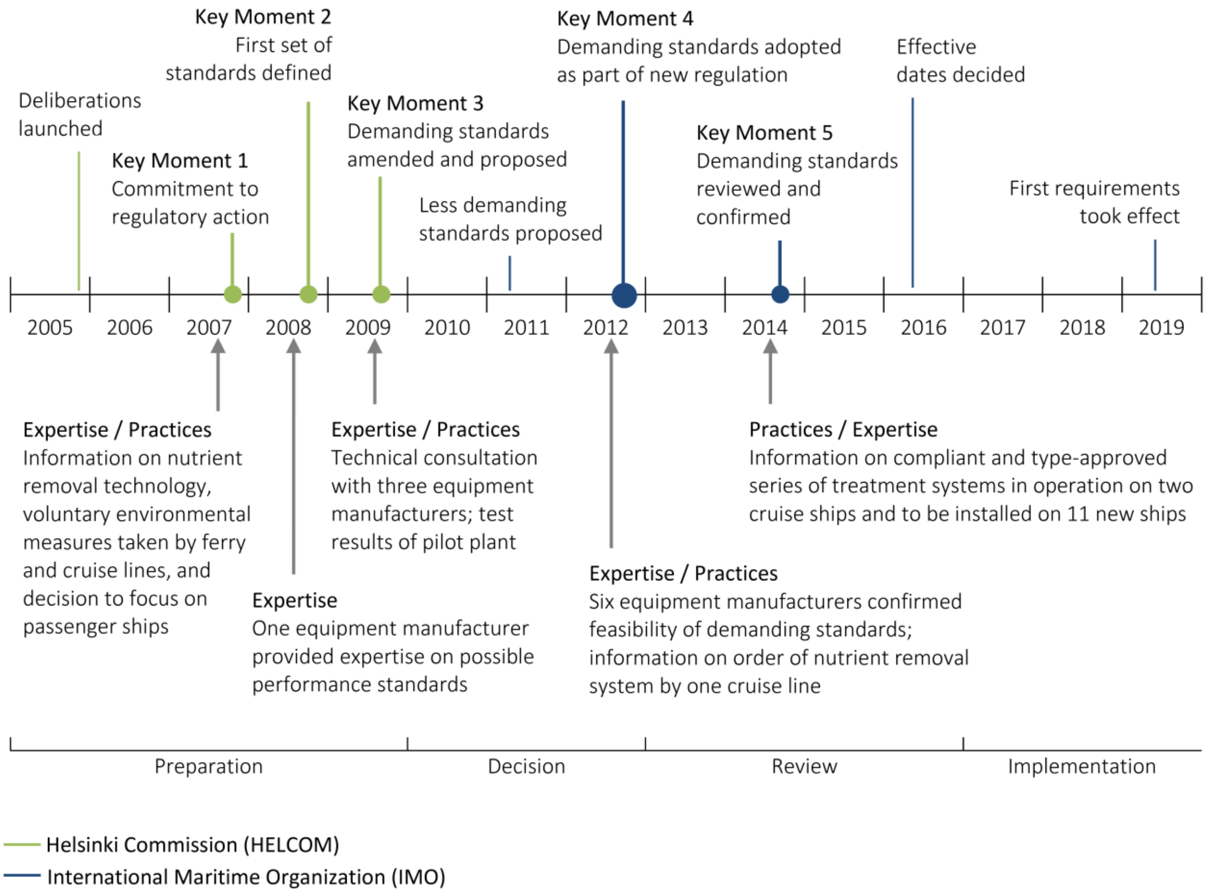
Summary

The application of argumentative coproduction elucidates the dependency of regulatory proposals and decisions on technological business expertise. Expertise provided by innovative equipment manufacturers influenced the nutrient limits that were proposed by the Baltic Sea states and later adopted by the IMO (see Figure 18). In the negotiations at the IMO, arguing over the technological feasibility of these limits became particularly intense. The proponents of demanding nutrient removal requirements faced feasibility-related counterarguments from the cruise industry and some major flag states. Ironically, the decisive piece of evidence that tipped the balance in favor of the more demanding standards was the uptake of new nutrient removal technology by a leading cruise company. This involuntary first-mover practice undermined the credibility of the arguments

[57] This can be contrasted with a concerted initiative by all EU member states and the European Commission in 2016. By threatening to go it alone, they attempted to push through the entry into effect of the special area regulation against the will of Russia (Austria et al. 2015). However, the disagreement here mainly related to port reception facilities rather than the nutrient limits. As noted earlier, the Baltic Sea states then agreed on a comprise that made limited material concessions to Russia's economic concerns.

put forward by the cruise industry association and states opposing demanding nutrient requirements. This helped mobilizing the necessary support for the confirmation of the demanding requirements by the IMO, while also demobilizing opposition to it. The new requirements have already begun to reinforce the technological innovations that inspired them beyond initial first movers. For instance, one equipment manufacturer which initially deemed the adopted nutrient limits too demanding today is selling equipment in compliance with them (Interview 4).

Figure 18: Business influence at key moments in nutrient regulation for the Baltic Sea



Source: Author.

The Explanatory Power of the Three Models Compared

How and to what extent can the practices and political influence of equipment manufacturers and cruise lines explain the contentious choice of the more demanding nutrient limits? This section takes stock of the explanatory power of the three theoretical approaches. The ideational-interventionist approach understands the actor constellation in the negotiations as a war of position. This captures the conflict between economic and environmental interests but neglects the role of equipment suppliers. The conflicting state positions in this war of position can partly be explained by differences in causal ideas and norms. By contrast, idea- and norm-based leadership by the WWF and research organizations was not particularly strong. Although framed in support of regulation, research findings on the small contribution of shipping to eutrophication of the Baltic Sea cannot count as a main driver of demanding nutrient requirements. Ideational interventionism adequately captures the response of hegemonic business actors to the threat of regulation. I showed that this response consisted of the provision of counter-expertise, efforts of accommodation through corporate environmental management, and intense technology lobbying. Again, the more constructive role of the equipment suppliers risks being neglected though. Moreover, it is surprising that the initially dominant business actors failed to prevent or preempt the adoption and confirmation of demanding nutrient limits. A piece of smoking gun evidence for the disruptive impact of environmental crisis is the observation that media reports about sewage discharges triggered the Finnish initiative in HELCOM. However, a sense of environmental crisis does not explain later developments in the decision and review of regulation. Moreover, the resulting regulation was not technology-forcing in the strict sense as the development of advanced nutrient removal technology had already begun before its eventual confirmation. In the language of process tracing, several ideational-interventionist predictions empirically do not jump through the hoop.

Similarly, the material-evolutionist approach only accounts for part of the empirical observations. The notion of business conflict is very useful for capturing the diverging positions of advanced equipment manufacturers and the reluctant cruise industry. A clear alignment of state preferences with dominant domestic business interests was seen in some, but not all, major flag states of the cruise industry and in a few host countries of equipment manufacturers. Especially states with strong economic interests in cruise shipping readily took up skeptical ideas advocated by the sector's interest group. The technological power of the equipment suppliers created possibilities for demanding nutrient requirements but alone cannot explain their adoption and confirmation by a majority of states. Interest-based leadership played some role in winning support for nutrient regulation. A piece of smoking gun evidence is the greater support for regulation following its restriction to passenger ships. However, it is deeply puzzling for material evolutionism that the cruise industry with its superior instrumental, structural, and discursive power resource lost the struggle over the level of new nutrient limits. The business Davids from the equipment industry won against the Goliaths from shipping. The result was a regulation that did not just follow the preferred practices of large businesses. This means that important material-evolutionist predictions do not leap through the empirical hoops. Thus, empirical observations are only partly congruent with both the ideational-interventionist and material-evolutionist model (see Table 15).

Table 15: Congruence of theoretical predictions and empirical observations in nutrient regulation

	Ideational interventionism	Material evolutionism	Argumentative coproduction
Actor constellation	Medium	High	High
Roots of different state preferences	Medium	High/Medium	Medium
Driver of change in state positions	Low	Medium	High/Medium
Role of business in regulation	Medium	High/Medium	High
Conditions for emergence of more stringent regulation	Medium	Low	High
Character of regulatory outcome	Low	Low	High
Overall congruence	**Medium/Low**	**Medium**	**High**

Source: Author.

The analysis showed that the model of argumentative coproduction can fill the explanatory gaps left by ideational interventionism and material evolutionism. Its notion of argumentative contests in which states take different roles accounts well for the observation that some states were leading the discussions and others were more reactive. Arguing between proponents and opponents of demanding nutrient limits took place through written submissions as well as oral interventions. States with different policy preferences seem to have held different views about both the need for regulation and the feasibility of demanding nutrient limits. This expectation has not been probed exhaustively though as I did not analyze the domestic process in all the countries involved. The analysis confirmed the central prediction of my model that new technological arguments and evidence can trigger changes in state positions. The support of the Baltic Sea states for nutrient regulation grew after they had learnt about voluntary reductions of sewage discharges by cruise and ferry companies. Even more importantly, the support for the more demanding nutrient limits in the IMO in 2012 and 2014 relied on evidence about the availability of compliant treatment technology.

The main source of proponent and opponent arguments about regulatory feasibility was the expertise provided by equipment manufacturers and the cruise industry association. Their competing expertise reflected conflicting material interests as demanding nutrient limits would benefit advanced equipment suppliers and create additional costs for cruise companies. A piece of smoking gun evidence for the high relevance of business expertise is the initial copy-pasting of performance data from an equipment manufacturer into the HELCOM policy proposal. Beyond that, the analysis also suggests that states acted as gatekeepers in stakeholder involvement and can be sources of authoritative information. For instance, Finland and Norway provided powerful arguments in support of the more demanding standards based on information about equipment that had been type approved by their administrations.

The analysis further confirmed that first-mover practices can tip the balance in tense argumentative contests. In 2012, evidence on the development of advanced treatment technology by a few equipment manufacturers was sufficient to mobilize a very thin a majority in support of the demanding nutrient limits. In 2014, information on the uptake of the new treatment technology by a major cruise line seriously undermined the argumentative power of the cruise sector association. It can be counted as smoking gun evidence that shortly thereafter a much larger majority of states than before backed the demanding nutrient standards. These standards reinforce the technology that equipment manufacturers began to develop early in the process. In parallel to the regulatory negotiations, the technology emerged from a niche innovation into a product that leading market actors were ready to adopt. Without the anticipation of regulation, however, it is unlikely that cruise companies would have adopted the frontrunner practices that are now set to become the new normal in the sector. Business practices and regulation thus coproduced each other, and arguments about technology played a crucial role in this process. Overall, the empirical observations show a higher congruence with the theoretical predictions of argumentative coproduction than with those of the alternative models.

Case Summary

I probed my argument using the case of new nutrient removal standards for sewage discharges from passenger ships in the Baltic Sea that became effective in 2019. Nutrients like nitrogen and phosphorus contribute to the eutrophication of the Baltic Sea. Eutrophication is a serious environmental problem in most closed or semi-enclosed seas and in many coastal waters where it leads to the spread of dead zones (WRI 2013). Beyond its environmental relevance, the case approximates the typical conditions for argumentative coproduction. It is technology-centered, with innovation in environmental technology occurring in the beginning of a process that produced regulation with relatively demanding requirements. The case also features common patterns of international shipping regulation, including the recurring conflict between flag and coastal states, the trend of regionalization, and the interplay between regional institutions and the IMO. In the case study, I traced the preparation, adoption, and confirmation of nutrient standards for sewage treatment plants by HELCOM and the IMO.

The case study showed that argumentative coproduction played a key role in the choice of relatively demanding standards. Underlying the regulatory process was a business conflict between progressive manufacturers of advanced wastewater treatment systems and reluctant cruise lines. The technological innovation that came to disrupt regulatory politics had its origin in a small number of medium-sized equipment producers. By ideational-interventionist and material-evolutionist measures, these firms should not have prevailed over the powerful cruise sector. By measures of argumentative coproduction, however, their corporate expertise was a powerful source of influence. I found that references to existing and emerging business practices successfully mobilized a majority of states in support of a regulation with rather demanding nutrient standards. Strikingly, the credibility of arguments advanced by the cruise sector association was severely undermined by progressive environmental practices of one of its member companies. Technological arguing thus linked the decisions of state delegates at the IMO in London back to corporate practices "on the ground."

Having demonstrated the explanatory power of argumentative coproduction in a typical case, I want to probe it in less favorable conditions next. The idea is to apply the theory in a context where technological innovation and arguing seem less pivotal for enabling the adoption of stringent regulation. At the same time, the material stakes and the level of environmental vulnerability should be higher to render the operation of material-evolutionist and ideational-interventionist mechanisms more likely. These conditions are fulfilled in the regulation of heavy fuel oil (HFO) as ship fuel in the Arctic. Compared to nutrient regulation in the Baltic Sea, this case varies some contextual aspects, including the regional institution involved and the most contentious design element in the negotiations. It is also about a region that is farther away from the IMO meeting halls in London and still less used by maritime shipping than the Baltic Sea. Have feasibility arguments and first-mover business practices mattered equally much in the negotiations of this Arctic regulation? The following case study provides an answer to this question.

6 Case Study: Heavy Fuel Oil in Arctic Shipping

In 2018, the IMO decided to develop a binding regulation that will ban the use of Heavy Fuel Oil (HFO) as fuel by ships in the Arctic.[58] This ban will reduce environmental damages of accidental fuel spills and operational emissions of climate-forcing black carbon. For more than a decade, the adoption of a mandatory ban has been contentious in international negotiations. Many states initially opposed binding HFO regulation. This led to the adoption of a nonbinding provision in 2014 which recommends refraining from the use of HFO in the Arctic. Since then, state support for a mandatory ban has grown but new disagreements have emerged as to whether and which ships should be eligible for temporary exemptions. As of February 2020, a broadly supported compromise tabled for adoption by the IMO foresees the possibility of far-reaching exemptions for existing ships. In this case study, I am going to demonstrate that ideational-interventionist and material-evolutionist lenses only capture part of the process that produced this emerging outcome. Environmentalists won the conflict over binding regulation by creating a sense of crisis but are about to lose the struggle over its scope. Structurally powerful business interests initially prevented an HFO ban but have lost influence in recent years. This chapter shows that argumentative coproduction can fill some of these explanatory gaps.

The chapter proceeds in six steps. First, I describe the environmental problems caused by HFO use in Arctic shipping and the regulatory responses of the IMO. Second, I recapitulate the defining case properties and report the sources used. Third, I identify key moments in the international negotiations about HFO regulation and outline a storyline that links them together. Fourth, I seek to explain the processes and outcomes observed at these key moments through the lenses of ideational interventionism and material evolutionism. Fifth, I reexamine the same storyline from the perspective of argumentative coproduction. I show that the voluntary phaseout of HFO by ever more shipping companies has supported arguments for a mandatory HFO ban. Persistent technical and affordability barriers to a fuel change faced by some existing ships are mirrored in extensive temporary exemptions. Sixth, I put the explanatory power of all three theoretical models in comparative perspective. Argumentative coproduction accounts

[58] Among the various definitions of the Arctic region, I follow the one applied by the IMO in shipping regulation (MARPOL 2019, Annex I, reg. 46.2; cf. Hofmann 2019, 216–17). Note that this definition has been criticized for leaving out areas that could be considered part of the Arctic for ecological reasons (Comer 2020).

relatively well for the empirical storyline, but certain observations are better explained by ideational interventionism and material evolutionism.

Reducing Oil Spill Damages and Black Carbon: The Regulation of Heavy Fuel Oil Use

The case study deals with the regulation of the use of HFO as fuel by ships in Arctic waters. The use of HFO by ships raises environmental concerns with respect to accidental and operational impacts. Heavy fuel oil is a residual from the distillation of crude oil in refineries. In case of accidental spillage, it is more harmful than lighter distillate fuel and difficult to clean up in harsh Arctic conditions (DNV 2011, 38–40; Comer et al. 2017, 2). During normal operations, incomplete combustion of HFO leads to emissions of black carbon (Comer, Olmer, and Mao 2016, 2). Black carbon contributes to climate change in the Arctic as its deposition on ice and snow increases sunlight absorption and warming (Comer et al. 2017, 3; DNV 2011, 43). It is also a component of particulate matter causing adverse human health impacts and premature mortality (Corbett et al. 2007). All these impacts will increase in conjunction with the expected growth of shipping activity in less ice-covered Arctic waters (IPCC 2019, 235–36; Ørts Hansen et al. 2016). A switch from HFO to distillate or alternative fuels could reduce both damages from accidental spills and fleet-wide emissions of black carbon.[59]

International regulation of HFO use in Arctic shipping has changed over time. In 2009, the policy instrument applicable to polar shipping touched upon the use of heavy grade oils but did not regulate it (IMO 2010b, sec. 16.3). In 2014/15, the IMO adopted the International Code for Ships Operating in Polar Waters (Polar Code) which contains a provision on the use of HFO (IMO 2015b, part II-B, para. 1.1). The formal tightness of this provision is low. It is contained in the nonmandatory part of Polar Code and uses nonbinding language. Ships operating in the Arctic "are encouraged" to apply the regulation banning HFO use in the Antarctic, for which a precise reference is given. The application of this recommendation is not subject to any monitoring system. By contrast, the substantive ambition of the provision is high. It has a large scope because it covers all ships. It calls for a substantial reduction in environmental impact by phasing out HFO while still allowing the use of other fossil fuels. Together with the regulation in force for Antarctica, it is the only international regulation that restricts HFO use by ships.

[59] There is an ongoing debate about the reduction of black carbon from such a fuel switch. One scientific estimate is that a phaseout of HFO would lead to a fleet-wide reduction of black carbon by one third (Lack 2017).

With its low tightness and high ambition, the currently applicable HFO regulation achieves an intermediate level of stringency.

The regulatory situation is set to change. In 2018, the IMO agreed to develop a mandatory ban on the use of HFO as a fuel in Arctic shipping. The adoption of the ban is still pending, but the current draft regulation aims at high formal tightness (IMO 2020f; 2020g, annex 12). The ban is proposed to be incorporated into the binding MARPOL Annex I. It contains a precise definition of HFO and an unambiguous prohibition of its use and carriage for use as fuel by ships in a geographically clearly delineated area. Like other provisions of MARPOL Annex I, compliance with the ban will be monitored through occasional port state controls. The draft regulation is thus binding, precise, and endowed with a weak monitoring and enforcement system. At the same time, its substantive ambition is only intermediate. The initial regulatory scope would be rather narrow as ships with fuel oil tank protection as well as ships flying the flag of an Arctic state and operating in its waters would or could be exempted from the requirements until 2029 (cf. Comer 2020). The level of the regulatory requirements in terms of externality reduction and in international comparison will remain intermediate and high, respectively. With its high tightness and intermediate ambition, the draft regulation overall scores higher than the current recommendation but is still on an intermediate level of stringency. It will achieve high stringency only when its requirements begin to apply to all ships from 2029. This will mark the preliminary endpoint of a transition from non-regulation to a policy with intermediate stringency and further towards stringent regulation.

The regulatory transition has involved negotiations at the Arctic Council and the IMO since 2009. The end of my observation period is February 2020 when a draft regulation for adoption later in 2020 or 2021 was agreed.[60] The Arctic Council is a consensus-based regional forum of the eight Arctic states (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the US), with permanent participation of six indigenous organizations (Ottawa Declaration 1996 art. 2, 7). The purpose of the organization is to promote "cooperation, coordination and interaction […] on common Arctic issues […], in particular issues of sustainable development and environmental protection in the Arctic" (Ottawa Declaration 1996, art. 1(a)). Its institutional structure consists of ministerial meetings, meetings of Senior Arctic Officials, working groups, and dedicated task forces

[60] Adoption was initially planned for MEPC 76 in October 2020. However, due to the COVID-19 pandemic, it is currently unclear when the IMO will be able to resume its meetings and discuss the draft regulation.

and expert groups. Shipping issues are covered by the Protection of Arctic Marine Environment (PAME) working group. The Arctic Council has a small permanent secretariat in Tromsø, Norway, but PAME has its own tiny secretariat in Akureyri, Iceland. Observers of the Arctic Council include thirteen non-Arctic states and a dozen mostly science- and environment-related NGOs (Arctic Council 2020). Maritime industry associations may be invited to expert forums, like the Shipping Expert Group, on a case-by-case basis. Observers may submit written documents and make oral statements at the discretion of the chair (Arctic Council 2016, 9, 12).

The description of the IMO and its structure that I provided in the previous chapter also applies here. However, the relationship of the IMO with the Arctic Council differs from its relations with HELCOM. The reason is that HELCOM has acted, at least occasionally, as a regional shipping regulator in the past. By contrast, the Arctic Council assumes a generative rather than regulatory role with respect to shipping (O. R. Young 2016). It has been argued that, through knowledge- and consensus-building among its members, the Arctic Council could support regulatory initiatives for Arctic shipping by the IMO (Stokke 2013). The IMO holds observer status at the Arctic Council, but not vice versa.

A very contentious issue in the IMO, and to some extent also in the Arctic Council, was the question of whether the use of HFO as fuel by ships should be legally banned in the Arctic.[61] The idea of a mandatory ban initially found little support among the members of both organizations. Only a few years later, however, an increasing number of states came to support a ban, while some Arctic states remained opposed to banning HFO use for all ships. In this context, the scope of the ban, i.e., to how many ships it will apply and from when, has become increasingly contentious. The discussions reflected two lines of conflict: between the environmental purposes advocated by activists and scientists and the economic interests of major parts of the shipping industry; and between a few progressive shipping companies and their more numerous reluctant counterparts. The emerging ban suggests that environmental interests and the limited number of progressive business actors managed to turn the tide. At the same time, the extensive temporary exemptions indicate that their victory is a limited one. Subsequently, I analyze changes in the support for a binding HFO ban between 2009-2014 and 2015-2020, including the recent struggle over temporary exemptions.

[61] There has been a related discussion on banning the transport of HFO as cargo by ships in the Arctic which also poses spill risks. This case study focuses on the use and carriage for use of HFO as fuel. It only refers to transport as cargo where this was linked to the case at hand.

Case Properties and Material

From an outside view, argumentative coproduction is a priori less likely to operate in the regulation of HFO in Arctic shipping than in the previous case. Although it is known that some companies have already switched to HFO in the Arctic, the relevance of that for the political discussions is unclear. The emerging regulatory outcome with its extensive exemptions does not seem to translate these new business practices into a general requirement. The scope conditions of my model are mostly present but not identical with the first case. An HFO ban would require a fuel switch but, given that lighter fossil fuels have been used in shipping for a long time, not the development of new technology. Regulatory negotiations took place in two organizations that grant business very different degrees of access. Some presence of audience states in these organizations can be expected because of the regional ambit of the regulation, even though the prospects of major trans-Arctic shipping routes suggest that the effects of a ban may extend to non-Arctic states. In comparison to the first case study, however, the mobilization of economic and environmental interests is presumably higher given the strategic importance of the Arctic and the symbolic value of its ecosystems (Blunden 2012; Hough 2013, 7; Keil 2019). The case also varies some contextual conditions in comparison to the previous one, including more complex material interests, less marine use at present, and a softer regional governance framework.

The within-case analysis probes the congruence of theoretical predictions and empirical observations and traces the causal processes. The basis for this is a storyline built around two types of key moments in the process. Branching points refer to a major decision or non-decision to embark on a specific regulatory pathway in a situation where at least one alternative pathway seemed possible. Critical moments are decisive points that prepare branching points or confirm, reinforce, or specify decisions taken at them. I use this storyline to deduce specific predictions from the three theoretical models about observable processes and outcomes. For each model, I then provide an analysis which assesses to what extent empirical observations are consistent or inconsistent with these predictions. I search for smoking gun evidence that lends strong support to a theory and for hoop evidence which is necessary for maintaining confidence in a theory. Ideally, the empirical evidence should reveal a temporal, spatial, or social proximity of causes and effects.

As in the previous case, the empirical analysis relies on a diverse set of primary sources (see Appendix I). Its backbone are 245 meeting documents from the IMO and 75 documents from the Arctic Council issued between 2009 and February 2020. For the IMO, I obtained all meeting reports and documents submitted by delegations. For the Arctic Council, only short meeting reports were accessible. I combine these documents with three other types of primary sources. First, I had access to audio-records of ten sessions of the IMO Marine Environmental Protection Committee (MEPC) and nine sub-committee sessions between February 2013 and February 2020. Audio-records enabled me to protocol relevant negotiations in more detail than the official meeting reports. Second, I attended four recent MEPC meetings (MEPC 71 to 74) at which the regulation of HFO use was discussed. I made notes on negotiation dynamics and contextual observations and had informal talks with delegates. Third, I conducted six semi-structured interviews with state, business, and NGO representatives to consider their perspectives in the interpretation of the other sources and to fill data gaps. Again, I consider negotiations on all institutional levels of the international organizations involved.

Two data limitations apply. One limitation is the lower availability and reliability of sources for the first part of the observation period. Audio-records only begin in 2013 and interviewees less accurately remembered events that are long ago. This may affect the accuracy of my analysis. However, as the major shift in support for a mandatory HFO ban falls within the second part of observation period, I am confident that my overall findings remain solid. Another limitation is that the regulatory process has not been concluded yet. Recently proposed text for an HFO ban in the Arctic confirms the trend towards higher stringency. It is not entirely certain though that these developments will reflect the eventual outcome. However, outcome observations are only one part of my analysis, which mostly focuses on process observations. These process observations remain valid even if the regulatory outcome should change.

I now turn to the storyline of the international negotiations of HFO regulation for ships in the Arctic and their key moments. I focus on the development of a legally binding ban as the most contentious design choice but refer to other design choices, such as regulatory scope, where relevant.

Storyline: Key Moments in the Arctic Council and IMO Negotiations

Based on the document analysis, I identified six key moments in the international negotiations on HFO in Arctic shipping. Three of them occurred in the first part of the policy process between 2009 and 2014. The policy process began with a widely-noticed assessment of oil pollution risks and black carbon emissions from shipping in the Arctic (Arctic Council 2009a, 140–42). The Arctic Council soon thereafter started a project on HFO in Arctic shipping (PAME 2010, 2–3, annex II, 7). The IMO launched discussions on addressing HFO use and black carbon through regulatory measures, but member states were somewhat reserved (IMO 2010e, para. 4.94-4.95; 2010h, para. 13.8.3). This heralded long and difficult negotiations.

A first key moment in these negotiations was the adoption of a work plan on black carbon by the IMO. In 2011, the organization discussed a Norwegian proposal for a work plan and approved three elements: the development of a definition of black carbon, the identification of appropriate measurement methods, and an investigation of potential control measures (IMO 2011d, para. 4.20). Defining black carbon and identifying measurement methods are preconditions for precise regulation and strong monitoring. By contrast, the development of a draft framework for reducing black carbon emissions was dismissed (IMO 2011d, para. 4.19; Norway 2011, annex). This was a critical decision as such a framework would have been one possible pathway leading towards an HFO ban, especially as other black carbon control measures face greater technological barriers.

A second key moment was the decision of the Arctic Council to pursue knowledge-generating rather than regulatory work on HFO. Initially, the HFO project of the Arctic Council, which was initiated by Norway, also foresaw the preparation of a joint regulatory proposal for submission to the IMO (PAME 2010, annex 2, 7). In 2012, this aim was abandoned and the consideration of an HFO ban excluded from future study work (PAME 2011, annex IV; 2012, 4). This was critical because all regulatory discussions about HFO now moved to the IMO. This freed the issue of HFO use in the Arctic from the very strong consensus culture of the Arctic Council and globalized it. Without this decision, most likely no regulatory proposal would have been ready for consideration in the context of the Polar Code that was under development at the IMO.

A third key moment was the incorporation of nonbinding guidance into the IMO Polar Code. Environmental NGOs had called for a mandatory ban on the use of HFO by ships in Arctic waters and for a provision on black carbon in the code (FOEI, IFAW, et al. 2011; FOEI et al. 2013; IMO 2013a). In 2013, the IMO rejected an HFO ban as premature and did not discuss a provision on black carbon (IMO 2013b, sec. 11; 2013e, para. 11.44, 11.53). Instead, negotiators agreed on a nonbinding provision recommending ships not to use or carry HFO in Arctic waters (IMO 2013f, annex, 58). This recommendation was approved in autumn 2014 and adopted as part of the Polar Code in spring 2015 (IMO 2014g, annex 1, 5; 2014h, para. 9.30; 2015f, para. 6.21). This was a branching point because a purely recommendatory HFO policy was chosen at a time when a binding ban had also been conceivable. Indeed, an HFO ban would have fitted into the structure of the Polar Code, which contains many mandatory provisions for Arctic shipping.

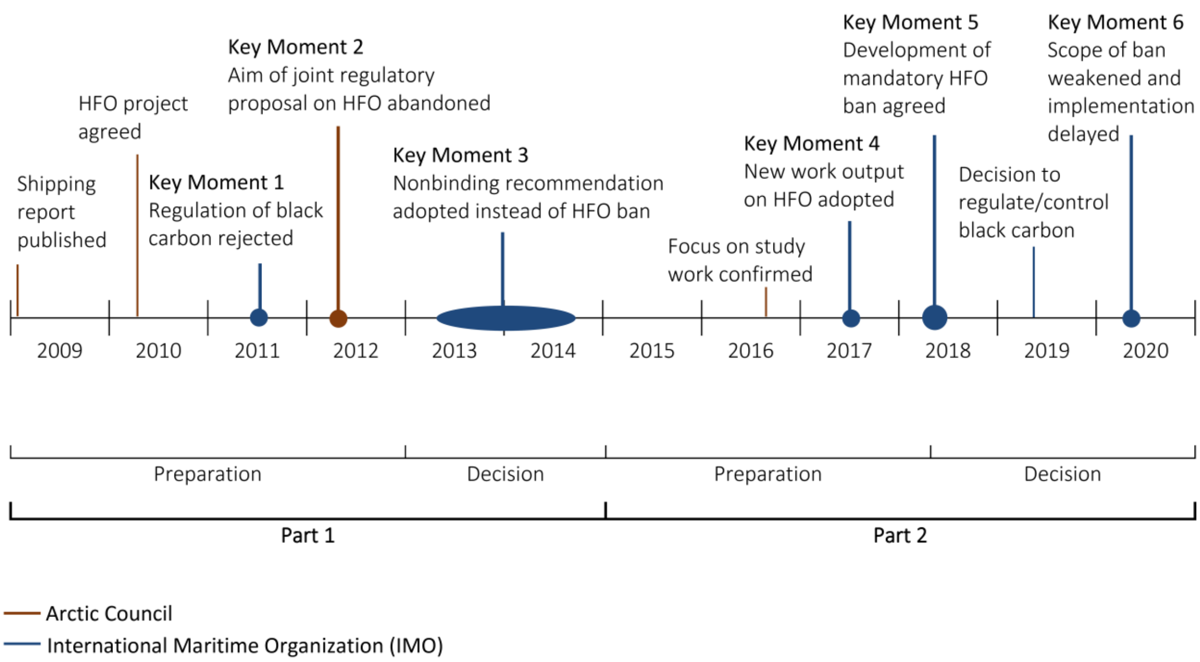
Another three key moments fall into in the second part of the process beginning in 2015. Environmental NGOs early called for addressing HFO use and black carbon in future revisions of the Polar Code (FOEI et al. 2014, para. 15). The IMO noted that this required the prior approval of a new work output (IMO 2014h, para. 9.21). It also continued the agreed work on black carbon. However, disagreements on the definition, measurement, and potential control of black carbon were going to delay the completion of the work plan until 2019 (IMO 2014a; 2014c, sec. 8; 2015a; 2015d, sec. 8; 2017a; 2017d, sec. 8). The negotiations on black carbon regulation were only recently reopened and therefore did not provide any impetus to the ban of HFO in the meantime (IMO 2019e, para. 5.66-5.67).

The fourth key moment was the adoption of a new IMO work output on the mitigation of environmental risks associated with HFO use in Arctic shipping. In 2016, the Arctic Council confirmed its earlier decision to conduct additional studies instead of developing a regulatory proposal (PAME 2016a, 3). In the IMO, however, calls for work on the mitigation of HFO risks received increasing support (Canada and United States 2016; IMO 2016a, sec. 17; 2016b). In 2017, the proposal of a new work output co-sponsored by eight member states received wide support (Canada et al. 2017; IMO 2017b, sec. 14; 2017e, para. 14.13.1). This was critical because it reopened the negotiations on HFO regulation, including the possibility of moving towards a mandatory ban. Without this decision, the regulation of HFO in the Arctic would not have been on the next biannual agenda of MEPC.

A fifth key moment was the decision of the IMO to develop a mandatory ban of the use and carriage for use of HFO as fuel by ships in Arctic waters. In 2018, three proposals were tabled under the new work item: the development of nonbinding risk mitigation guidelines (Russian Federation 2018a); the development of a mandatory HFO ban (Finland et al. 2018); and a prior impact assessment (Canada and Marshall Islands 2018). The member states agreed on the preparation of risk mitigation guidelines and on the development of an HFO ban based on an impact assessment (IMO 2018b; 2018d, para. 11.4-11.5, 11.9). This was a branching point because it meant that the IMO turned away from its previous nonbinding policy and towards formally tighter regulation. A rejection of the proposal to develop a ban would have implied a continuation of non-binding policies for several years.

A sixth key moment was the agreement on a draft HFO ban on the sub-committee level of the IMO. In February 2020, the IMO discussed a proposal by eleven states for a comprehensive ban with limited transitional exemptions (Denmark et al. 2019). Other submissions criticized the idea of a ban and/or called for far-reaching exemptions that would reduce its scope (Canada 2020; Russian Federation 2019b, para. 17). The draft agreed by the member states contains a binding ban applicable from 2024 (IMO 2020f; 2020g, annex 12). However, until 2029, the ban will not apply to ships with oil tank protection like double hulls. Additionally, national administrations of Arctic coastal states can exempt ships flying their flag and operating in their waters. The agreement on this draft regulation was critical because it confirmed the previous decision to develop a mandatory ban but also specified it by weakening its scope. Failure to reach such an agreement could have jeopardized the entire regulatory project; yet, the IMO could have also chosen a comprehensive ban with more limited exemptions. At the time of writing, the adoption of the HFO ban is pending, so that future amendments to its design cannot be excluded.

Figure 19: Key moments in the development of HFO fuel regulation for ships in the Arctic



Source: Author.

In the next section, I analyze the six key moments depicted in Figure 19 and the related sequences through the lenses of ideational interventionism, material evolutionism, and argumentative coproduction. For each theory, I formulate theoretical predictions about the causal process which prepare the ground for an in-depth analysis. The three analytical spotlights are going to reveal that the three theories account for different facets of the case. Argumentative coproduction provides the most complete explanatory account of the empirical story but is not without limits either.

Ideational-Interventionist Spotlight: The Influence of Activists and Scientists and Its Limits

This section applies an ideational-interventionist lens to the process of HFO regulation and its outcomes. Prior to the analysis, I outline more specific theoretical predictions for the storyline at hand, based on the general expectations developed in chapter 4. The empirical analysis identifies activists and scientists as important drivers of HFO regulation in the Arctic. However, it also demonstrates that economic interests of some Arctic coastal states impose material limits on the influence of ideas and norms. In addition, some of the shipping companies that would be targeted by regulation seem to be more progressive than ideational interventionists would expect.

Theoretical Predictions

An ideational-interventionist lens approaches the actor constellation in the case with the concept of a war of position. It predicts that the main dividing line was between the environmental goals of activists and scientists and the economic interests of a reluctant shipping industry. Support of the shipping industry for a binding ban of HFO would not fit this prediction. Ideational interventionism considers state preferences to build on causal ideas and normative understandings of the problem. For instance, states should have supported an HFO ban based on the belief that it reduces accidental spill damages and emissions of black carbon. The expectation would not be met if states supported HFO regulation without holding such corresponding ideas, or vice versa. The ideational-interventionist logic further posits that state positions change in response to knowledge- and norm-based leadership. Environmental NGOs and scientific findings should have played important roles in creating support for a mandatory HFO ban. This prediction would be disconfirmed if new ideas and norms were trumped by purely material considerations of state representatives.

The ideational-interventionist perspective expects reluctant business actors to defend their hegemonic position by means of various discursive strategies. It predicts that the reluctant shipping industry mobilized counter-expertise, made accommodating moves, and lobbied for their preferred technology solutions to avoid or weaken new fuel regulation in the Arctic. The absence of industry resistance to more stringent regulation would puzzle ideational interventionists. To overcome the hegemony of reluctant business actors, the model stresses the disruptive effect of crisis. The move towards an HFO ban should thus have been supported by a sense of crisis or urgency, for instance, because of a major oil spill. Support for a comprehensive HFO ban without clear signs of crisis or lack thereof despite crisis-like circumstances would be surprising. Eventually, ideational interventionism understands regulation as technology-forcing. It predicts that shipping companies will not phase out HFO unless they are legally required to do so. A voluntary switch to lighter or alternative fuels would contradict this prediction.

Analysis

Ideational interventionism conceives of regulatory politics as a war of position between a dominant historical bloc and outside challengers. In this view, a historical bloc of shipping interests and major flag states seeks to avoid costly environmental regulation for maritime transport in the Arctic. Indeed, operational costs on Arctic supply and transit routes would increase if ships had to switch from HFO to more expensive distillate fuels. Major international associations of the shipping industry, like the Baltic and International Maritime Council (BIMCO) and the International Chamber of Shipping (ICS), have been skeptical towards banning HFO and regulating black carbon. Important allies of the shipping industry have been Russia and major flag states such as China, Liberia, and the Marshall Islands. Canada has been skeptical towards banning HFO, too. This historical bloc has been challenged by activists and scientists who fear the environmental impacts of increased ship traffic in the Arctic. Five environmental NGOs[62], in collaboration with indigenous Arctic representatives, have advocated a mandatory HFO ban to reduce risks associated with accidental fuel spills as well as emissions of black carbon. Research by the US-based International Council on Clean Transportation (ICCT) and individual scientists has supported this position. Interestingly, also several expedition cruise companies, like the Norwegian Hurtigruten, have supported the policy

[62] The five NGOs are: Clean Arctic Alliance (CAA), Clean Shipping Coalition (CSC), Friends of the Earth International (FOEI), Pacific Environment, and the WWF.

position of the environmental NGOs (Interview 13). The latter observation does not quite fit the ideational-interventionist prediction.

Activists and scientists have attempted to exert normative and ideational leadership in the negotiations. The idea of banning HFO in the Arctic emerged around 2010 when the IMO banned the use and carriage of HFO in Antarctic waters to mitigate spill risks (Interview 11; Interview 14). Since then, environmental NGOs have depicted Arctic ecosystems as vulnerable and in need of equal protection (e.g., CAA 2018b; FOEI et al. 2010, para. 2; 2016a, para. 3; FOEI, WWF, and Pacific Environment 2016, para. 4; IMO 2016a).[63] They recalled that the Arctic Council had identified accidental and illegal oil discharges as the largest environmental threats from Arctic shipping (FOEI et al. 2016a, para. 2; cf. Arctic Council 2009a, 5). They gathered information and commissioned studies showing that HFO spills cause greater damage than distillate fuel spills (FOEI, CSC, et al. 2011, para. 10; FOEI et al. 2016a, para. 2; WWF 2018, para. 4.4). They also provided a platform for indigenous representatives to testify the threats to food security and subsistence culture (FOEI, WWF, and Pacific Environment 2019, paras. 4–9).

Environmentalists have also advocated HFO regulation as a means to reduce black carbon and mitigate climate change (IMO 2013a; Pacific Environment in 2019a). Activists and scientists informed about the warming effect of black carbon and possible emission reductions from an HFO phaseout (CSC, FOEI, and WWF 2011; FOEI 2008; Lack 2017, 3; 2018, 4; LITEHAUZ et al. 2012, 19). The ICCT facilitated the evaluation of black carbon control measures, including a switch to distillate fuels (ICCT 2018b, 9). In general, the environmentalist argumentation for an HFO ban was rather “ad hoc” in the first part of the regulatory process. With the creation of the Clean Arctic Alliance and its “HFO-free Arctic” campaign in the second part, this argumentation became more comprehensive and systematic (Interview 14).

As predicted by ideational interventionism, a bloc of shipping and flag state interests sought to fend off normative and ideational outside challenges. First, it provided counter-expertise on the need for regulation. With respect to spill risks, the shipping industry noted that fuel tank protection already increased the safety level (IMO 2018b). With respect to black carbon, the shipping and petroleum industries, some flag states like the Bahamas, the Cook Islands, and Liberia, as well as Russia questioned whether

[63] Relevant NGO activities included written submissions, oral statements, lunch-time presentation, and the organization of a well-attended Arctic photo exhibition for delegates at the IMO.

the limited contribution of shipping to total emissions justified policy action (IMO 2011d, para. 4.19; 2014a; Liberia, OCIMF, and IPIECA 2013, para. 8; Russian Federation 2015, paras. 14–15). Additionally, the shipping and engine industries represented by the ICS and EUROMOT expressed doubts about emission reductions when switching from HFO to distillate fuel (IMO 2019a).

Second, the dominant historical bloc attempted to accommodate increasing regulatory pressures. When the IMO's work on HFO risk mitigation began in 2017, the secretary-general of ICS declared that he was "fairly sure a ban will happen one day" but that he sought to avoid "a disproportionate disadvantage to ships that use HFOs in the Arctic today" (Hinchliffe in *The Guardian* 2017). The shipping industry supported a Russian proposal which favored nonbinding mitigation guidelines over a ban (IMO 2018b; Russian Federation 2018a; 2018b, para. 15). When the IMO agreed to develop an HFO ban in 2018, shipping interests and flag states successfully mobilized state support for a prior impact assessment (IMO 2018d, para. 11.5). Considering that ample research on HFO in the Arctic already existed, this represented an attempt to at least delay regulation (IMO 2018b; 2018d, para. 11.10-11.11). Accommodation strategies have also been employed in the work on black carbon. For instance, the ICS participated in the compilation of candidate control measures, but mostly highlighted prevailing complexities and uncertainties (Canada 2018b).

Third, parts of the industry have lobbied for regulatory measures that fit existing technology strategies. Regarding spill risk mitigation, shipping industry associations like BIMCO, CLIA, and ICS supported measures that would improve navigational safety without restricting fuel choice (IMO 2018b). They also supported an impact assessment prior to the development of an HFO ban which could justify exemptions (IMO 2018b). Furthermore, the industry successfully opposed a ban on HFO carriage as cargo, which would prohibit an entire market segment (IMO 2018d, para. 11.7). Regarding black carbon control, the picture is still fuzzy because of a large number of candidate measures. Engine manufacturers seem to favor measures that build on ongoing technology development, such as increasing engine efficiency and the use of Liquefied Natural Gas (LNG) (EUROMOT in Canada 2018b). Overall, these multifaceted responses to the outside challengers are very much in line with ideational-interventionist predictions.

The initial dominance of the reluctant industry actors was partly overcome by the ability of activists and scientists to create a sense of crisis and urgency. Environmentalists repeatedly reminded IMO delegates of past ship accidents and of projected increases in Arctic shipping (FOEI, CSC, et al. 2011, paras. 4–6; FOEI et al. 2013, paras. 3–4;

2016b, para. 2; 2017, paras. 3–5, 11–15). In 2016, environmental NGOs and native inhabitants from Alaska, referring to recent ship accidents, called on the US administration to consider an HFO ban (FOEI, WWF, and Pacific Environment 2019, para. 10; *The Maritime Executive* 2016a; Williams 2016). Shortly thereafter, the US and Canada announced joint work on HFO spill risk mitigation in the Arctic (IMO 2016a). In December 2016, US President Obama and Canadian Prime Minister Trudeau made an HFO phasedown part of their new Arctic partnership (The White House 2016). This initiative culminated in the proposal of a new IMO work output on HFO in 2017. Both this and the later proposal for the development of an HFO ban prominently mentioned expected increases in traffic and spill risks (Canada et al. 2017, para. 4; Finland et al. 2018, para. 3). This created an impression of high threat and imminent crisis, even though no major HFO spill has actually occurred in Arctic waters in recent years. The observed increase in the number of states that supported an HFO ban, including many non-Arctic states, is consequential from an ideational-interventionist point of view.

A sense of crisis and urgency should have also been present regarding the warming effect of black carbon. Early on, black carbon was linked to climate change mitigation and the opportunity for a short-term policy response (FOEI 2010, para. 3; Norway, Sweden, and United States 2010, para. 14.4). After the adoption of the Paris Agreement in December 2015, the IMO made climate change mitigation a priority and developed a greenhouse gas reduction strategy (IMO 2018c). Unusual protests of climate activists in front of IMO headquarters have underscored the public interest in this work. In April 2018, delegates were greeted by the eye-catching call "IMO DON'T SINK Paris" painted on the Thames Embankment. A recent report by the Intergovernmental Panel on Climate Change also raises the issue of black carbon from ships (IPCC 2019, 236). Yet, progress on the regulation of black carbon has remained slow and states have not supported an HFO ban in this context. Thus, an environmental crisis is not always sufficient to bring about regulatory change.

To what extent did ideas and norms drive the positions that states took? The evidence is mixed. An example for a potentially independent influence of ideas is that the non-Arctic support for a ban grew in conjunction with a more fully developed argumentation of environmentalists. Many supporters of an HFO ban stressed the anticipated environmental harm and the normative obligation of taking precautionary action (IMO 2018b). These statements often related back to ideas and norms put forward by environmentalists, whose side events were well-attended by state delegates from both Arctic and non-Arctic states. However, the environmentalist ideas only fully unfolded their effect because of their uptake by leading member states of the Arctic Council. Without this, it is unlikely that many non-Arctic observer states of the Arctic Council would have supported a ban as they generally "go with the flow" (Interview 14). This counterfactual is underscored by the limited non-Arctic support for a ban in 2013, when Arctic states themselves were still hesitant.

Another instance of ideational influence is the observation that some states supported an HFO ban as a measure to mitigate spill risks but not to control black carbon. Spill risk mitigation was largely uncontested because, except for Russia, there was broad scientific consensus on the damages that HFO could cause (cf. FOEI et al. 2016a; IMO 2016b). With respect to black carbon, the reduction potential of a fuel switch was far less certain based on measurement data from different engines types and sizes as well as deposition modelling for the Arctic region (Finland 2017, para. 10; 2018, para. 7.3, 17.1; IMO 2019d, annex 9; Norway 2013; Russian Federation 2015; Interview 2). Scientific uncertainties and a long learning process have inhibited the black carbon negotiations (Interview 11; Interview 12). Based on new measurement results, current discussions about black carbon seem to be turning increasingly towards the influence of the aromatic content of fuel (EUROMOT 2019; Finland and Germany 2019; IMO 2020i, para. 8.3, 8.7).

Different interpretations are possible regarding an independent effect of ideas in the Russian opposition to an HFO ban. On the one hand, the Russian position may reflect a distinct set of ideas and norms held by decision-makers. Russia contended that HFO spills were unlikely and less damaging than distillate fuel spills (IMO 2016a; 2016b; Russian Federation 2017, para. 11; 2018b, paras. 8–9). Together with Canada, Russia further argued that an increase in transport costs would threaten the viability of Arctic settlements (Canada 2018c, para. 9; Russian Federation 2018b, para. 12). The Russian delegation also disputed that non-Arctic states were able to make informed choices on this matter (IMO 2018d). On the other hand, economic goals may have guided the adoption of ideas about the environmental problem. Russia and Canada, the two states which have been most skeptical about a comprehensive HFO ban, are reliant on ships running on HFO for resupplying their Arctic communities.

Other observations quite clearly suggest that material factors limited the influence of ideas and norms. Finland, Norway, and the US expressed their general support for an HFO ban already in 2013 but did not actively push for its incorporation into the Polar Code (IMO 2013a; 2013b). This was not because they were no longer convinced of the risks that HFO use in the Arctic posed. Rather, they lacked the necessary support for a ban from other Arctic states. Moreover, the emerging consensus on a mandatory HFO ban with far-reaching exemptions is not in line the causal ideas advocated by environmentalists and scientists. The draft regulation would allow for exempting ships of Arctic coastal states from the requirements. This exemption is not research-based as these ships do not pose lower pollution risks.

Finally, the case currently offers mixed evidence for an interventionist logic in which corporate environmental practices improve only if forced by stringent regulation. In 2015, already 58% of all ships in the Arctic operated on fuels other than HFO (Comer et al. 2017, 24). Observers do not attribute this to the nonbinding guidance of the Polar Code adopted in May 2015, suggesting that other factors than regulation also affect fuel choice (Interview 12; Interview 14). Between 2015 and 2017, however, the share of ships using HFO in the Arctic increased from 42% to 46% (Comer 2019). This suggests that more stringent regulation may be needed to contribute to an effective reduction of HFO use. Thus, while parts of the industry have moved away from HFO, an industry-wide transition to cleaner fuels may presuppose a more stringent regulatory intervention.

Summary

The analysis shows that activists and scientists attempted to exert ideational and normative leadership for bringing about a mandatory, encompassing HFO ban in Arctic shipping. A bloc of reluctant shipping and flag state interests devised discursive strategies to deal with this outside challenge. Yet, over time, environmental NGOs and scientists managed to create a sense of crisis and urgency with respect to the mitigation of increasing oil spill risks. State support for a legally binding ban grew in conjunction with that. However, the analysis also reveals that the influence of environmentalists and scientists was not without limits. Some state delegates expressly acted against their convictions by supporting a nonbinding recommendation rather than a mandatory ban. Furthermore, decision-makers' uptake of ideas for or against more stringent regulation seems to have followed material lines of conflict between states with different shipping interests in the Arctic.

Material-Evolutionist Spotlight: Bargaining and the Fading Influence of Business Goliaths

This section examines the negotiations and decisions on HFO regulation for Arctic shipping from the perspective of material evolutionism. I deduce theoretical predictions from the general propositions of the model and adapt them to the storyline at hand. In the analysis, I find that a business conflict has unfolded between shipping companies using HFO and those that have already switched to less environmentally damaging fuels. Issue linkages and bargains in international negotiations played an important role in forging compromise agreements on HFO regulation. By contrast, material evolutionism struggles to explain the timing of the transition towards an HFO ban and the fading influence of some major business actors. The availability of fuel alternatives and the limited power resources of the small number of business actors supporting a ban hardly make for a convincing explanation.

Theoretical Predictions

Material evolutionism examines patterns of business conflict or cooperation in international environmental negotiations. It predicts that HFO regulation will be welcomed by shipping companies that already use less environmentally damaging fuels and that want to level the playing field. Companies still using HFO should oppose a cost-increasing ban. Cooperation between these different material business interests would not be in line with the model. Material-evolutionist thinking posits that the interests of dominant domestic businesses translate into state preferences. Arctic coastal states with a lot of shipping activity reliant on HFO should clearly oppose its general ban. If even these states came to support a comprehensive ban, the prediction would not hold. Moreover, the model expects changes in state preferences to occur through interest- and power-based leadership. The agreement on a nonbinding recommendation in 2014 and the emerging consensus on a binding ban with limited scope should reflect issue linkages or pressures from powerful states. Changes in state positions that occurred without such linkages or pressures would puzzle the model.

Material evolutionists argue that the technological power of business can shape regulatory options. One prediction is that the move towards an HFO phaseout has been supported by business innovation in alternative propulsion systems and fuels. The HFO ban should thus not contain requirements that cannot be met with available technology. The theory further expects that the outcome of business conflict depends on the distribution of instrumental, structural, and discursive power resources. The prediction is that a transition towards more stringent HFO regulation emerged as HFO users got weaker in relation to progressive business actors over time. The theory would be weakened if regulatory change occurred in the absence of such a change in power resources. In the end, the material-evolutionist model expects that the technologies and practices of influential firms are codified in regulation. The move from a nonbinding recommendation to a binding HFO ban should reflect the decision of major industry actors from influential states to use other fuels than HFO. The prediction would be disconfirmed if HFO regulation went significantly beyond the dominant practices of the business Goliaths.

Analysis

Material evolutionism views international regulatory negotiations to be driven by cooperation or conflict of business interests. In the first part of the regulatory process, industry was united in its passive stance on a possible HFO ban. When the idea of a mandatory ban became more concrete in the second part, however, some limited intra-industry tensions arose. The first business actor to have pushed for a ban was the Norwegian expedition cruise company Hurtigruten (*The Maritime Executive* 2016b). It has been joined by five other expedition cruise operators and the Association of Arctic Expedition Cruise Operators (AECO). As these operators voluntarily use more expensive fuels than HFO, they would benefit from the level playing field created by a mandatory ban. Two national shipping associations from Arctic states have lent conditional support to an HFO ban (Danish Shipowners' Association 2016; 2018; Norwegian Shipowners 'Association 2017). By contrast, the global shipping industry associations BIMCO, CLIA, and ICS held reserved or skeptical positions also at the second branching point (IMO 2018b). The underlying material consideration is that a mandatory HFO phaseout would increase fuel costs in Arctic shipping by 3% to 19% in 2021 (Nelissen and Tol 2018, 3). This will raise consumer prices in the Arctic and may undermine the global competitiveness of mineral resources from the Arctic (Interview 12). The observed actor constellation confirms the prediction that diverging material interests cause business conflict.

Some divisions within business also exist on black carbon regulation but not primarily in relation to HFO use. The engine manufacturers which would benefit from a market for cleaner propulsion technology have contributed extensively to work on this issue (EUROMOT 2011; 2012; 2013; 2015; in Canada 2018b). By contrast, several major associations of the shipping and petroleum industries have repeatedly warned against rapidly taking policy measures (IMO 2013a; 2015a; 2017a; 2019a).[64] For the shipping industry, regulation requiring new equipment for black carbon abatement would create additional costs. For the petroleum industry, it might threaten traditional fuel oil markets as alternative propulsion systems like LNG, battery electric, and hydrogen fuel cells effectively reduce black carbon (ICCT 2018b, 9–12). Business is more united though in its skepticism towards controlling black carbon by means of an HFO ban (IMO 2019a; 2019b). Besides cost increases for ship operators, a ban would shrink demand for the refinery waste product HFO and fail to create new markets for engine manufacturers. These more harmonious business interests can explain why an HFO ban has received only little support as a black carbon control measure.

Business possesses technological power in relation to both fuels and black carbon, but the constructive effect predicted by material evolutionism is not obvious. The petroleum and bunker industries control fuel supply. Distillate fuel has existed as an alternative to HFO for a long time, implying that a mandatory ban could have been adopted much earlier. In recent years, Shell and other suppliers have been promoting LNG as another fuel alternative (S&P Global Platts 2019). The future availability and prices of different fuels are dependent on industry reactions to the new global sulfur regulation applicable to marine fuels from 2020 (Nelissen and Tol 2018, 13; DeCola et al. 2018, 41–42). However, these reactions were still unknown in 2018 when the decision to develop a mandatory HFO ban was taken. Moreover, suppliers of emission control technology and engine manufacturers shape solutions for reducing black carbon.[65] Yet, when environmentalists suggested that using distillate fuel together with diesel particulate filters was the most promising solution, EUROMOT identified several unresolved technical challenges (IMO 2019a; Pacific Environment and CSC 2019, para. 13). Thus, technological innovation does not seem to have played a major role in the transition towards an HFO ban.

As suggested in the preceding ideational-interventionist analysis, material interests have been underlying some of the opposition to a comprehensive and binding ban. Several observations suggest that Russia opposes an HFO ban because it primarily wants to avoid the related economic costs: Russia promotes cost-efficient maritime transport

[64] These associations include BIMCO, ICS, the International Association of Independent Tanker Owners (INTERTANKO), IPIECA (an association working on the sustainability performance of the oil and gas industry), and the Oil Companies International Marine Forum (OCIMF).

[65] Potential solutions include diesel particulate filters, electrostatic precipitators, alternative propulsion systems, and engine optimization.

along its Northern Sea Route[66] (Blunden 2012, 115–16); its Northern supply activities cover a substantial number of people spread across a vast territory (Russian Federation 2019a, 21–27); and its ships presently consume large amounts of HFO (Comer et al. 2017, 28–29). An even clearer example for interest-based state preferences are the Marshall Islands. Together with Canada, they called for assessing the potential impacts of an HFO ban on Arctic communities and economies before developing regulation (Canada and Marshall Islands 2018, paras. 4–5). The Marshall Islands are one of the top five flag states in Arctic maritime traffic (Comer et al. 2017, 27). It therefore seems very plausible that their interest in an impact assessment was primarily motivated by concerns about their shipping industry (Interview 14). If several states followed economic interests, did traditional material power resources determine which competing business interests won?

The distribution of structural business power has worked mostly against an HFO ban. Structurally dominant sectors influenced the regulatory preferences of Arctic and non-Arctic states. The two Arctic states that have been most hesitant to support a costly HFO ban are Canada and Russia. In both states, ships are essential for resupplying Arctic communities and exporting raw materials like ores, oil, and gas (Arctic Council 2009a, 75–77, 91). Shipping also matters in parts of the US Arctic but the US support for an HFO ban seems to reflect the interests of the Alaskan seafood industry which would benefit from additional protection (United States 2019, para. 7). Structural power has also been at play in major non-Arctic flag states, in which the shipping industry has large economic weight. Accordingly, several of the world's ten largest flags have opposed an HFO ban or supported alternatives to it at different occasions: Liberia, the Marshall Islands, and Panama in 2013; the Bahamas, China, and the Marshall Islands in 2018 (Canada and Marshall Islands 2018; IMO 2013b; 2018b).[67] The structural power of economic interests becomes very clear when assuming their presence away in the Arctic. An Arctic without transit shipping and major resupply operations would look much more like the Antarctic. For the Antarctic, an HFO ban was already adopted in 2010 and entered into force in 2011.

[66] The Northern Sea Route is sometimes also referred to as the Northeast Passage. It links Northeast Asia to Northern Europe via Arctic waters off the Russian coast. Alternative trans-Arctic shipping routes are the Northwest Passage, which leads along the coasts of the Canadian and US Arctic, and the future Central Arctic Route, which would run from the Bering Sea to Iceland through the Central Arctic Ocean.
[67] The only exception to this has been Japan which supported the development of a ban based on an impact assessment and with due consideration of possible exemptions and transitionary provisions (IMO 2018a).

Instrumental power should have also worked against a mandatory HFO ban, at least to some extent. Major shipping associations with direct access to IMO negotiations took a skeptical stance on a ban. The ICS, representing over 80% of the world merchant fleet, supported exploring other measures first (IMO 2018b). The global cruise industry raised skeptical questions about the proposed ban (CLIA 2018; IMO 2018d). Other industry associations with consultative status at the IMO criticized efforts to regulate black carbon emissions, including from the use of HFO. The only international business association clearly supporting an HFO ban, AECO, has provided inputs to delegations but has not been represented in IMO negotiations (Interview 13). The Norwegian Shipowners' Association, which supports a moderate ban, has had access to the Norwegian delegation at the IMO. Yet, it failed in its attempt to lobby for exempting HFO carriage in fuel tanks from a ban. Hurtigruten as a major proponent of an HFO ban voiced its position domestically in Norway as well as through a transnational network involving environmental NGOs. Still, this is not comparable to the privileged access that reluctant industry actors had to the international negotiations.

The distribution of discursive power between supporters and skeptics of an HFO ban was less clear. On the one hand, public interest in the protection of the Arctic environment has constrained industry opposition to pollution prevention measures. Becoming associated with oil pollution is particularly problematic for cruise lines that market the unspoilt Arctic wilderness. Accordingly, CLIA has not openly opposed a ban and several cruise companies have already declared to phase out HFO (*Marine Insight* 2019a; Hapag-Lloyd Cruises 2019; *The Medi Telegraph* 2019). On the other hand, discursive barriers for industry opposition are lower for the less publicized issue of black carbon. Various industry organizations argued that the problem was small in magnitude, complex to address, and not necessarily reduced by phasing out HFO (IMO 2014a; 2017a; 2018a; 2019a; 2019b). They thereby pushed back the environmentalist frame of an HFO ban as a measure that reduces both spill risks and black carbon. As a consequence, the proposal for the development of an HFO ban, which was adopted by the IMO in 2018, solely mentioned the aim of reducing damages from fuel oil spills (Finland et al. 2018).

The overall distribution of these power resources suggests that reluctant business actors should have been rather successful in their opposition to a mandatory HFO ban. Indeed, reluctant business interests manifested themselves in the decision of the IMO to adopt a nonbinding recommendation at the first branching point in 2013/14. However, they failed to prevent the move towards a binding ban at the second branching point in

2018. The evidence suggests that factors other than purely economic ones mattered in this respect. For instance, Denmark became more supportive of a ban despite Greenland's reliance on maritime resupply. Non-Arctic countries which lack major interests in the region, like the Czech Republic, Estonia, Portugal, and Switzerland, were among the supporters of a ban. For Germany and the Netherlands, both of which also supported the ban, economic considerations do not seem to have mattered in preference formation. This is surprising given that, because of their location in Northern Europe, German and Dutch seaports stand a good chance of benefitting from future low-cost trans-Arctic liner routes. Thus, material interests and traditional business power alone cannot account for the growing support for more stringent regulation.

These gaps in the material-evolutionist explanation should not lead us to overlook elements of bargaining and interest-based leadership in the negotiations. Three major instances deserve mention. In 2013, Norway and others strategically chose not to endorse the incorporation of an HFO ban into the Polar Code (IMO 2013a; 2013b). An HFO ban could have adversely affected the code by absorbing negotiation resources, causing delays, and creating opposition to the final policy package (IMO 2013a; Interview 11; Interview 12). In 2018, the advocates of an HFO ban proposed temporary exemptions for ships with fuel tank protection, mainly to stretch the economic costs of a ban and get Arctic communities and industries onboard (Finland et al. 2018, para. 5). In addition, this exemption would reward shipowners that already invested in double hull protection (Interview 10). In 2020, Canada and Russia made their support for a mandatory ban contingent on delayed implementation and even more far-reaching exemptions (Canada 2020; Russian Federation 2019b).

In contrast to this, power-based leadership has not played any major role. In 2011 and 2017, the European Parliament passed resolutions calling for unilateral measures if the IMO failed to ban HFO in the Arctic (European Parliament 2011, para. 67; 2017, para. 58). As the European Commission did not follow these calls, this threat has not materialized (Stępień and Raspotnik 2016, 6). In addition, no formal coordination on the HFO issue has taken place on the EU level (Interview 10; Interview 11). Other major actors, like the US, have refrained from unilateral measures, too (*Maclean's* 2016). A plausible reason is that the political importance of the issue has remained limited. More recently, however, Russia has come to stress sovereignty concerns as well as its crucial position in the implementation of any regulations for the Arctic (IMO 2020a). It has received indirect support for its position from China, Belarus, and Venezuela.

Finally, the decision to develop an HFO ban did not merely codify dominant business practices as material evolutionists would predict. Although most ships already use distillate fuel in the Arctic, HFO remains the most prevalent fuel in terms of bunker volumes. It is burned mostly by large cargo ships, bulk carriers, tankers, and cruise ships (Comer et al. 2017, 19–24; Comer 2019, 7). An HFO ban would thus exceed the current practices of the industry's Goliaths. Pioneers of an HFO phaseout were the Norwegian Hurtigruten and some small expedition cruise operators. Again, these business Davids are not the kind of actors that material evolutionists would expect to be able to influence regulatory decisions of a global institution like the IMO. Only recently, in conjunction with the political decision to develop an HFO ban, also larger companies have decided to phase out HFO. This is not fully in line with the bottom-up dynamic expected by material evolutionism.

Summary

The material-evolutionist analysis sheds light on the business conflict between companies that would benefit from an HFO ban and those facing additional costs. The latter were more numerous, had high structural power in several important Arctic coastal states and non-Arctic flag states, and were better represented in the IMO. These business Goliaths prevailed in the first part of the policy process when the IMO chose not to adopt a binding HFO regulation. However, it is surprising that their influence has faded in the second part, so that the IMO decided to move towards a mandatory ban of HFO. Certain compromise solutions in the negotiations can be interpreted as interest-based bargains among states. Yet, these compromises did not merely codify the technologies and practices of dominant business actors.

Argumentative Coproduction: First Movers, Latecomers, and a Ban with Loopholes

The ideational-interventionist and material-evolutionist spotlights have elucidated different lines of conflict in HFO regulation, the regulatory push by environmentalists and scientists, and the economic bargaining that limited their influence. The previous analysis also suggests that a few business actors have played a constructive role in the transition towards a mandatory HFO ban. Several questions remain unanswered though: Why did the availability of fuel alternatives not suffice to bring about a mandatory HFO ban early in the process? What explains the timing of the transition towards a ban considering that the material constraints remained relatively stable throughout the process?

And why have the supporters of a ban recently consented to delaying the implementation of the envisaged HFO ban and allowing for far-reaching exemptions? The following analysis through the lens of argumentative coproduction answers these questions.

Theoretical Predictions

The model of argumentative coproduction conceives of international negotiations as argument- and evidence-based contests involving proponent, opponent, and audience states. It predicts that the states which engaged the most in the HFO negotiations sought to rhetorically coerce, mobilize, and persuade others to support their position. If states took contentious decisions on HFO regulation without having exchanged competing arguments, this prediction would not be confirmed. More specifically, the model understands state preferences to reflect propositions about the need for and feasibility of regulation. Proponents are predicted to have provided an environmental rationale for an HFO ban as well as technological arguments supporting its feasibility. The absence of one or both elements would weaken the model. Argumentative coproduction further suggests that new arguments and evidence about regulatory feasibility can modify state positions. Changing state positions on an HFO ban should reflect new arguments about the availability, affordability, reliability, or safety of other fuels. The explanatory power of my model would be limited if technology-related arguments did not precede changes in state positions.

Argumentative coproduction considers arguments about regulatory feasibility to be rooted in competing business expertise. It predicts that proponents of an HFO ban took up expertise from companies that have already phased out HFO, whereas opponents relied on inputs from HFO users. The prediction would not hold if scientists, administrations, or civil society were the main sources of feasibility arguments and evidence. The model further stipulates that frontrunner practices can credibly prove the feasibility of more stringent regulation. Accordingly, I expect that the transition towards an HFO ban goes back to a growing number of shipping companies that have switched to cleaner fuels. It would be surprising if the emerging ban contained provisions for which such proof of feasibility is lacking. Related to this point, argumentative coproduction expects that the resulting regulation reinforces progressive practices that have possibly emerged in niches. Thus, I should be able to observe firms that are already using alternatives to HFO and others that wait until regulation forces them to do so. Both the absence of other ship fuels and an almost universal use of HFO in the Arctic would contradict this prediction.

Business Actors, Corporate Expertise, and State Roles

Argumentative coproduction posits that regulatory negotiations are characterized by arguing over the technological leeway for more stringent regulation. Technologies compliant with an HFO ban are the use of distillate fuel or alternative fuels, such as LNG. Considerations about their availability, reliability, and affordability are found throughout the regulatory process. The aspect of availability involved questions about sufficient fuel supply and possibilities for the adaptation of existing fuel and engine systems. Reliability comprised potential safety challenges arising from fuel switches. Policymakers and stakeholders also discussed whether the use of distillate fuel instead of HFO would reliably reduce spill damages and black carbon. Finally, affordability has been a key concern in the negotiations, including the implications of higher fuel costs for Arctic communities and industries.

Table 16: Main actors in the negotiation of an HFO ban for the Arctic

	Progressive position	**Reluctant position**
Main state actors	Finland Norway US	Canada Russia
Important audience states	Arctic states, European states	Non-European flag states, incl. China and Marshall Islands
Main business interests	Shipping companies that have phased out or are willing to phase out HFO, especially expedition cruise operators, icebreaking, and some container operators	Shipping companies that continue to rely on HFO use, mainly bulk cargo operators and resupply shipping
Business actors	Industry associations: AECO, national shipowner associations of Denmark and Norway Individual companies: Hurtigruten, Arctia, and others	Industry associations: BIMCO, CLIA, ICS Individual companies less visible (Tschudi Group, partly Royal Arctic Line, and others)
Other nonstate actors	Environmental NGOs organized in the Clean Arctic Alliance (CAA), Arctic indigenous representatives	-

Source: Author.

Business practices and expertise have increasingly demonstrated or endorsed the feasibility of an HFO phaseout. First movers emerged in the expedition cruise sector, namely the Norwegian operator Hurtigruten and the sector association AECO (see Table 16).

An HFO ban would put these frontrunners on a level playing field with overseas cruise operators. The cruise association CLIA has taken a reserved position on a ban. Recently, however, a few major overseas cruise companies phased out HFO in the Arctic to avoid reputational risks associated with accidental spills and NGO pressure. Furthermore, several companies in different shipping sectors (icebreaking, cargo, and tankers) have announced or supported the use of distillate fuel or LNG. The resulting competitive disadvantage would be slashed or reduced by a ban of the less expensive HFO. By contrast, other shipowners have doubted the affordability of a fuel change. They have argued that higher fuel costs threaten the competitiveness of trans-Arctic shipping and Arctic resource production and transport. This position is reflected in the skeptical stances taken by most shipping associations, including BIMCO and ICS. Yet, overall, ever more companies have announced to move away from using HFO in the Arctic since 2015.

Argumentative coproduction expects that states whose decision-makers hold many convergent propositions about the need for an HFO ban and its feasibility act as proponents and opponents. In the first part of the regulatory process, Norway came closest to the role of a proponent of stringent regulation. Norway had some experience with a local HFO ban imposed on cruise ships around Svalbard. Together with Finland and the US, it generally supported the idea of an Arctic-wide HFO ban but did not expressly propose or endorse it. A ban was opposed by Canada, Iceland, Russia, and major flag states like Liberia, the Marshall Islands, and Panama. In the second part of the process, Finland, Norway, and the US became active proponents of a stringent ban. Both Finland and Norway are home to companies that have been phasing out HFO in the Arctic. Main opponents of stringent regulation have been Canada and Russia. These states have questioned or delayed the development of a ban and sought to weaken its scope. Ships under their flags have been relying on HFO in the Arctic, implying that operators pay attention to the challenges that a fuel switch involves.

The model further expects that decision-makers holding fewer or diverging propositions assume a reactive or passive stance in the negotiations. In the first part of the process, Germany, France, and Spain supported the idea of banning HFO in the Arctic but did not submit concrete proposals. Most non-Arctic states remained a passive audience. In the second part, an increasing number of audience states have come to support the development of an HFO ban, including Sweden, France, Germany, the Netherlands, New Zealand, and Spain. Even formerly unfavorable or opposed countries like Denmark and Iceland are now among the supporters (see Table 17). Several non-Arctic states have lent support to an HFO ban at decisive moments, while flag states like the Bahamas, China, and the Marshall Islands have remained skeptical.

Table 17: Growing support of IMO member states for a mandatory HFO ban, 2013-2018

	Continued support for more stringent regulation	**Increasing support for / less opposition to more stringent regulation**	
Proponents	**-**	**Finland** **Norway** **US**	
Opponents	-		**Canada**
Audience	France Germany Spain	Australia Belgium Czech Rep. Denmark Estonia Iceland Ireland Japan Netherlands New Zealand Poland Portugal Sweden Switzerland	Dominica Liberia Panama

Source: Author.

How can the observed changes in state positions be explained? Argumentative coproduction expects that shifts in state positions resulted from rhetorical coercion, argumentative mobilization, and sincere persuasion in relatively quiet politics. As previous parts of the analysis have shown, the issue of HFO use in Arctic shipping has certainly not been as quiet as other issues in shipping regulation. Yet, once again, decision-making in the IMO has been taking place in a rather closed setting. The subsequent analysis shows that, within this setting, technological arguing unfolded at several key moments. Somewhat paradoxically, references to existing or emerging business practices both facilitated the move to a mandatory ban and weakened its scope.

The First Key Moment

At the critical moment in 2011, scarce experience and expertise explain why the IMO decided to refrain from regulatory work on black carbon. Such work could have produced restrictions on the use of HFO, which causes emissions of black carbon. Policy discussions began after a report by the Arctic Council (2009a, 142) had noted that "the release and deposition of BC [black carbon] in the Arctic region is of particular concern." Norway, a member of the Arctic Council, became the main proponent of policy action and, together with Sweden and the US, launched discussions in the IMO (Norway, Sweden, and United States 2010). Norway also raised the option of dedicated black carbon regulation in the Polar Code (Norway 2010, para. 4.6). Based on this initiative, MEPC 60 agreed on the need to address black carbon (IMO 2010e, para. 4.95). Next, Norway proposed a work plan which foresaw the development of a draft framework for reducing black carbon (Norway 2011). Environmental NGOs even proposed the adoption of reduction requirements (CSC, FOEI, and WWF 2011, para. 24). However, at MEPC 62, "a number of delegations reasoned that it was premature to consider the development of regulatory measures" (IMO 2011d, para. 4.19). Future work was geared towards defining black carbon, identifying measurement methods, and investigating possible control measures. This decision was going to block black carbon regulation for several years. What role did technological considerations play in this decision?

The early negotiations suffered from a lack of technological expertise. The IMO member states only provided few specific inputs. For instance, they ignored the invitation of MEPC 60 for the submission of "proposals for specific pollution control measures to facilitate progress" (IMO 2010e, para. 4.95; 2010g, para. 5.89). The proponents of black carbon mitigation had earlier listed direct and indirect measures for reducing emissions of black carbon (Norway, Sweden, and United States 2010). However, no tangible evidence backed the bold claim that "all of these measures and techniques are widely available" (UNECE LRTAP 2011, para. 12). A similar limitation applied to a scientific assessment of black carbon control technologies disseminated by environmentalists (CSC 2011). The relevant study did "not address various constraints that may exist when considering the implementation of emissions controls on vessels" (Corbett, Winebrake, and Green 2010, 211). Most industry actors did not have experience with black carbon control and thus remained silent in the policy discussions. The lack of a common definition of black carbon and of accepted measurement methods further inhibited the discussions.

The lack of expertise was problematic because the feasibility of black carbon reduction was neither clear nor trivial. In 2010/11, diesel particulate filters were considered the most effective reduction measure (CSC 2011, para. 5; Norway, Sweden, and United States 2010, para. 11). The proponents of black carbon regulation qualified that "this technology is suitable only for high grade […] distillate fuels and cannot be used together with residual fuels" (Norway, Sweden, and United States 2010, para. 11). Arguably, a measure incompatible with the most widely used marine fuel is not readily applicable. The IMO secretariat noted that "effective regulatory measures require thorough consideration to ensure that any additional mitigation activities are technically robust […]" (IMO Secretariat 2011, para. 11). Indeed, none of the documents submitted to the IMO discussed technical robustness in detail.

Given the uncertain feasibility of potential control measures, proponents failed to mobilize state support for regulatory considerations. In addition, opponents called into question the general need for addressing black carbon (IMO 2011d, para. 4.19). As shown in the ideational-interventionist analysis, this partly reflected the still underdeveloped narrative of environmental activists and the limited scientific knowledge. However, it was also in line with the prediction of argumentative coproduction that propositions on both regulatory need and feasibility matter for state preferences. The resulting decision to refrain from black carbon regulation closed off a potential pathway towards early restrictions of HFO use in the Arctic.

The Second Key Moment

At the critical moment in 2012, differences in domestic policies and industry practices contributed to the Arctic Council's decision not to prepare a proposal for HFO regulation. As with black carbon, the activities of the Arctic Council on HFO began with the Arctic Marine Shipping Assessment in 2009 (Interview 14). The report identified accidental oil spillages as the most serious environmental threat from ships in the Arctic (Arctic Council 2009a, 152). Based on this finding, the Arctic Council working group PAME planned to identify risk mitigation options for HFO use and carriage, "aiming at [the] establishment of appropriate international regulations" (PAME 2009, annex V, 2). The Norwegian proposal guiding this work had two stages: the compilation of knowledge on the prevalence, risks, and environmental effects of HFO in Arctic shipping; and the development of a joint regulatory proposal for submission to the IMO (Norway in PAME 2010, annex II, 7). The latter goal was quickly watered down, delayed, and eventually dismissed (PAME 2011, annex IV). This is perhaps not surprising from an institutional perspective considering that the Arctic Council generally focuses on generative rather than regulatory tasks. However, struggles over HFO regulation even continued in PAME's study work. For instance, the Arctic states were "unable to reach consensus on the inclusion in the HFO Phase II analysis of a ban on the use of HFO in the Arctic" (PAME 2012, 4). Argumentative coproduction suggests that this disagreement was rooted in competing business practices and expertise.

Norway's role as a proponent of international regulation on HFO reflected its domestic policy agenda and business practices. Already in 2007, Norway had banned HFO in protected areas of the Arctic archipelago of Svalbard to reduce pollution risks. The local ban, which primarily targeted cruise ships, was extended in 2009/10 (Norwegian Ministry of Justice and Public Security 2017, 60). Around that time, Hurtigruten, operating cruises along the Norwegian coast as well as to Svalbard and other polar destinations, phased out HFO from its fleet (Digges 2019; Hurtigruten 2018, 14). This decision allowed Hurtigruten to maintain its green image and to avoid public outrage in case of accidental spills which would threaten its social license to operate. In conjunction with the ban in Svalbard, the expedition cruise association AECO adopted an operational guideline recommending its members to refrain from using HFO (Interview 13; cf. Evenset and Christensen 2011, 41). In contrast to the expedition cruise companies, overseas cruise companies continued using HFO. Norway granted an exception for HFO use in certain areas around Svalbard until 2015 to allow "the cruise industry to adjust to the new fuel quality requirement" (Norwegian Ministry of Justice and the Police 2010, 119). When the exception expired, a diversion of large overseas cruise ships away from Svalbard was feared (Norwegian Polar Institute 2019; *The Telegraph* 2016). An Arctic-wide HFO ban was an opportunity for putting Svalbard and competing cruise destinations on equal footing. The practices of the expedition cruise operators had demonstrated that a transition to lighter fuels was feasible (see Table 18).

The Norwegian experiences contrasted with those of several other Arctic states where the use of HFO was still unrestricted and widespread. In 2012, a study commissioned by the Arctic Council identified large ships on longer routes as the main users. Hotspots were the Russian Northern Sea Route and the Greenlandic West coast as well as routes to the Canadian Hudson Bay and around Svalbard (DNV 2011, 31–33). The data did not allow for assessing the impacts of possible fuel restrictions for each country though.[68] The study reported industry experiences but did not feature notable frontrunner practices.[69] The Royal Arctic Line, a cargo line serving Greenland, was quoted to prefer switching to cleaner distillate fuel. However, affordability was an issue: "the significantly higher price […] means that this alternative is not considered profitable" (DNV 2011, 12). Besides the challenge of affordability, it was also noted that technical problems might arise if distillate fuels were used in machinery not designed for them. The study explained that "*most* marine engines running on HFO will have been designed for operation also on distillate fuels of marine diesel oil quality […], but not necessarily on marine gas oils […]" (DNV 2011, 8, my emphasis). The term "most" signals that some ships (the number of which was unknown) might face problems in case of a mandatory fuel change. Furthermore, the availability of fuel alternatives in remote parts of the Canadian and Russian Arctic was more of a challenge then in Europe (Interview 13). Thus, there were still several techno-economic unknowns or obstacles to an HFO phaseout.

Table 18: Business practices and expertise in fuel use in the Arctic, 2009-2014

Progressive	**1 business association** Association of Arctic Expedition Cruise Operators (AECO)
	Expedition cruise operators Hurtigruten (Norway), other AECO member companies
Unprogressive	**DNV studies on HFO use** HFO mainly used by large ships on longer routes in 2010; 75% of all fuel onboard ships in the Arctic in 2012 was HFO
	Shipping companies Royal Arctic Line (Denmark-Greenland), Seamar Management (Greece), Tschudi Group (Norway), overseas cruise companies, and others

Source: Author.

This uncertainty about the implications of an HFO ban impeded the mobilization of support for the development of a regulatory proposal within the Arctic Council. As a result, regulatory negotiations shifted to the IMO. This "globalized" the issue of HFO use in the Arctic and extended the circle of audience states that could be mobilized or

[68] For instance, the study did not provide detailed data on the share of HFO within the fleet and resupply operations of each Arctic state. Additionally, it did not capture seasonal variations as it only covered four months of ship data (DNV 2011, 5).

[69] The only first-mover practice reported was the fuel conversion of a Swedish icebreaker in response to the HFO ban adopted for Antarctica in 2010 (DNV 2011, 11). However, experiences from the Antarctic region did not appear very relevant for the Arctic because of differences in infrastructure and marine use (Norway in PAME 2010, annex II, 6).

persuaded by proponents and opponents. Additionally, the involvement of business experts increased as they have greater access to the IMO than to the Arctic Council. In the long run, these new institutional conditions were going to prove conducive to technological arguing over HFO use and regulation.

The Third Key Moment

At the branching point in 2013/14, the IMO had the opportunity to agree on a binding ban of HFO in Arctic shipping. The issue came up in negotiations of the Polar Code, which addresses safety and environmental aspects of Arctic and Antarctic shipping. In 2013, environmental NGOs proposed to add to the code a mandatory ban of HFO in the Arctic and a provision on black carbon (CSC et al. 2013; FOEI et al. 2013). Both proposals were rejected at the 57th session of the IMO Sub-Committee on Ship Design and Equipment (DE 57) and at MEPC 65 (IMO 2013a; 2013b; 2013d, para. 11.21; 2013e, para. 11.44, 11.53). As a substitute for a mandatory ban, a nonbinding provision recommending ships to neither use nor carry HFO in the Arctic was proposed (Germany 2014, para. 5.2; IMO 2013f, annex, 58). In 2014, the member states agreed on the nonmandatory language for this provision and incorporated it into the code (IMO 2014e, para. 11.40; 2014g, annex 1, 5; United Kingdom 2014, annex 1, 7). The provision states that "ships are encouraged to apply regulation 43 of MARPOL Annex I [i.e., the regulation that bans HFO in Antarctic waters] when operating in Arctic waters" (IMO 2015b, annex, part II-B, para. 1.1). It is precise and ambitious but neither binding nor monitored. This outcome of the first part of the process reflects the widespread use of HFO and concerns about the feasibility of its mandatory phaseout.

The incorporation of a nonbinding provision into the Polar Code was a compromise between supporters and opponents of a mandatory ban (see Table 19). The only active supporters were the non-Arctic states France, Germany, and Spain (IMO 2013a; 2013b). Their position followed the environmentalist interpretation of existing business practices. In this view, the widespread use of HFO called for policy action because it entailed a high risk of ecological damages from accidental spills (FOEI, CSC, et al. 2011, para. 10; FOEI et al. 2013, para. 4). This interpretation resonated with experiences of the three states because each of them had suffered high ecological damages from ship-related oil spills in the past (Interview 14).[70]

[70] Notably, the Pallas oil spill in Germany in 1998, the Amoco Cadiz and Erika oil spills in France in 1978 and 1999, and the Prestige oil spill in Spain in 2002.

Table 19: IMO member state positions on incorporation of HFO ban into the Polar Code, 2013

	Supported ban	**Did not endorse ban**	**No position taken**	**Opposed ban**
Proponents	-	**(Finland)** **Norway** **(US)**	-	-
Opponents	-	-	-	**Canada** **Russia**
Audience	France Germany Spain	Australia	Sweden +all other IMO member states	Denmark Dominica Iceland Liberia Marshall Isl. Panama

Source: Author. Positions according to IMO (2013b).

Norway and the US generally supported the idea of an HFO ban but did not actively endorse its inclusion into the Polar Code (IMO 2013a; 2013b; 2013e, para. 11.53). Norway argued that an HFO ban required in-depth discussion because it involved many policy questions (IMO 2013a). These included challenges related to feasibility. In 2013, associations of the oil and tanker industries listed the technical modifications that a fuel changeover required on ships. They noted that the properties of HFO and distillate fuel "result in significant differences with regard to the safe operation of installed systems" (INTERTANKO and OCIMF 2013, 4). In 2014, based on industry information, specialized media reported that fuel switches en route can cause a loss of propulsion and thus accidents and spills (*S&P Global Platts* 2014a; *S&P Global Platts* 2014b). The reports related to experiences with air emission regulation in Californian waters but were also relevant for fuel restrictions elsewhere. Uncertainty about pending IMO emission regulation and its impact on fuel availability added further complexity (Azzarra 2014). Admittedly, the documented negotiations do not feature explicit arguing about these aspects.[71] Yet, strategically, technological uncertainties increased the risk that negotiations on an HFO ban would delay or shipwreck the entire Polar Code.

[71] The lack of in-depth arguing may be due to limited time resources of committees and sub-committees given the large amount of issues covered by the Polar Code negotiations. It may also be an artefact of the available data though as the documentation of working group meetings and correspondence group work provides little or no details on the discussions.

Clear opponents of an HFO ban were Canada, Russia, and major flag states like Liberia, the Marshall Islands, and Panama. An HFO ban would have created techno-economic challenges for businesses aligned with these states. The large ships consuming most HFO are often registered with flags of convenience (cf. Comer et al. 2017, 29) and the routes with the highest HFO use are in the Canadian and Russian Arctic. One main opponent concern was that an HFO ban "would lead to a significant increase in shipping costs in polar areas" (Russian Federation in IMO 2012b, annex 21, 1). Another concern was the unclear impact on industries dependent on HFO, such as resource extraction, and on the resupply of Arctic communities (Bognar 2018, 38–39; IMO 2013b). In 2013, an updated study commissioned by the Arctic Council found that HFO accounted for 75% of the total bunker fuel onboard ships in Arctic waters (DNV 2013, 6). The owner of Tschudi Group, a Norwegian shipping company operating in the Russian Arctic, warned that an HFO ban would divert future transit shipping away from the Arctic. He backed his argument by underlining that "there are no large vessels, like bulk-carriers, that are not running on heavy fuel oil today" (Tschudi in *Barents Observer* 2014). For instance, in 2013, the MV Nordic Orion transporting 73,500 tons of coking coal became the largest bulk carrier to have transited the Northwest Passage. The ship, which was operated by Seamar Management (Greece) and sailing under the flag of Panama, completed its journey on HFO. Widespread HFO use thus provided strong techno-economic arguments against a ban.

The incorporation of a recommendation on HFO into the Polar Code was acceptable for both the supporters and opponents of a mandatory ban. For the supporters, a nonbinding recommendation allowed for flagging HFO use as an issue for future consideration (Interview 11; Interview 12; Interview 13). By defining a new best practice, it also created an incentive for shipping companies to voluntarily halt the use of HFO. For the opponents of stringent regulation, a nonbinding provision promised to be a toothless instrument that would not lead to actual changes in fuel use. In contrast to HFO, no recommendation for reducing emissions of black carbon was agreed on (IMO 2013a; 2013b; 2013d, para. 11.21). The main reason was procedural: the work on the sub-committee level was still ongoing and the definition and measurement of black carbon were still under discussion. It was thus too early to define a best practice for black carbon.

The adoption of the HFO recommendation in the Polar Code marked the end of the first part of the negotiations. As shown in the material-evolutionist analysis, this outcome partly resulted from issue linkages within the broader Polar Code negotiations. However, these linkages only became relevant because an HFO phaseout would have entailed several challenges in terms of techno-economic feasibility. Absent such feasibility challenges, it appears much more likely that Finland, Norway, and the US would have actively supported a ban already at this point. Active support by Arctic states could have also mobilized greater support from non-Arctic observers in the Arctic Council. However, as only very few visible shipping companies had already phased out HFO from their fleets, no active proponents of an HFO ban emerged and the few supporters were unable to prove its feasibility. This situation was going to change in the second part of the process when more companies adopted progressive fuel practices. In addition, the time and negotiation constraints imposed by the comprehensive policy package of the Polar Code disappeared.

The Fourth Key Moment

At the critical moment in 2017, the IMO adopted a new work output on the mitigation of HFO risks in the Arctic. In 2016, Canada and the United States (2016, paras. 7–8) announced that they were working with stakeholders on risk mitigation options. The Arctic Council also invited proposals for risk mitigation (PAME 2016a, 3). Environmentalists suggested that the organization could pioneer the phaseout of HFO, but its members kept the focus on information gathering (CCU and WWF 2016; PAME 2016b, 5). This corresponded to the institutional identity of the Arctic Council as a place mainly for knowledge creation rather than regulation. In the IMO, however, the US-Canadian initiative produced a proposal for a new work output. Together with five other states, they proposed "to develop measures to reduce environmental risks of use and carriage of HFO as fuel by ships in Arctic waters, particularly with respect to environmental damage associated with potential spills of that fuel" (Canada et al. 2017, para. 2). In July 2017, MEPC 71 unanimously decided to put this new output onto the committee's biennial agenda but left open the legal design of the future policy (IMO 2017e, para. 14.13). This decision had been facilitated by new business practices and expertise.

Norway, Finland, and the US became vocal proponents of working towards an HFO ban in conjunction with changing domestic business practices. In Norway, the expedition cruise operator Hurtigruten teamed up with environmental NGOs. In January 2017, Hurtigruten signed the Arctic Commitment, a declaration which called for a voluntary HFO phaseout by shipping companies and a mandatory ban by the IMO. Moreover, the Norway-based association AECO had in place a no-HFO policy for its members.[72] In July 2017, also the national shipping association of Norway expressed its support for an HFO ban (Norwegian Shipowners 'Association 2017). In Finland, the important icebreaking industry moved towards LNG as an alternative fuel. In September 2016, a Finnish shipyard, co-financed by the EU, delivered the world´s first icebreaker running on LNG and low-sulfur diesel (Arctia 2016a). The state-owned icebreaking service provider Arctia declared its support for an HFO ban in the Arctic. It believed "that the use of LNG and the vessel's built-in oil recovery system are the future of cost-effective multipurpose icebreakers" (Arctia 2016b). In the US, the Californian cruise company Crystal Cruises used distillate fuel for a much publicized voyage through the Northwest Passage in summer 2016 (Comer, Olmer, and Mao 2016, 6; *The Guardian* 2016). From the perspective of these business practices, an HFO ban would level the playing field in ship operation and create new markets in shipbuilding.

New expertise on fuel alternatives to HFO was also conducive to regulatory work. In 2008, the IMO had adopted new global air emission regulations that lowered the maximum sulfur content of ship fuel from 3.5% to 0.5% in 2020 (IMO 2008a, regulation 14). The application date of this regulation was reviewed in 2016 with respect to whether the supply of compliant low-sulfur fuels would be large enough to replace high-sulfur fuels. In July 2016, a comprehensive study commissioned by the IMO confirmed that the production of compliant fuel would meet the expected demand in 2020 (Faber 2016, 13). In October 2016, the IMO confirmed that the new sulfur limit should become effective from 2020 (IMO 2016d). This did not eliminate the need for HFO regulation as the sulfur limit can be met with new HFO blends or exhaust gas cleaning (Prior and Walsh 2018, 8). However, it was recognized that the "global sulphur cap requirement is expected to result in the increasing availability and use of marine distillate fuels globally, including in the Arctic" (Canada et al. 2017, para. 5). Fears about the safety implication of a fuel changeover were qualified by a new scientific report stating that "barriers to successful fuel switching are minimal with written protocols, training, and minimal equipment retrofits required" (Lack 2016, 14). Thus, with respect to fuel availability and safety, an HFO ban now appeared feasible.

In contrast to these developments, Arctic-wide practices of HFO use were interpreted differently regarding the feasibility of a ban. An ICCT study found that, in 2015, only 44% of all ships in the Arctic had used HFO. When considering the distances sailed,

[72] Although this was not cited as an adequate industry standard in the proposal for the new IMO work output, it can be assumed that at least the delegates from Arctic states were aware of the practices in the cruise and expedition sectors.

HFO accounted for 56% of all onboard fuel transports (Comer, Olmer, and Mao 2016, 5). On the one hand, this signaled that HFO still constituted an environmental threat but that a phaseout was possible. Accordingly, the adoption of a new work output marked a first step towards an HFO ban for most proponents and supporters. For instance, Germany and the Netherlands followed government strategies or parliamentary mandates which aimed for an HFO ban (Auswärtiges Amt 2013, 8–9; Tweede Kamer der Staten-Generaal 2017). These strategies and mandates reflected environmental concerns in the administration and the public (Interview 10; Interview 11). In Iceland, domestic concerns about air pollution from ships had created a momentum for an HFO ban and the country's ports even signed the Arctic Commitment of the Clean Arctic Alliance (*World Maritime News* 2017; *High North News* 2018).

On the other hand, the existing practices nourished concerns of opponents that the industry was unable to afford a ban. Part of what might look like a voluntary phaseout of HFO by the industry merely reflects operational considerations. For instance, many smaller ships and ships engaged in ice management tend to use distillate fuel as HFO is impractical for their operations (Interview 12; Interview 14). The work proposal co-sponsored by Canada called for "a pragmatic solution that effectively addresses environmental concerns, considers impacts on Arctic communities and economies, and facilitates transition for industry" (Canada et al. 2017, para. 11). Russia floated ideas on more affordable accident prevention measures, such as ship routeing (Russian Federation 2016c, para. 11). Somewhat surprisingly, the major non-Arctic flag states remained passive in the discussions on the new work output.

Like the nonbinding recommendation on the Polar Code, a new IMO work output on HFO had different meanings for different actors. For the proponents of an HFO ban, it was a first step into this direction. Both the availability and safety of fuel alternatives were now undisputed. As the feasibility barriers to a ban seemed to have decreased, the proponents were able to mobilize growing support from other IMO member states. By contrast, for the opponents of a ban, the new work output was an opportunity to steer discussions towards other policy options than a ban. Their support for the work output was thus not a result of ideational influence exerted by environmental activists and scientists. Instead, the opponents remained concerned about the affordability of a ban. This facet of technological arguing was set to resurface soon again.

The Fifth Key Moment

At the branching point in 2018, feasibility aspects mattered in the decision of the IMO to develop an HFO fuel ban for Arctic shipping. At MEPC 72, three policy proposals were tabled. First, eight states jointly proposed the development of a mandatory ban of HFO use and carriage for use as fuel (Finland et al. 2018). The sponsors were Finland, Iceland, Norway, Sweden, and the United States as well as Germany, the Netherlands, and New Zealand. They envisaged stringent regulation in the form of a formally tight and ambitious ban with limited transitional exemptions. Second, Canada and the Marshall Islands (2018) pushed for an impact assessment before developing regulation. Third, Russia proposed alternative risk mitigation measures instead of a ban (Russian Federation 2018b). These measures related to navigation, ship operation, infrastructure and communication, emergency preparedness, and training (Russian Federation 2018a, para. 8). Their codification in nonbinding, unmonitored guidelines would not exceed an intermediate level of stringency. As shown in Table 20, the first two proposals received wide support; the third one only some (IMO 2018b; 2018d, para. 11.4-11.5). The IMO decided to develop an HFO ban based on an impact assessment and to compile complementary guidelines (IMO 2018d, para. 11.9). Technological arguing can explain why support for the three proposals differed.

Russia opposed an HFO ban on various grounds. It contended that the probability of a fuel spill was low; that HFO did not cause higher damages than distillate fuel; that an HFO ban could procedurally only be "a last resort;" that a ban would negatively affect sea trade; and that it faced feasibility constraints (Russian Federation 2018a; 2018b; IMO 2018b). With respect to feasibility, the Russian delegation argued that:

> "Some local areas of the Russian Arctic are 100% dependent on external supply, including the supply of liquid fuel for heat power industry. The supply is provided by cargo ships and it is limited by the short navigation period. The said ships mainly operate on HFO and the conversion to alternative fuels is not possible within a short time." (Russian Federation 2018a, para. 7)

The propositions about the importance of maritime supply in the Russian Arctic corresponded to findings of previous HFO studies (Comer et al. 2017; DNV 2013). The propositions about technical barriers mattered for the implementation of future regulation. Russia is the country with the largest Arctic population and territory and by far the highest total HFO consumption by ships in Arctic waters.

Table 20: IMO member state positions on the development of a mandatory HFO ban, 2018

	Supported ban	Supported impact study	No position taken	Opposed ban
Proponents	**Finland** **Norway** **US**	**Finland**	-	-
Opponents	-	**Canada**	-	**Russia**
Audience	Australia Belgium Czech Rep. Denmark Estonia France Germany Iceland Ireland Japan Netherlands New Zealand Poland Portugal Spain Sweden Switzerland	Bahamas Belgium China Denmark Estonia Ireland Japan Netherlands New Zealand Marshall Isl. Poland Sweden	Dominica Liberia Panama +all other IMO member states	China

Source: Author. Positions according to IMO (2018d).

Still, Russia failed to mobilize skeptical audience states to oppose a ban. Unusually long, repeated interventions by its delegation at MEPC 72 created the impression of principled rather than reasoned opposition to an HFO ban. The plethora of arguments against an HFO ban can be considered an example of belief system overkill and inhibited focused deliberation. Moreover, the feasibility-related argument lacked credibility as it was not backed with any tangible evidence at that point in time. The industry observers of BIMCO and ICS which supported the Russian proposal did not provide any evidence either (IMO 2018b). Among all IMO member states, only China aligned itself with Russia (IMO 2018d). This primarily seems to reflect China's strategic interest in low-cost maritime transport along the Northern Sea Route as part of a new "Polar Silk Route" (Blunden 2012, 125–27; State Council Information Office of the People's Republic of China 2018). For instance, the major Chinese shipping company COSCO has not responded to a request by environmentalists about its HFO use in the Arctic (Walsh 2018). Germany and the Netherlands also supported the nonbinding guidelines proposed by

Russia, but only as a complementary measure to an HFO ban. Germany clearly defended the need for a ban by rebutting the Russian argument that HFO spills would cause less damage than distillate fuel spills (IMO 2018b).

Canada, supported by the Marshall Islands, did not oppose an HFO ban in general but questioned its affordability. The two states opined that "potential impacts of the measures on Arctic communities and economies should be taken into account" (Canada and Marshall Islands 2018, para. 4). Their arguments were more focused than those put forward by Russia. They recognized the need for protecting the Arctic from impacts of HFO use but stressed that the economic implications of regulatory measures were not fully understood yet (Canada and Marshall Islands 2018, para. 3; IMO 2018d). They also reminded delegations that this concern had already been raised in the proposal for a new work output adopted in 2017 (Canada and Marshall Islands 2018, para. 2).

The proposal for an impact assessment persuaded and mobilized states from two camps. One camp comprised the Bahamas and China which were skeptical towards an HFO ban. Like China, the Bahamas appeared concerned about the impacts on their own fleet. One major study had identified the Bahamas as a leading flag state in Arctic shipping, with 70% of its fleet in the geographic Arctic operating on HFO (Comer et al. 2017, 28). The other camp backing an impact assessment comprised nine states that also supported an HFO ban. In their short interventions, seven of them explicitly referred to the Canadian argument about potential impacts on local and indigenous communities. Denmark, Finland, and Sweden have own indigenous populations. Other IMO delegates had attended a lunch-time presentation where indigenous representatives called for an inclusion into the process. Additionally, an impact assessment was an acceptable way forward for parts of the shipping industry (Danish Shipowners' Association 2018).

The proponents of an HFO ban made two main arguments for the feasibility of a fuel transition in the Arctic. First, they argued that new global sulfur regulation would trigger a switch to distillate fuel before the entry into force of the ban in 2021:

> "The mandatory global cap on marine fuel sulphur content, to be implemented in 2020, is expected to expand the range of fuels in use globally. Therefore, by 2021 it is expected that marine distillate fuels will be increasingly available and that many ships will have switched to using them." (Finland et al. 2018, para. 4)

This argument stood largely unchallenged. BIMCO and CLIA noted that it was unclear which fuel blends would fall under an HFO ban but did not question the availability of fuel alternatives (CLIA 2018, para. 6; IMO 2018b). Without the global sulfur cap and the anticipated changes in fuel practices, uncertainty about the availability of distillate fuels would have likely been higher. For instance, especially in the Canadian and Russian Arctic, distillate fuel bunkering has been challenging in the past (Interview 13).

Second, the proponents reduced the ban in scope by foreseeing temporary exemptions for ships with fuel tank protection. While environmentalists feared persistent spill risks (CSC et al. 2018, para. 5), this design choice was meant to overcome practical constraints and dampen the economic effects of a ban. The proponents argued that:

> "Arctic communities and industries could have additional time to adjust their port and ship operations to the HFO ban. Delayed implementation for ships with fuel tank protections also provides the international shipping community with additional flexibility as an expanded range of marine fuels comes to market." (Finland et al. 2018, para. 5)

With these arguments, the proponents successfully mobilized or persuaded nine EU member states as well as Australia, Japan, and Switzerland to support an HFO ban. Several oral interventions of these delegations acknowledged the need for regulatory action, and some also explicitly referred to feasibility aspects (IMO 2018b). One delegation highlighted that alternatives to HFO were readily available; another one stressed that regulation should be based on reliable evidence. Continued concerns about affordability among these supporters were accommodated by the parallel agreement on an impact assessment. This way forward was also acceptable to the shipping industry, which otherwise would have been a candidate for opposition. Thus, somewhat ironically, the prospect of an impact assessment seems to have created wider support for an HFO ban.

In summary, arguing over feasibility shaped the decision to develop an HFO ban. The decision built on the general idea promoted by environmental NGOs and scientists that regulatory measures were needed to address the risks posed by HFO use in Arctic shipping. However, techno-economic barriers had the potential to block regulatory progress. While the availability of fuel alternatives was expected to improve, affordability concerns remained valid. These concerns got reflected in the agreement to conduct an impact assessment and in temporary exemptions from the proposed ban. Hence, the content of bargains was informed by arguments about techno-economic feasibility. Based on the impact assessment results, these arguments were going to develop further and shape the design of the HFO ban.

The Sixth Key Moment

At the critical moment in 2020, the IMO specified the design of the future HFO ban. In February 2020, the IMO Sub-Committee for Pollution Prevention and Response (PPR) discussed a regulatory draft co-sponsored by eleven states. They proposed a comprehensive ban of HFO use and carriage for use as fuel by ships in the Arctic, with a five-year exemption for ships with fuel tank protection (Denmark et al. 2019). Russia still considered "it impractical to develop the ban" but proposed additional permanent exemptions in case a ban is pursued (Russian Federation 2019b, para. 17). These exemptions would have greatly reduced the scope of the ban. Canada (2020) took a middle position as it supported a ban with delayed implementation and extensive transitional exemptions. The PPR sub-committee eventually agreed on a draft regulation which would delay the HFO ban in the Arctic until July 2024. A five-year exemption would be possible for ships with fuel tank protection like double hulls as well as for ships registered in Arctic coastal states and operating within their waters (IMO 2020f; 2020g, annex 12). To what extent was this draft regulation, which is expected to be finalized and adopted by MEPC in 2020 or 2021, influenced or shaped by business practices and expertise?

Impact assessments submitted by Norway and the US confirmed the feasibility of an HFO ban based on existing business practices. Norway (2019, annex, 31) expects only limited costs from a ban. Cruise ships would be most affected, but several operators have already phased out HFO voluntarily because of image concerns, their commitment to sustainable tourism, or to create an additional selling point (Norway 2019, annex, 21; Interview 13; Interview 14). Recently, industry leader Carnival Corporation and smaller companies, like Hapag-Lloyd Cruises, have renounced HFO use in the Arctic (Hapag-Lloyd Cruises 2019; *Marine Insight* 2019a). The members of AECO have upgraded their operational guideline into a mandatory HFO ban within their association (Interview 13). Compared to Norway, the US expects much higher increases in transportation costs, especially for bulk carriers and tankers (United States 2019, paras. 4–5). Affordability concerns would be dampened though by the five-year exemption for ships with fuel tank protection covering approximately 77% of the bulk carriers using HFO in Alaska (United States 2019, para. 8). By contrast, impacts on food supply for indigenous and local communities were expected to be low "as most food items are imported via airplanes or tugs and barges, which operate on distillate fuels" (United States 2019, para. 6). Neither report mentions technical barriers to an HFO phaseout.

Denmark became supportive of an HFO ban as domestic political and business considerations were converging. In 2018, based on an impact study, the Greenlandic government expressed support for an HFO ban (*The Maritime Executive* 2018). Greenland's main cargo carrier, Royal Arctic Line, declared that it was "likely to be positive about a ban on using HFO in the Arctic" (Hammeken in *ArcticToday* 2018), even though a preference for delayed implementation was made public after PPR 7.[73] The owner of a Greenlandic mining project, Ironbark Zinc, chartered a cargo ship owned by the Canadian Fednav to operate on distillate fuel instead of HFO (Ironbark Zinc Limited 2018). Outside of Greenland, the Danish container giant Maersk chose ultra-low sulfur fuel for a ship transit through the Northern Sea Route (CAA 2018a; *World Maritime News* 2018). Maersk also announced to aim for carbon neutrality by 2050, requiring the use of carbon-free fuels (A.P. Møller - Mærsk A/S 2018). These Danish company decisions at least partly responded to pressure from environmentalists (CAA 2018a; *Nunatsiaq News* 2018a; *High North News* 2020). They may explain why Denmark remains committed to an HFO ban despite much higher costs revealed by a recent impact study (Denmark 2018; 2019).

Favorable non-Arctic audience states have continued to actively support a ban, in line with ever more progressive business practices (see Table 21). A major development has been that shippers like IKEA, Nike, and H&M increasingly raise questions about Arctic shipping practices (Interview 14). Nike and the environmental NGO Ocean Conservancy, together with other global manufacturers, launched the Arctic Corporate Shipping Pledge which includes a commitment to refraining from trans-Arctic shipping (*High North News* 2019). Major container liners like CMA CGM, MSC, Evergreen Line, and Hapag Lloyd have signed this pledge (Ocean Conservancy 2020). In addition, the French expedition cruise operator Ponant phased out HFO from its fleet (*The Medi Telegraph* 2019). An HFO ban would put the competitors of all these companies on a level playing field or prevent them from using the Northern Sea Route in cost-efficient ways. Moreover, also the German port authority bremenports (2018) supported the call for an HFO ban. This can be interpreted as an attempt to increase the social acceptance of a deep-water port project in Finnafjord, Northeast Iceland, in which bremenports

[73] The CEO of the state-owned company expressed hopes that the Greenlandic government would exempt the company's ships from the HFO ban until 2029. He also proposed to push this date further to 2040. Environmental NGOs reacted with strong criticism and asked the Greenlandic government to replace the company management. Faced with this public criticism, the company reiterated its general support for an HFO ban and referred to its ongoing preparations for a fuel change onboard its ships. (cf. *High North News* 2020)

holds major shares. These business practices provided additional support for the view of favorable audience states like France and Germany that an HFO ban is both timely and feasible.

Table 21: Business practices and expertise in fuel use in the Arctic, 2015-2019

Progressive	**ICCT studies on HFO use** HFO share of fuel onboard ships in the Arctic down to 56% in 2015; use of LNG growing **1 business association** AECO **≥20 expedition cruise operators** Hurtigruten (Norway); Ponant (France); Silversea (Monaco); and ~20 other AECO member companies (incl. Australia, Canada, Netherlands, US) **3 overseas cruise companies** Carnival Corp. (UK/US); Crystal Cruises (US); Hapag Lloyd Cruises (Germany) **≥7 shipping companies** Arctia (Finland); CMA CGM (France); Evergreen Line (Taiwan); Hapag Lloyd (Germany); Hudson Shipping Lines (US); Maersk (Denmark); MSC (Switzerland); Sovcomflot (Russia) **Charterer** Ironbark Zinc (Australia/Greenland) **Shippers** H&M, IKEA Supply, Nike, Puma, and others **Ports** Bremenports (Germany); Associated Icelandic Ports and Faxaports (Iceland)
Unprogressive	**ICCT study on HFO use** Almost all fuel on ships from Liberia, Panama, Marshall Islands, and Malta was HFO in 2015; most HFO on board of bulk carriers, container ships, oil tankers, and general cargo ships **ICCT study on HFO use** HFO share of fuel onboard ships in the Arctic up to 67% in 2017 **Resupply shipping** Canadian sealift and Russian Northern supply still reliant on HFO; older Russian ships not able to switch to distillate fuel **Shipping companies** COSCO (China)

Source: Author.

Importantly, technological arguing within the IMO partially changed the position of previous opponents like Canada. The Canadian position reflects a tension between indigenous calls for an HFO ban (*Nunatsiaq News* 2018b; *Nunatsiaq News* 2018c) and affordability issues raised by shipping companies (*ArcticToday* 2017). The Canadian impact assessment acknowledged the benefits of a ban in reducing spill risks, emissions of black carbon, and other air pollutants (Canada 2019, paras. 10–31). However, it also found that "any projected increase in fuel prices that would result from a ban will be transferred to consumers, who already face very high prices for goods and store-bought foods" (Canada 2019, para. 54). This argument has not been confronted effectively by environmental NGOs that generally place strong emphasis on the rights and concerns of indigenous people (Interview 14). Moreover, higher transport costs "could impact the competitiveness of Canada's mining sector and Canada's only northern port shipping grain overseas" (Canada 2019, para. 55). Fednav, which is the country's largest shipping company, operates many of the mining routes with large bulk carriers. At the occasion of PPR 7, Canada (2020) aptly linked these concerns to increasing price volatilities and uncertainties about future fuel qualities resulting from the new global sulfur regulation. This undermined proponents' earlier argument that new sulfur regulation would support an HFO phaseout.

Likewise, Russia no longer categorically opposed an HFO ban. As shown before, Russian arguments about an allegedly low need for restricting HFO use in the Arctic had been rebutted by proponents of a ban. The reorientation of the Russian position was preceded by a change in domestic business practices. State-owned Sovcomflot, which is the country's largest shipping company, has put itself at the forefront of the shift from oil-based fuels to LNG (*Riviera Maritime Media* 2017). The marine bunker supplier Gazpromneft will stop trading fuel oil in 2025 (*S&P Global Platts* 2018). In conjunction with a greater use of LNG, the Russian government has signaled some openness towards an HFO ban (*The Arctic* 2017). In August 2018, Russian President Putin endorsed a call by the Finnish president for cleaner fuels in the Arctic (*PortNews 2018)*. Thus, commercial interests in creating new markets for Russian LNG have reduced opposition to an HFO ban.

Still, Russia faces techno-economic barriers to a rapid HFO phaseout in the Arctic. The Russian impact assessment highlighted the implications of a ban for the "Northern Supply" of its Arctic communities and industries. A major barrier is that most ships involved in the Northern Supply are old and "were not primarily designed for constant use of distillate fuels or fuels other than HFO" (Russian Federation 2019b, para. 13). Russia argues that a comprehensive HFO ban would require decommissioning these ships and thus endanger supply. It proposed that ships older than ten years should be eligible for exemptions from the ban on domestic voyages (Russian Federation 2019b, para. 17.4). Another main barrier is affordability. An earlier study found that HFO accounted for 67% of all fuel consumed by Russian-flagged ships in the Arctic (Comer et al. 2017, 29). The recent impact assessment "revealed substantial economic losses due to the increase of cargo transportation costs when switching to more expensive alternative fuels" (Russian Federation 2019b, para. 8). The agreement of the IMO on the possibility of Arctic coastal states to exempt their ships from the HFO ban for five years directly reflects these arguments. Yet, concerns of proponents and their supporters about an "uneven playing field" prevented agreement on more far-reaching waivers (IMO 2020e, paras. 17, 20) .

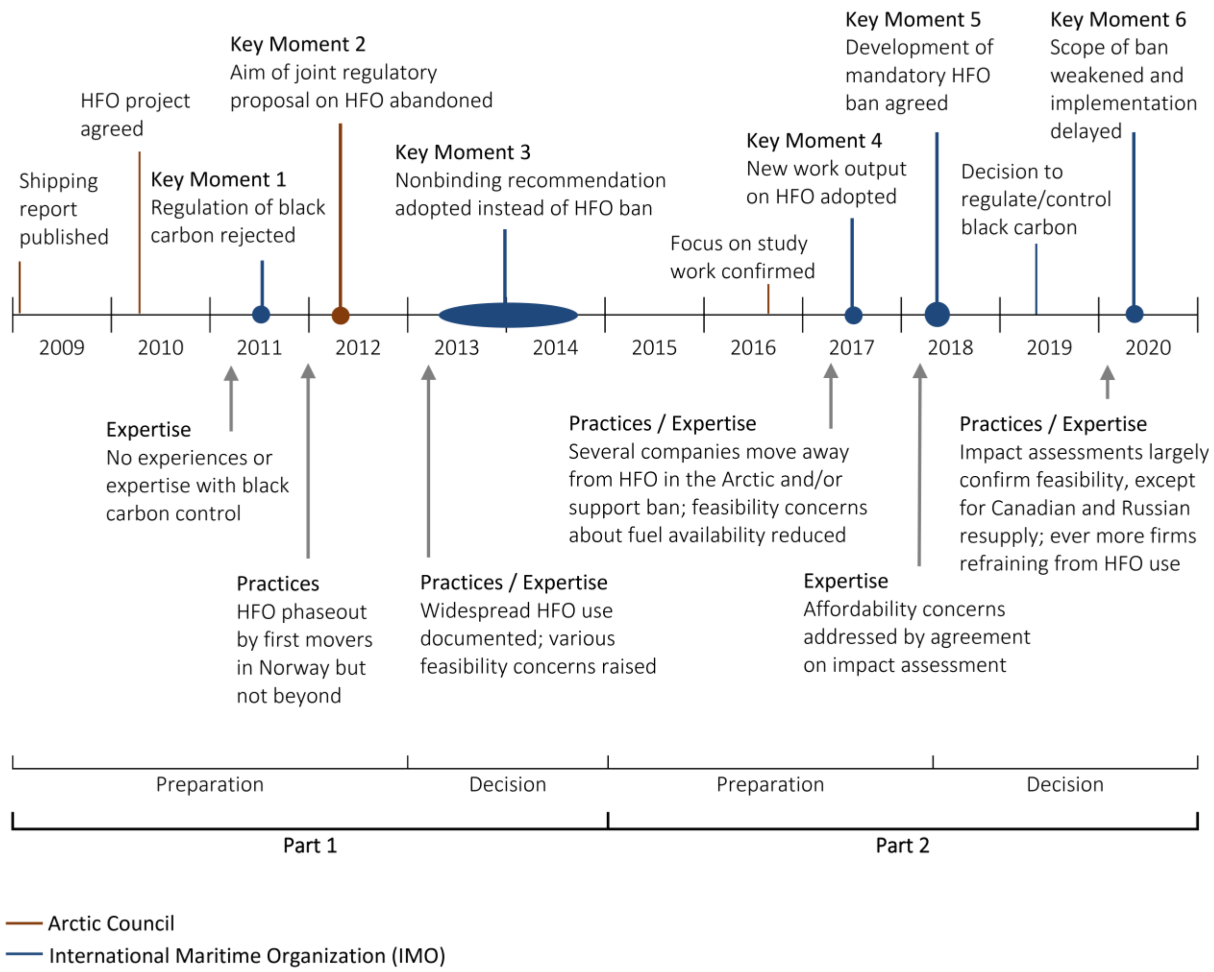
The agreement on a draft regulation reached in 2020 does not fulfill the demands of environmental NGOs. While the emerging outcome seems to reflect an interest-based bargain, its precise terms are only understood by the model of argumentative coproduction. It demonstrates that the reduced scope of regulation follows those techno-economic arguments to which the proponents of a ban did not have convincing rebuttals. For instance, one of the supporters of an HFO ban confessed that "it is clear that the Arctic regions need to be supplied and that the shipping taking place there is not necessarily in a position to instantly switch to [fuel] alternatives" (Interview 10). A decisive advantage for Canada and Russia is that they have almost exclusive knowledge about the business practices along their Arctic coastlines. Existing studies on HFO use have not provided enough information for challenging the proposition that Canadian and Russian resupply fleets would run into technical and economic problems in case of a quicker fuel transition. The prior agreement on conducting impact assessments has coerced states to consider the arguments arising out of them.

Of course, as the eventual outcome is still pending, there may be additional unforeseen bumps in the road to an HFO ban. Especially Russia, supported by China and now also Saudi Arabia, is still pressing for additional exceptions (IMO 2020g, annex 22, 9-10; 2020i, para. 14.21). It is also conceivable that the future decision on an HFO ban may still come to interact with black carbon regulation. In 2019, the IMO completed its initial work on a definition of black carbon, measurement methods, and possible control measures.[74] At MEPC 74, states agreed on regulating or otherwise controlling black carbon in a mandatory or nonmandatory form (Finland et al. 2019, para. 5.1; IMO 2019a, sec. 5; 2019e, para. 5.67). A recent expert workshop identified an HFO ban with a switch

[74] The resulting list of 41 candidate control measures included a residual fuel ban and switch to distillate fuel (IMO 2019d, annex 9). However, business experts from EUROMOT, ICS, and IPIECA questioned whether a fuel switch would reliably reduce black carbon (IMO 2019a).

to cleaner fuels as one of six appropriate policy options (Canada et al. 2019). An HFO ban appears much more feasible than most other options, such as black carbon emission limits, new fuel quality standards, and area bans for older ships. This may indirectly facilitate agreement on an HFO ban. However, it may also slow down the regulation of black carbon emission once such a ban has been adopted.

Figure 20: Business influence at key moments in HFO fuel regulation for the Arctic



Source: Author.

Summary

The perspective of argumentative coproduction reveals that concerns about the feasibility of an HFO phaseout initially inhibited a mandatory ban of this environmentally damaging fuel. A central concern has been the affordability of a fuel transition. Other concerns related to available fuel alternatives, the conversion of older ships, and safety hazards of a fuel switch. In the first part of the negotiations, these concerns were widespread as only few visible business examples of HFO phaseouts existed. As a result, an HFO ban lacked active proponents and support from audience states. In the second part of the process, many feasibility barriers disappeared as the number of companies using cleaner fuels increased (see Figure 20). Progressive business practices were driven by environmentalist campaigning, reputational risks for companies, domestic policies, and the anticipation of international regulation. Three Arctic states became active proponents that mobilized and persuaded several Arctic and non-Arctic audience states to support a binding ban. Yet, the opponents have retained argumentative power regarding potentially adverse effects of a ban on their HFO-reliant Arctic resupply shipping. Their arguments were accommodated in the recent draft regulation which delays the implementation of the HFO ban and grants far-reaching temporary exemptions. Hence, paradoxically, business practices have both facilitated a binding HFO ban and weakened its scope.

The Explanatory Power of the Three Models Compared

How congruent are the empirical observations with the different theoretical predictions about the process of HFO regulation in the Arctic Council and the IMO? This section puts the explanatory power of the three theoretical models into comparative perspective. The ideational-interventionist notion of a war of position captures the basic conflict between environmental concerns of activists and scientists and economic interests of large parts of the shipping industry. However, it risks neglecting that some business actors, such as expedition cruise companies, have supported a mandatory HFO ban. State preferences can partly be accounted for by ideas and norms held by decision-makers. Support for a ban by non-Arctic states increased following stronger ideational leadership by environmental NGOs and scientists. However, it is not certain that ideas and norms had major effects on states with material interests in Arctic shipping independent of economic lines of conflict. As predicted by the model, most business actors adopted a reluctant stance on more stringent regulation. The disruption of this initially dominant bloc after 2015 was facilitated by the creation of a sense of imminent crisis and urgency by activists and scientists. The uptake of this crisis framing by the US, Canada, and other Arctic states in 2016/17 comes closest to a piece of smoking gun evidence for the operation of an ideational-interventionist mechanism. Yet, slow progress on equally pressing black carbon regulation suggests that crisis alone may not suffice for enabling regulatory change. I also showed that the relationship between HFO regulation by states and HFO use by companies is more complex than the top-down interventionist view. Thus, based on the available empirical evidence, some predictions of ideational interventionism do not entirely pass the hoop empirically.

A material-evolutionist lens reveals that the move towards more stringent regulation was based on rising intra-business tensions about an HFO phaseout. As predicted, a distributional conflict unfolded between companies that phased out HFO and those that continued using it. These business interests also mattered for state preferences. Arctic coastal states and non-Arctic flag states with a lot of HFO-based shipping activity in the region were more opposed to a mandatory ban than others. Instances of interest-based leadership can partly explain the compromises reached between these opponents of a ban and its supporters. Smoking gun evidence includes the adoption of a nonbinding recommendation in the Polar Code in 2013/14 and the emerging consensus on a ban with limited scope in 2020. However, several shifts in state positions, like those of many non-Arctic states, were not rooted in changing business interests or bargains. Material evolutionism further suggests the availability of fuel alternatives has been a precondition for the transition towards a binding HFO ban. The timing of this ban is not comprehensible in purely material terms though. A particularly puzzling observation is that, despite their superior structural power resources, the operators of large HFO-fueled ships have lost influence in the second part of the process. In further contrast to the model's prediction, the emerging regulation is not set to merely codify the technology and practices of business Goliaths. Material evolutionism thus fails to jump through at least two important hoops. In short, both ideational interventionism and material evolutionism only account for parts of the empirical story (see Table 22).

Does argumentative coproduction provide a more complete explanation for the process and outcomes of HFO regulation in Arctic shipping? The analysis has shown that several parts of the negotiations can be understood as argumentative contests. Because of a lack of active proponents of a ban, explicit arguing was still limited around the first branching point in 2013/14. Since 2015, however, the exchange of arguments has become much more intense. States like Canada, Finland, Norway, Russia, and the US have discussed both the need for HFO regulation and its feasibility. Need has been a prominent topic until the relaunch of regulatory work on HFO in 2017, when feasibility concerns took over. Arguments and evidence about the feasibility of a mandatory HFO phaseout mattered for state positions but took a techno-economic form. Thus, technological arguing often blended into interest-based bargaining. Changing business practices and impact assessment results made several Arctic states supportive of a ban. The Finnish and Danish support for an HFO ban following the emergence of progressive domestic industry practices can count as smoking gun evidence in this respect. For other countries, it has been more difficult to demonstrate the social or temporal proximity of both elements.

Table 22: Congruence of theoretical predictions and empirical observations in HFO regulation

	Ideational interventionism	**Material evolutionism**	**Argumentative coproduction**
Actor constellation	Medium	High	High/Medium
Roots of different state preferences	Medium	High/Medium	Medium
Driver of change in state positions	Medium/Low	Medium	Medium
Role of business in regulation	High/Medium	Medium	High/Medium
Conditions for emergence of more stringent regulation	High/Medium	Low	High/Medium
Character of regulatory outcome	Low	Low	High
Overall congruence	**Medium**	**Medium**	**High/Medium**

Source: Author.

The arguments presented by states for or against the feasibility of an HFO ban reflected competing practices and expertise from the shipping sector. Business was not always able to directly communicate its expertise to regulators. Instead, fuel practices in Arctic shipping were gathered and reported in studies by consultancies commissioned by the Arctic Council or conducted by research bodies with links to environmental NGOs. Media reports also captured corporate environmental practices, even though it is not clear which reports policymakers noticed. It is interesting that pressure by environmental NGOs was an important driver of more progressive corporate practices. In line with the prediction of argumentative coproduction, the phaseout of HFO by visible frontrunners supported arguments for the feasibility of a ban. At the same time, a lack of progressive practices in some Arctic shipping segments made it difficult to invalidate arguments about remaining techno-economic barriers to a fuel transition. A piece of smoking gun evidence is the weakening of the ban's scope in 2020 following new Canadian and

Russian arguments and evidence about their HFO-reliant resupply shipping. This suggests that first-mover business practices in all major segments are a prerequisite for the emergence of more stringent regulation.

Finally, the emerging HFO ban can be considered a technology-reinforcing regulation. Initial users of lighter fuels have been expedition cruise companies and smaller ships, while many overseas cruise companies and large cargo ships are still using HFO. Thus, when fully in effect, an HFO ban will require all companies to adopt the practices that some smaller frontrunners initially implemented and that are now spreading to ever more larger companies. Overall, argumentative coproduction thus provides a relatively sound explanation for the process and outcomes of HFO regulation in the Arctic. Yet, the case also demonstrates that ideational-interventionist and material-evolutionist explanations are needed to account for those parts of the process where technological arguing was limited.

Case Summary

In this chapter, I examined the regulation of HFO use in Arctic shipping since 2009. The use of HFO poses environmental threats in case of accidental spillage and contributes to operational emissions of black carbon. Spills of HFO can cause great damages to Arctic marine ecosystems and black carbon emissions accelerate Arctic warming. These environmental effects have repercussions beyond the Arctic region because of their effects on migratory species and on sea level rise. In addition to its environmental relevance, the case represents a less-likely case for the model of argumentative coproduction. An HFO phaseout does not require technological innovation, whereas the Arctic has a high symbolic value and is subject to growing economic interests. A priori this did not suggest that argumentative coproduction could have more explanatory power than ideational interventionism and material evolutionism. The Arctic HFO case also varied some contextual conditions in comparison to the previous case study. It involved more complex lines of material conflict within coastal states, a region that is peripheral but has a strong potential for growth, and the Arctic Council as a softer regional institution. The analysis traced the two-stage transition from nonregulation to a nonbinding recommendation and further towards a mandatory ban of HFO tabled for adoption by the IMO.

The case study showed that, contrary to prior expectations, argumentative coproduction explains many empirical observations in this regulatory transition. Competing views about the techno-economic feasibility of a binding HFO ban formed an important stream in the negotiations. These views reflected conflicting business interests of first movers that have phased out HFO and of continued HFO users. First-mover practices emerged in the expedition cruise sector and have extended to several other shipping companies. Yet, many large cargo ships as well as resupply shipping in Canada and Russia have continued to rely on HFO. From the perspective of material evolutionism, the structural power of these HFO users should have prevented the emergence of a regulation that requires a switch to more expensive distillate fuel. From the perspective of ideational interventionism, normative pressure to address the well-known environmental threats posed by HFO should have led states to develop a comprehensive, mandatory ban of HFO. I have found that the emerging regulatory outcome is in partial contradiction to both expectations. A mandatory ban with narrow scope rather reflects diverging business practices. First-mover practices have demonstrated the feasibility of a fuel transition, whereas a strong reliance on HFO in some shipping segments has supported arguments against the affordability of a comprehensive ban. In a nutshell, technological arguing projected the practical constraints of shipping in (still) remote Arctic waters into the busy meeting halls of the IMO.

However, the analysis also demonstrated that argumentative coproduction is not without limits. Competing propositions about the feasibility of a transition to less polluting fuels were not the only factor underlying state preferences and actor constellations. A sense of imminent crisis in a region with highly vulnerable ecosystems drew non-Arctic states into the pro-ban coalition. Interest-based bargains created compromise solutions between proponents and opponents of a ban. Yet, once again, existing business practices inspired the content of these compromises. All this suggests that the models of ideational interventionism, material evolutionism, and argumentative coproduction are not mutually exclusive but may operate to varying extents under different contextual conditions. The concluding chapter discusses the findings of the two case studies and reflects on the scope conditions and generalizability of argumentative coproduction beyond the shores of the Arctic Ocean and the Baltic Sea.

7 Conclusions

The two case studies of nutrient regulation in the Baltic Sea and HFO regulation in Arctic waters are just two examples from the dynamic field of international shipping regulation. The IMO recently confirmed a global cap on the sulfur content of ship fuels applicable from 2020 and is about to adopt more demanding energy efficiency requirements that will apply to ships from 2022. Moreover, it currently works on new or revised regulations for several environmental impacts, including emissions of greenhouse gases and black carbon, marine plastic litter, and discharges of pollutants collected in exhaust gas cleaning systems (IMO 2019e; 2019f, annex 22). Discussions are also (re-)emerging on externalities like underwater noise and presently unregulated discharges of greywater[75] (IMO 2020i, para. 16.6; 2018e, para. 18.13-18.16). The regulatory progress may not always be as fast as environmentalists wish. Still, this regulatory agenda seems surprisingly loaded for an international organization that grants business representatives extensive access to negotiations. Business representatives sit in member state delegations, participative through industry associations with consultative status, and are invited to expert meetings and lunch-time presentations. Would this strong business participation not lead us to expect that decision-making by the IMO is captured by industry interests? And why do we see dynamic regulatory developments in other international environmental regimes and treaty systems, many of which also involve business actors (Gehring 2008; Ratner 2008, 816–18)?

I have argued that, theoretically, there are two ways to resolve this puzzle. Critical observers of global environmental governance would question the quality of regulations produced by the IMO and other international organizations that involve business actors. They would suspect these regulations to be acts of window-dressing that do not exert any significant control over corporate environmental practices: because their substantive provisions are not ambitious enough to mandate major improvements and their form is too loose to elicit corporate compliance. Other analysts would not share this pessimistic assessment. They would argue that, despite certain shortcomings, many regulations require significant change in corporate environmental behavior and have formal properties that facilitate compliance. Based on this more optimistic assessment of regulation, these analysts would scrutinize the conventional assumption that business participation in

[75] Greywater refers to “wastewater from, sinks, dishwashers, showers, hand basins, baths, and washing machines, and contains fats, oils, harmful chemicals, bleaches and germs that affect human health. Untreated greywater can have impacts on water quality and public health through high bacterial loads, nutrient discharge, biological oxygen demand and salinity impacts” (EPA SA 2019).

regulatory negotiations necessarily weakens their output. Some would argue that the dominance of reluctant business actors can be overcome by environmental NGOs and scientists. Others would stress that business is part of the solution as it develops new technologies and practices that reduce environmental impacts.

The dissertation explored these different approaches to the puzzlingly dynamic development of regulation under business participation. In this chapter, I report the findings of this effort. I begin by summarizing the results of the first part of the dissertation, which mapped the design of international maritime environmental regulations. Next, I highlight the main findings from the second part, which examined business influence on contentious regulatory decisions. Especially, I discuss the explanatory power of the model of argumentative coproduction and its limits compared to ideational-interventionist and material-evolutionist explanations. Based on this discussion, I reflect on the generalizability of my findings and the contributions to broader debates in global environmental politics and international relations. Finally, I outline how policymakers, progressive businesses, environmental NGOs, and international organizations can strengthen regulatory dynamics that reduce the environmental footprint of economic activities.

The Partial Stringency of International Maritime Environmental Regulation

The first part of the dissertation explored to what extent international maritime regulations are designed to really exert control over corporate environmental conduct. Answering this question required conceptual work on how to assess the design of international environmental regulations and empirical work to identify patterns of its variance. International environmental regulations are explicit and formal rules, standards, and guidelines. They are agreed by two or more states with the aim to control externalities of business operations that are perceived to degrade the natural environment. Specifically, I examined to what extent such regulations require improvements in corporate environmental practices and seek to elicit corporate compliance with these requirements. The empirical focus was on regulations for maritime shipping and offshore oil and gas production. The strategic economic importance of these two sectors would not lead us to expect that states are willing to adopt regulations with formal teeth and ambitious substance. Regulation should be designed merely for purposes of window-dressing. The empirical analysis proved this pessimistic expectation wrong.

Findings: Diverse and Dynamic Regulation beyond Window-Dressing

To assess the design of international environmental regulations, I developed the novel concept of regulatory stringency. Stringency captures the formal tightness and substantive ambition of regulations. Formal tightness refers to design elements that facilitate compliance with regulatory requirements by shaping their international and/or domestic implementation. Corporate compliance is facilitated by legally binding and precise provisions that come with strong monitoring and enforcement systems. Substantive ambition comprises design elements that define the extent of behavioral change required from business actors. Extensive change results from requirements that apply to many pollution sources, demand high externality reductions, and exceed requirements in other regions. Based on operationalizations of these design elements, I constructed a quantitative stringency index. In contrast to existing concepts of regime and agreement design, this stringency index provides a condensed assessment of formal and substantive properties of regulations whose eventual targets are corporate actors. Anecdotal evidence from shipping regulation in the North Sea underpinned my assumption that, all else being equal, more stringent regulation stands a better chance of reducing operational environmental externalities. Importantly, stringency creates the conceptual preconditions for moving empirical research from international environmental regimes and agreements to the more dynamic microlevel of their embedded regulations.

Generally, the application of the stringency concept to international maritime environmental regulation revealed a diverse policy landscape. The analysis drew on the IMER Database which covers all international regulations that applied to operational environmental impacts of shipping and offshore oil and gas production in selected years. The landscape mapped by the descriptive data analysis exhibits truly lax regulations as well as a number of stringent regulations. The former may count as attempts of window-dressing, whereas the latter most clearly go beyond such a purpose. Both in shipping and offshore oil and gas, however, most international environmental regulations fall in between these two poles. This suggests that while the regulatory framework has come a long way since regimes and agreements for marine environmental protection were created in the second half of the 20th century, some gaps persist. Accordingly, the overall impression from the analysis is that of a living body of regulations under constant development. This impression is confirmed by recent additions, like the global sulfur cap for ship fuel and the newly adopted standards for offshore hydrocarbon production in the Mediterranean Sea and along the Western coast of Africa.

More specifically, the descriptive analysis of the IMER Database revealed five patterns of variance. First, in 2019, the number of stringent regulations was higher in shipping than in offshore oil and gas production, despite similar types of externalities. Second, impacts that cause oil and other water pollution have become subject to stringent regulation earlier than air pollution and other ecosystem impacts. Third, regulatory activity and stringency have been highest for polar areas with little marine activity and the highly used Baltic Sea and North Sea. Fourth, some of the cross-regional variance is linked to differences of international regulatory bodies in the number and stringency of the regulations they produce. A striking commonality of the most stringent regulators like the IMO, HELCOM, and the OSPAR Commission is a strong business participation in their negotiations. Fifth, the alleged trade-off between formal tightness and substantive ambition has not been an insurmountable barrier to the adoption of ever more stringent regulation over time. These five patterns of variance clearly speak against dismissing all international environmental regulation as hollow. They rather call for sophisticated explanations.

Implications for Research: From Regimes and Agreements to Regulations

My findings have implications for research on maritime regulation and on global environmental governance. In the maritime area, the quantitative-descriptive analysis puts qualitative reviews of international environmental regulations into a broader perspective. On the one hand, it confirms several patterns described in the literature: that maritime regulation has a strong regional dimension (van Leeuwen 2010; 2015); that oil pollution has been the initial focus of regulatory activity and other impacts only followed later (cf. Mitchell 1994a; Tan 2006); and that the governance of offshore oil and gas is much more fragmented than that of shipping (Lyons 2015; Molenaar 2015; Rochette et al. 2014). On the other hand, the analysis corrects some overly pessimistic assessments of shipping regulation. It suggests that it is misleading to depict regulation of this sector as generally plagued by governance failures and capture by industry interests (cf. Amin, McDevitt, and Gibbs 2018; InfluenceMap 2017; Roe 2013; Lister, Poulsen, and Ponte 2015). Instead, the picture is more differentiated as regulations with high, intermediate, and low stringency coexist. Causal inquiry should thus explore why stringent regulations have emerged for some impacts in some regions at certain points in time but not in other contexts.

These findings have broader implications for research on public forms of global environmental governance. Existing scholarship in this field has primarily studied variance in regime and agreement design, its drivers, and its effects (e.g., Breitmeier, Young, and Zürn 2006a; Mitchell 2003; Mitchell et al. 2020; O. R. Young 1989; 2014). My analysis has shown that, even within regimes or agreements, there is a high variance on the microlevel of regulations. This variance can be further explored based on the stringency concept, its index operationalization, and the maritime regulation data. To begin with, these elements can be used to explore under which conditions trade-offs between formal and substantive design choices occur (Guzman 2010; Raustiala 2005). Moreover, stringency data supplies the independent variable for assessing the environmental effectiveness of design choices (Raustiala and Victor 1998; Breitmeier, Underdal, and Young 2011) and their impacts on innovation and competitiveness (Ambec et al. 2013; Porter and Van der Linde 1995). When combined with transnational governance data, it can also be used to map the distribution and interaction of public, private, and hybrid regulation (Büthe and Mattli 2011, 19; Falkner 2003; Haufler 2003; Knill and Lehmkuhl 2002). Finally, issue-specific regulations are a more appropriate unit of analysis than multi-issue negotiations for assessing the influence of nonstate actors (Betsill 2008, 184). Refocusing research on regulations thus promises to revitalize some longstanding debates in global environmental politics.

Future research could also seek to overcome the conceptual and empirical limitations of my contribution. A limitation of the stringency concept is that not all regulatory development become visible. For instance, the reduction of the global sulfur limit for ship fuel from 1.5% to 0.5% marks a major change in practice (Zis and Cullinane 2020, 9–10) but is hidden by my coding scale (both values meet my definition of intermediate externality reductions). In addition, the coding does not consider that one option to comply with the sulfur requirements is to use exhaust gas cleaning systems which may lead to additional discharges of pollutants into the sea (Endres et al. 2018). Furthermore, international regulatory requirements sometimes interact with domestic regulations of major markets (DeSombre 2000; Drezner 2008, 35–39; Tan 2006, 347–48). For example, the United States is not a party to the Ballast Water Management Convention and has issued own regulations for limiting the introduction of invasive species in ships' ballast water (Gollasch et al. 2014, 67–70). Ships trading to the US have to comply with these regulations under which fewer ballast water treatment systems have received type-approval than under the IMO (*Hellenic Shipping News* 2019; *The Maritime Executive* 2015). Thus, while the stringency concept captures major regulatory dynamics, a refined operationalization of the substantive design elements may increase its coverage.

A limitation of my data analysis is its exclusive focus on maritime industries. The observed presence of stringent regulation in shipping and offshore hydrocarbon production is unexpected considering the economic weight and strategic importance of these sectors. This suggest that international environmental regulations in sectors like aviation, chemicals, and hazardous wastes may also go beyond window-dressing. Confirmation of this expectation, however, is only possible by collecting data on regulatory stringency in these areas. Another limitation of the analysis is that it has not examined the counterfactual of no business involvement. Would regulations by the IMO have been even more stringent if business had had less access to negotiations? Or would they have been less stringent as suggested by the observed variance across international regulatory bodies? Statistical analysis of a possible correlation between the degree of business involvement in international negotiations (this data still needs to be collected) and the stringency of their regulatory outputs could answer these questions. However, while potentially informative, such an analysis would not identify the mechanism through which business facilitates or hinders stringent regulation. This was the focus of the second part of the dissertation.

The Constructive Influence of Business Practices on Regulatory Decisions

The second part of the dissertation examined how and to what extent business and its environmental practices can influence or shape contentious decisions in international regulation. Environmental practices of business comprise all kinds of technological, operational, and organizational behavior of a company that affect the amount of its environmental externalities. They can be said to influence or shape regulation when intentionally or unintentionally bringing about a design decision that would not have emerged otherwise. I was particularly interested in how business practices may influence or shape regulations in situations where the state of technology is contested. I formulated a theoretical model which posits that business practices and regulatory decisions coproduce each other through processes of argumentation. The empirical part probed the explanatory power of this new model against that of existing ideational top-down and material bottom-up models of regulation. I examined two cases of shipping regulations which I anticipated to be a typical and a less-likely case for argumentative coproduction. In both cases, the observed regulatory process and outcomes were most congruent with argumentative coproduction, even though its explanatory power is not without limits.

General Finding: Argumentative Coproduction as a Powerful Explanation

Argumentative coproduction posits that business practices can inspire or facilitate more stringent regulation by producing arguments and evidence for its feasibility. Business actors may face different incentives regarding their environmental practices. Many firms do not exceed existing regulation and oppose more stringent regulation that would raise the bar in terms of environmental performance, cause additional costs, or create competitive disadvantages. A few others, however, become first movers that overcomply with existing regulatory requirements and support more stringent regulation to level the playing field, create new market opportunities, or gain competitive advantages. The different interests and practices of companies give rise to competing expertise about the technological leeway for more stringent regulation. State officials rely on such expertise in the decision-making process. In this process, proponent and opponent states, each holding many convergent views about regulatory need and feasibility, engage in argumentative contests. They seek to rhetorically coerce their counterpart to consent to their policy position and to mobilize and persuade audience states initially holding fewer or less convergent views. The argumentative power of proponents and opponents hinges on their ability to provide credible evidence that references existing or emerging business practices. First-mover practices may thus tip the scales in favor of more stringent regulation; and their absence may prevent it. The resulting regulation reinforces green frontrunner practices more widely across the targeted sector.

Argumentative coproduction differs from ideational-interventionist and material-evolutionist models of regulation. According to ideational interventionism, business does not play a constructive role in environmental regulation. It typically seeks to fend off challenges to the regulatory status quo put forward by environmental activists and scientists. These challengers can disrupt business dominance only when gaining superior discursive power in exceptional circumstances, like a situation of crisis. Following crisis-related idea and norm change, decision-makers adopt regulation that forces new technology and practices onto reluctant business actors in a top-down manner. Material evolutionism outlines a bottom-up model in which business innovation can be at the root of regulatory change. In this model, conflict unfolds between green business interests that would benefit from more stringent regulation and grey business interests that would loose from it. While this constellation is similar to argumentative coproduction, its outcome depends on the distribution of instrumental and structural power resources. In simplified terms, regulation usually codifies technologies and practices of large firms from influential states. This means that more stringent regulation only emerges when business

Goliaths push for it as they face incentives to become greener. Compared to these top-down and bottom-up models of regulation, the notion of coproduction stresses the dialectic relationship between business practices and regulation. My focus on arguing highlights that the material implications of technology are not independent of their discursive representation.

I initially probed the explanatory power of these three models of regulation in the case of new IMO regulations for nutrient inputs from ships in the Baltic Sea. A contentious element in the negotiations within HELCOM and the IMO between 2005 and 2016 were the nutrient limit values for sewage treatment plants of passenger ships. Demanding limit values were supported by environmental NGOs and progressive manufacturers of innovative wastewater treatment systems. Less demanding standards were proposed by reluctant cruise companies that would have to install these new systems on their ships. From an ideational-interventionist point of view, the problem of eutrophication caused by excessive nutrient inputs explains some of the regulatory movement. However, given the relatively small contribution of ships to total nutrient inputs into the Baltic Sea, a sense of crisis was not sufficiently widespread to explain how states came to select the more demanding standards. From a material-evolutionist perspective, the choice to only regulate passenger ships was a strategy to reduce economic impacts and business opposition to nutrient regulation. Still, the large cruise companies possessed greater instrumental and structural power than the few medium-sized equipment suppliers. The adoption of the demanding standards was therefore a surprising victory of business Davids against the Goliaths.

The outcome and the process that produced it are not so surprising when applying the model of argumentative coproduction. The equipment manufacturers were influential because they possessed first-hand knowledge of treatment technology. Their expertise was taken up by Finland and Norway which were proponents of demanding standards. Opponent states like the Bahamas and Liberia relied on the expertise provided by the cruise industry. Throughout the negotiations, the proponents successfully mobilized and persuaded European audience states from outside the Baltic Sea region to support the more demanding nutrient standards. The decisive piece of evidence in the argumentative contest were frontrunner practices indicating that sewage treatment plants compliant with the demanding standards were available. In anticipation of possible future regulation, a major cruise line installed the equipment which, according to the claims of its industry association, did not even exist yet. This ironic situation which tipped the argumentative balance in favor of the more demanding standards exemplifies how business practices and regulation can coproduce each other.

Next, I probed the explanatory power of the different models in the case of IMO regulation addressing the use of HFO as ship fuel in Arctic waters. In the negotiations since 2009, a contentious issue has been the adoption of a legally binding ban of this type of fuel. A mandatory ban applicable to all ships has initially been supported by environmental NGOs and scientific findings; later also by several individual shipping companies that have or are willing to phase out HFO from their fleets. A comprehensive, legally binding ban has been viewed critically by most global shipping associations as well as individual companies that have continued to rely on HFO. Through an ideational-interventionist lens, the transition from nonregulation to a nonbinding recommendation and further towards a binding ban has occurred in conjunction with greater awareness of the ecological dangers of increasing trans-Arctic shipping. However, considering the well-known risks associated with HFO use, it is not understandable why states have decided to weaken the ban by delaying its implementation and adding major exemptions. Through a material-evolutionist lens, the weakening of the ban represents a bargain that is supposed to soften the opposition of states with strong economic interests in Arctic shipping. It is unclear though what shaped the content of this compromise and why the structurally powerful HFO users in Canada, Russia, and elsewhere have been unable to halt the post-2015 movement towards an HFO ban altogether.

Again, argumentative coproduction provides a more complete account of the empirical observations. Discussions about an HFO ban involved several feasibility issues, including the availability of fuel alternatives, the safety of a fuel switch, and the affordability of a fuel transition. The main sources of expertise on these issues have been shipping companies operating in the Arctic. Expedition cruise companies had phased out HFO early but were not very visible before 2015. As a result, feasibility concerns were not resolved and only a nonbinding recommendation was adopted in the context of the Polar Code. This situation changed after 2015. Ever more companies, including cruise and cargo operators, have phased out HFO from their fleets and communicated this proactively. Proponents of a mandatory and comprehensive HFO ban like Finland, Norway, and the US garnered support from Denmark, Iceland, and many non-Arctic states. Opponents like Canada and Russia, based on expertise from HFO users, maintained that a comprehensive ban would not be feasible in the short term due to techno-economic barriers. The HFO reliance of their resupply shipping provided powerful evidence for these arguments. With these arguments and supporting evidence, proponents and opponents rhetorically coerced each other away from their initial positions towards a compromise solution. The resulting draft HFO ban tabled for adoption by the IMO reflects the desirability of an HFO phaseout as well as the prevailing practical constraints.

Table 23: Summary of congruence analysis in the two case studies

	Ideational interventionism	**Material evolutionism**	**Argumentative coproduction**
Nutrient inputs from ships in the Baltic Sea	Medium/Low	Medium	High
Heavy fuel oil use by ships in Arctic waters	Medium	Medium	High/Medium

Source: Author.

The results of the congruence analysis show that, in both cases I studied, argumentative coproduction has greater explanatory power than existing explanations (see Table 23). The nutrient regulation in the Baltic Sea is a typical case of argumentative coproduction where different modes of technological arguing and the dialectic dynamic of corporate practices and regulation fully operated. The actor constellation and the role of competing business interests were also congruent with material-evolutionist predictions. Congruence with ideational-interventionist expectations was more limited, even though concerns raised by environmentalists and scientists about eutrophication contributed to the initial regulatory movement. Arctic HFO regulation demonstrates that argumentative coproduction has also been present in a context where its operation was a priori less likely. Yet, this case study also suggests that the explanatory power of the model is not without limits. Parts of the actor constellation and the roots of certain state preferences rather matched the predictions of material evolutionism. Ideational interventionism rightly directs attention to how a sense of urgency and imminent crisis has supported the regulatory movement. Overall, however, the two case studies lead me to conclude that corporate environmental practices can decisively influence or shape contentious regulatory decisions. They unfold causal impact through serving as evidence that affects the argumentative power of states with competing policy positions and thus their respective ability to garner wider support.

Specific Findings: Empirical Varieties of Argumentative Coproduction

Besides this general assessment, the two cases share some specific similarities. In both cases, Finland and Norway were among the proponents of more stringent regulation. This is partly due to the regional focus of the case studies, but it also reflects that both countries possess specialized maritime clusters with strong incentives for environmental innovation (Koilo 2019, 63; Laaksonen and Mäkinen 2013, 98; Makkonen, Inkinen, and Saarni 2013, 6; Shinohara 2005, 285). This quality shipping approach contrasts with the low-cost shipping approach of flags of convenience like the Bahamas, Liberia, and the Marshall Islands that were on the skeptical side in both cases (van Fossen 2016; cf. DeSombre 2006, 71–81). Both in the Arctic and Baltic Sea case, support from European audience states was critical for moving towards more stringent regulation. I suspect that this is because decision-makers in European states are confronted with rather similar domestic and transnational propositions about the need for regulation. Their support, especially that of major shipping nations like Cyprus, Denmark, and Greece, then depends on the proponents' ability to prove that regulation would also be feasible. Regular exchanges in the EU context create additional opportunities for presenting arguments and supporting evidence. With respect to the different modes of technological arguing, argumentative mobilization and sincere persuasion were more widespread in the negotiations than rhetorical coercion. Nevertheless, rhetorical coercion mattered in softening the stances of proponents and opponents in the Arctic case, and to some extent also of opponents in the Baltic Sea case.

Another observation made in both cases is that environmental NGOs were an important driver of "voluntary" improvements in business practices. In the Baltic Sea, the WWF made several ferry companies and a few cruise lines commit to a no-discharge policy for sewage. In the Arctic, the Clean Arctic Alliance and Ocean Conservancy have gathered pledges from shipping companies to not use HFO or to refrain from trans-Arctic shipping altogether. These commitments have been a channel for communicating progressive corporate environmental practices to regulators. In both cases, environmental NGOs and progressive business actors supported more stringent regulation. In the Arctic case, this Baptist-and-bootlegger coalition involved active collaboration between expedition cruise operators and the Clean Arctic Alliance. In the Baltic Sea case, equipment manufacturers and the WWF pushed in similar directions but did not coordinate.

Table 24: Comparison of key actors and business practices in nutrient and HFO regulation

	Nutrient inputs from ships in the Baltic Sea	Heavy fuel oil use by ships in Arctic waters
Proponents	Finland, Norway	Finland, Norway, US
Opponents	Bahamas, Liberia, Marshall Islands	Canada, Russia
Important audience states	Baltic Sea coastal states, EU member states, non-European flag states (Dominica, Panama)	Other Arctic coastal states, non-Arctic states (European countries, Australia, New Zealand, Japan), non-Arctic flag states (Bahamas, China, Marshall Islands)
Business with progressive environmental practices	Innovative manufacturers of sewage treatment plants, many ferry lines, some cruise operators	Expedition cruise operators, some cargo and overseas cruise companies, icebreaker industry, shippers
Material incentives for overcompliance	Added value from technology leadership, anticipation of potential regulation, reputational benefits	Compliance with local regulation, concerns over reputation (social license to operate) and consumer relations, operational reasons, public subsidies
Function of more stringent regulation for first movers	Create new market for more sophisticated technology, level the playing field	Level the playing field, increase societal acceptance of Arctic shipping, create new market for alternative propulsion systems
Communication of business expertise on practices to regulators	Direct: firms to delegations, international expert meetings and side events Indirect: reports by research institution, industry commitments made to NGO	Direct: firms and sector association to delegations and international side events Indirect: intra- and inter-firm standards, several reports by research institutions and consultancies, industry commitments made to NGOs, media reports
Business practice that tipped the scales	Installation of treatment system with nutrient removal onboard two large cruise ships unintendedly demonstrated feasibility of demanding standards	HFO phaseout by ever more shipping companies demonstrated feasibility of fuel change; continued HFO reliance in resupply shipping justifies exemptions

Source: Author.

A comparison of the two cases also reveals some interesting differences in the operation of argumentative coproduction (see Table 24). Companies differed in their material motivations for adopting progressive practices and supporting more stringent regulation. In the Baltic Sea case, advanced equipment manufacturers wanted to create a demand for new sewage treatment technology on which they were leading. Cruise companies began to adopt the new technology reluctantly in anticipation of potentially upcoming regulation. Ferry companies committed to a no-discharge policy that promised low-hanging reputational benefits. In the Arctic, shipping companies moved away from HFO for diverse reasons, including compliance with local bans, concerns over their reputation and consumer relations, operational reasons, or public subsidies for alternative propulsion systems. For these progressive companies, a mandatory HFO ban mainly promises to level the playing field. Additional benefits include an increased societal acceptance of Arctic shipping as well as higher demand for alternative propulsion systems. Moreover, the channels for communicating corporate environmental practices to decision-makers partly differed. In the Baltic Sea case, direct contacts between equipment manufacturers and delegations of their home countries were crucial. In the Arctic case, direct contacts also mattered but an inter-firm standard adopted by AECO as well as reports in specialized media also increased the visibility of business practices. Reports compiled by research institutes and consultancies covered business practices in both cases. They were more numerous in the HFO case but more strongly focused on assessing available technology in the nutrient case.

Interestingly, companies also differed in whether their practices had a political intention. In the Baltic Sea case, the cruise company that tipped the scales with the installation of a new treatment system unintentionally undermined the argumentative power of its own industry association. In the Arctic case, the phaseout or continued use of HFO by different companies generally seems to reflect their policy preferences. A final difference concerns the meaning of feasibility in the two cases. In the nutrient case, the key concern was clearly technological as it related to the availability of sewage treatment plants with high nutrient removal capacity. In the HFO case, the concerns are better described as "techno-economic" considering that they relate to both the technical possibilities for and economic challenges of a switch to cleaner fuels. As economic feasibility barriers were also subject to arguing and linked to technology choice, they are equally well captured by the model of argumentative coproduction.

The empirical analysis also gives some hints with respect to potential intervening factors identified in chapter 3, even though these were not investigated systematically. One intervening factor is issue framing because it can expand or restrict the regulatory measures that come under consideration. In the Baltic Sea case, the coastal states largely framed nutrient inputs from sewage as a ship-side problem. This paved the way towards developing nutrient removal standards for onboard sewage treatment plants. The alternative framing as a port-side problem could have led to an exclusive focus on the upgrading of port reception facilities and onshore treatment capacities. In the Arctic case, the spill risk frame strongly supported an HFO ban. This framing was not due to environmental NGOs and scientists. It mainly reflected the position of the US which wanted to work on spill risks but not on climate-related issues. The delinking of the issue of spill risks from black carbon emissions exemplifies another intervening factor. Without this issue linkage, it has become more difficult to discuss comprehensive technology strategies, like the combined use of distillate fuel and diesel particulate filters.

With respect to institutional factors, the differences in the case study settings are not large enough to allow for strong conclusions. Among the three international bodies covered, the Arctic Council was the one where technological arguing was least developed. Its strong consensus culture allowed opponents to easily block in-depth discussions about an HFO ban. By contrast, the IMO's softer consensus culture, in which a single actor usually cannot block discussions, facilitated technological arguing as well as agreement on more stringent regulation. This confirms the finding from regime studies that consensus decision-making does not necessarily lead to "lowest common denominator" outputs[76] (Breitmeier, Young, and Zürn 2006a, 231; Hovi and Sprinz 2006). In both case studies, some path dependencies in regulatory design existed as the new regulations have been or will be embedded in the existing MARPOL framework. The nutrient regulations did not modify the preexisting type approval procedure for sewage treatment plants and the draft HFO ban uses established definitions from the Antarctic HFO ban. Future research should aim at better capturing the importance of these and possibly also other intervening factors in argumentative coproduction.

Implications for Research: Qualitative and Quantitative Strategies

In line with the paradigm of pragmatism, these findings are a stepping stone towards more comprehensive research. I see two avenues for strengthening and extending the reported findings. One avenue is to tackle empirical and method-related limitations of my study by conducting additional case studies. To begin with, I focused on the main international bodies for the selected regulations and did not examine all nested deliberative systems in global environmental governance (cf. Pickering 2019). For instance, future investigations of argumentative coproduction could systematically examine domestic governance arenas and discussions within business associations. I see great

[76] This refers to international decisions that reflect the position of the least ambitious party to which they apply and has also become known as the "law of the least ambitious programme" (Underdal 1998, 5).

potential in zooming in on specific countries and examining more closely their domestic arguing processes. An exploration of domestic arguing may reveal additional links between business practices and regulatory positions that have not been covered by my analysis of technological arguing largely taking place on the international level. For instance, why did Canada recently become more positive about an HFO ban but not Russia, even though both have been exposed to the same feasibility arguments put forward by the proponents of a ban? I suspect that the answer not only has to do with domestic corporate practices and expertise but also with how they interact with economic and societal considerations.

Moreover, while access to primary sources was generally good for the two cases, some blind spots remain. Early stages in the processes are less well covered as meetings were not recorded on audio and interviewees had gaps in memory. Participant observation in the HFO case was limited to four meetings of MEPC which cover important but not all parts of the process. Participation as a single researcher limited the number of parallel meetings observed. I also did not have any direct access to informal negotiations in between or on the sidelines of formal meetings. While it may be difficult to close these blind spots for the cases I studied, future research projects can learn from these limitations. My experiences support arguments for the use of collaborative event ethnography where several researchers observe international negotiations on the spot (Campbell et al. 2014). Ideally, observing researchers would be fully embedded in state delegations that have access to informal negotiations.

A persistent challenge for research into regulatory processes is to empirically disentangle the micro-foundations of different theoretical models. Even the use of process tracing in the case studies was not able to fully overcome some well-known difficulties in differentiating material and ideational factors (Jacobs 2015, 45–47). For example, Russia's reluctance to support a comprehensive HFO ban in the Arctic has been broadly consistent with material, ideational, and argumentative factors. I also posited that some normative considerations of audience states are a precondition for the operation of rhetorical coercion. The case studies did not attempt to directly probe the psychological micro-foundations of argumentative coproduction, but I concede that such a probe should be one of the next steps. The big challenge here is that cognitive processes are eventually unobservable as they take place "between the earlobes" (Checkel 2001, 560). Yet, researchers could attempt to observe some empirical implications of consistency-seeking. This requires closely monitoring reactions of individual policymakers to new arguments and evidence about the feasibility of regulatory options and any ensuing changes in views. This task calls for extensive participant observation with shadowing techniques and perhaps repeated interviewing (Gervais 2013; Schwartz-Shea and Yanow 2012, 65–66). Initial uncertainty about which decision-makers will turn out most relevant in the process again speaks for a broad collaborative effort.

Another avenue for moving research on argumentative coproduction forward is to conduct large(r)-n analyses. My basic expectation is that, under certain scope conditions, the involvement of expertise from companies with progressive environmental practices correlates with the adoption of more stringent regulation. The IMER Database is a rich source on regulatory stringency, whereas data on the involvement of progressive business expertise still needs to be collected. My case studies showed that expertise can come in different forms, including contacts with delegates, business standards, and third-party reports about business practices. Based on the findings of the Arctic HFO case, future analyses should also consider the role of unprogressive business expertise in impeding more stringent regulation. Furthermore, the interaction between competing technological arguments could be grasped more systematically through formal modelling. Such attempts could borrow inspiration from information-processing models that have been applied to decision-making in energy and foreign policy (Axelrod 1973; Sylvan, Goel, and Chandrasekaran 1990; Taber 1992).

More specific expectations and possible extensions of such an analysis can be formulated with respect to the five observed patterns of regulatory variance. First, considering regulatory variance across industries, shipping companies are expected to adopt progressive environmental practices more readily than offshore oil and gas companies. Related to that, it could be explored whether incentives for overcompliance are higher in shipping, for instance, thanks to green shipping schemes offered by seaports and environmental demands of shippers (Lister 2015, 121–22; van Leeuwen 2010, 100). Second, regarding cross-issue variance, the expectation is that companies have adopted progressive practices for oil and other kinds of water pollution earlier than for air pollution and other ecosystem impacts. It could be examined whether this has been linked to higher societal awareness and pressures on firms because of a more direct observability of these impacts and the symbolic value of water (Blatter 2009, 106).

Third, argumentative coproduction expects cross-regional variance in regulatory stringency to reflect geographical differences in standard practices of firms and in the presence of business experts in state delegations. In this context, it seems worth exploring whether companies in particularly vulnerable or affected regions face greater pressures to “voluntarily” reduce their environmental footprint. Also, it can be examined whether different state-business relations affect the receptiveness of states for business expertise. Fourth, in line with the empirical indications I provided, the presence of business expertise should be high in regulatory projects of institutions that produce high shares of stringent regulation. Closer examination of differences across regulatory projects could shed light on regulatory variance within institutions. Fifth, where regulations have become ever more stringent over time, this is expected to have been driven by a virtuous circle of progressive business practices and technology-reinforcing regulation. This expectation is consistent with the observation that the regulatory principles of "best available technology" and "best available practice" have contributed to a ratcheting up of global regulation (Braithwaite and Drahos 2000, 518–23). Of course, all these expectations only apply when the scope conditions of argumentative coproduction are present.

Generalizability: Argumentative Coproduction Elsewhere

What do the two case studies tell us about the scope conditions and the generalizability of argumentative coproduction? Four out of five scope conditions identified in the theory chapter were largely present in both case studies: regulations were negotiated in international organizations; they address problems that can be reduced through enhanced technology and business practices; business actors had direct or indirect access to the regulatory discussions; and audience states were present. Another theorized scope condition was the quietness of regulatory politics due to low domestic issue salience. Although the problem of eutrophication received some media attention in the Baltic Sea states, the contribution of nutrients from ships was not very salient. Accordingly, negotiations in the first case were relatively quiet and focused on technological arguments. This was partly different in the second case. The use of HFO in Arctic shipping has attracted more attention in relevant coastal states because of environmental and economic concerns. The vulnerability of the Arctic marine ecosystems and growing interest in Arctic shipping routes made the negotiations in the HFO case noisier than in the Baltic Sea case. The analysis has shown that, even in this context, argumentative coproduction had most explanatory power. While this increases the confidence in my theory, it should be noted that ideational-interventionist and material-evolutionist predictions empirically manifested themselves at relevant parts of the process. The conclusion that can be drawn from this is that the explanatory power of argumentative coproduction indeed seems to decrease with higher noisiness of regulatory politics.

Argumentative coproduction is likely to operate more widely in international environmental politics for two reasons. The first reason is that the scope conditions of argumentative coproduction are frequently present. Decision-making in international organizations is typically subject to low salience and thus quiet politics (cf. Tallberg et al. 2018, 234). Moreover, the reduction of environmental impacts often depends on technological innovations (Jänicke and Jacob 2004). The second reason is that the explanatory power of argumentative coproduction has been proven under these scope conditions both in a typical and a less-likely case. The high congruence of empirical evidence with the theoretical expectations of argumentative coproduction in the case of nutrient regulation in the Baltic Sea established basic confidence in my theory. The high to medium congruence in the case of HFO regulation in the Arctic suggests that the theory is applicable more widely. While not seeking to test this claim here, I illustrate the potential relevance of argumentative coproduction by means of a few examples.

In my field work, I was able to observe another example of shipping regulation in which argumentative coproduction seems to have been at play. The example concerns future fuel efficiency requirements under the so-called Energy Efficiency Design Index (EEDI). The EEDI was introduced in 2013 and lays down mandatory efficiency improvements in ship design. It is the most important technical measure for reducing fuel consumption and thus emissions of greenhouse gases (Zhang 2016, 567). The basic idea is that the efficiency requirements will be made more demanding over time. In recent discussions about the next EEDI phase, which only received limited public attention, a contentious issue were the requirements for container ships. In October 2018, the IMO decided to bring the new EEDI phase (phase 3) forward from 2025 to 2022 and, based on a majority of delegations, agreed on a uniform 40% reduction rate for container ships (IMO 2018e, para. 5.56). The shipping industry and non-European flag states strongly objected to this requirement, arguing that it was not feasible for small container ships while larger ones could achieve even higher reductions. Their arguments were closely aligned with on-the-ground practices as they drew on datasets that monitor developments in ship design efficiency over time. In view of these arguments, the IMO decided to revisit the issue at the next meeting (IMO 2018e, para. 5.80-5.83). In May 2019, the IMO then followed a proposal of the container shipping industry and revoked its earlier choice by approving differentiated reduction rates ranging from 30% for the smallest container ships to 50% for the largest ones (IMO 2019e, para. 5.83, 5.126; WSC 2019). While this process was not devoid of material interests, arguments related to technology and corporate practices seem to have turned the tide.

Beyond maritime regulation, technological arguing surfaces in other areas of international environmental regulation, like the control of mercury and persistent organic pollutants (POPs). The mining, use, emission, and release of mercury is internationally controlled through the Minamata Convention adopted in 2013. The convention contains a positive list of industrial processes with phaseout dates and reduction targets for mercury use. Countries negotiated feasible timeframes for a phaseout of mercury from the production of chemicals like vinyl chloride monomer, a precursor to PVC (Selin 2014, 10–11). The convention also contains a negative list of products exempted from regulatory controls, including “uses where no feasible mercury-free alternative is available” (Selin 2014, 10). For point sources emitting mercury as an unintended byproduct, like coal-fired power plants, the convention merely states that new installations should apply best available technologies and best environmental practices. It has been noted that this provision “reflects the belief that these industries do not have clear ways to eliminate mercury emissions and no obvious target would seem feasible” (Ovodenko 2017, 131). The apparent importance of technological feasibility in these regulatory decisions represents a very plausible entry point for argumentative coproduction.

A possible entry point for technological arguing also exists with respect to POPs which are regulated through the Stockholm Convention signed in 2001. After an initial focus on “dead” chemicals which are no longer widely in use, the regime has turned to also regulating the production and use of “live” chemicals (Downie and Templeton 2013, 419). New proposals for phasing out toxic chemicals are dealt with by a scientific review committee and decided by the conference of parties. Even in the scientific committee, industry representatives participate as observers and lobby for or against banning certain chemicals (Templeton 2011, 169–70). Different business interests reflect which chemicals companies hold patents on and produce (Clapp 2003, 12). The assessment of proposed additions to the list of banned POPs includes the consideration of socio-economic information, such as current uses and the availability of technical alternatives (UNEP 2009a). Again, business actors possess much of the relevant knowledge and their consultation is therefore an integral part of the assessment process (UNEP 2009b, 7–8). While progressive practices thus seem to be an important prerequisite for more stringent regulation, such regulation can also reinforce the rise of “green chemistry” (Weber, Aliyeva, and Vijgen 2013, 1904).

I suspect that while noisier international environmental politics favor ideational-interventionist and material-evolutionist explanations, they may also exhibit some traits of argumentative coproduction. One example for an ideational-interventionist process is the Brent Spar controversy about the dumping of disused offshore oil structures into the sea. In 1995, plans of Shell to dump a disused offshore oil structure into the North-East

Atlantic sparked an environmentalist campaign with consumer boycotts and protests in several countries (Löfstedt and Renn 1997, 132–33). Public outrage triggered political negotiations which quickly led to the adoption of a temporary dumping moratorium by a majority of OSPAR member states despite the dissent of the two major oil and gas producers Norway and the UK (Woodliffe 1999, 113–14). Interestingly, public pressure made Shell abandon the idea of sea disposal already before the moratorium was eventually adopted by the OSPAR Commission (Bakir 2006; Zyglidopoulos 2002, 144–45). Moreover, the permanent regulation on decommissioning adopted by the OSPAR Commission in 1998 came to reflect technological arguments grounded in business expertise. Far-reaching provisions on the removal of disused offshore structures built on progressive expertise from the decommissioning industry, whereas exemptions for very heavy concrete structures reflected remaining feasibility constraints (Jordan 2001, 270–74). Thus, despite the strong normative drive of the regulatory process, technology and industry practices were not irrelevant.

An example for a material-evolutionist process seems to be the development of carbon dioxide standards for aircraft which were adopted by ICAO in 2017. Politics here have been noisier than in my shipping cases: aviation has received quite some attention in public debates about climate change, and aircraft industries represent large economic interests in the EU and the US. An analysis of the new standards concludes that they reflect the emission levels already achieved by new aircraft models of the industry giants Airbus and Boeing (ICCT 2017). Considering that the aircraft industry supported the new standards, it seems that these dominant business actors managed to get their technology level codified in international regulation (M. M. Jensen 2017, 841–42). Nevertheless, it might be useful to examine how feasibility arguments did and will affect the specific requirements and their implementation schedule. The relevant committee itself recognized “the importance of reflecting technology developments in the ICAO standard-setting process” by way of regular reviews (ICAO 2016, para. 5.1.40).

These examples suggest that argumentative coproduction may be able to explain many quiet processes of international environmental regulation and complement existing explanations of noisier regulatory politics. The universe of potential cases comprises all industry-related environmental externalities in transboundary contexts. This includes impacts like air pollution, biodiversity reduction, chemical pollution, greenhouse gas emissions, ozone depletion, and water pollution from sectors like aviation, chemicals, energy production, fisheries, mining, offshore oil and gas, pesticides, land and water-borne transport, and waste management (cf. Braithwaite and Drahos 2000, chap. 12).

Not all these externalities and industry sectors are presently subject to extensive regulation under binding international treaties. Yet, there is no theoretical reason why argumentative coproduction should not operate in the nonbinding instruments which international organizations have developed to guide global industry practices (cf., e.g., Friedrich 2013).

Beyond environmental impacts, international health and safety regulations are the most obvious candidates for the operation of argumentative coproduction. The IMO has developed a large body of safety regulations for ships (Barrows 2009). In the competent Maritime Safety Committee, industry representatives are equally well represented as in the Maritime Environment Protection Committee covered in my two case studies. Furthermore, corporate expertise plays an important role in the development of the Codex Alimentarius, which contains comprehensive standards and guidelines for food safety (cf. Winickoff and Bushey 2010). The codex is a joint initiative of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO). Food and agrochemical companies send large numbers of delegates to codex negotiations and have been reported to exert influence "through shaping early drafts on Codex technical committees that set the framework for later debates" (Braithwaite and Drahos 2000, 408, 401). Additionally, argumentative coproduction may be a useful lens for understanding embryonic international attempts to control emerging technologies, such as nanotechnology (cf. Falkner and Jaspers 2012; Marchant and Abbott 2012). Besides the crucial impact of science (Andresen, Rosendal, and Skjærseth 2018), the discursive representation of new technology by its business owners and users may shape regulatory toeholds and instruments that states consider.

Contributions to the Academic Literature

My findings on the explanatory power and operation of argumentative coproduction contribute to theoretical debates in global environmental politics, international relations, and beyond. The notion of technological arguing among consistency-seeking state representatives contributes to debates about the logic and dynamics of international negotiations. In contrast to most literature on arguing (Deitelhoff and Müller 2005; Deitelhoff 2009; Morin and Gold 2010, 569–73; Risse 2000), I did not assume an ideal speech situation in which actors deliberate to find truth. Instead, I assumed an argumentative contest involving actors whose choices are driven by psychological processes. In this contest, proponents and opponents holding many convergent views use arguments and supporting evidence to garner support for their position among audience states with fewer or diverging views. Decision-makers cognitively process competing arguments according to a logic of consistency. This means that they resolve dissonance-increasing propositions by amending them or rejecting them as invalid. The focus on the validity of competing claims implies that the perceived quality of the supporting evidence is of paramount importance. In both of my case studies, proponents and opponents of more stringent regulation made great efforts to provide sound evidence for the arguments they were making about the state of technology.

When states argue over technology, changes in position result from rhetorical coercion, argumentative mobilization, and sincere persuasion. Rhetorical coercion occurs when proponents or opponents are pushed by the other or by themselves into an argumentative corner they cannot escape without violating previously accepted ways of reasoning (Krebs and Jackson 2007; Risse 1999; Schimmelfennig 2001). Argumentative mobilization refers to the amplification of audience state preferences through arguments that increase the number of convergent propositions held by decision-makers. Sincere persuasion denotes the formation or change of audience state preference based on arguments that increase the convergence of the propositions held. In the case studies, I observed changes in the positions of proponents, opponents, and audience states. The mobilization and sincere persuasion of audience states was more frequent than the rhetorical coercion of proponents or opponents. However, the latter proved important in negotiations of an HFO ban in the Arctic where both sides argued each other away from their initial positions. The three modes of technological arguing capture dynamics in international negotiations that fall in between the rationalist bargaining and constructivist socialization and learning.

Moreover, my findings extend existing knowledge about how business actors can influence or shape regulatory choices. To begin with, they offer a new perspective on the operation of business influence based on a combination of technological and discursive power. Previous research has highlighted connections between the technological power of business and "traditional" instrumental and structural forms of power (Falkner 2005b, 130; 2008, 72–74; Vormedal 2012, 259–61). In the case studies, I showed that business can intentionally influence or unintentionally shape contentious regulatory decisions through its practices. References to existing and emerging business practices are an important piece of evidence supporting technology-related arguments about the feasibility of regulatory options. I further showed that, because of this demonstration effect of business practices, not only large multinational firms with instrumental and structural power resources can influence policies. Innovative first movers from niches can equally have influence when they succeed in effectively communicating their practices to regulators.

Corporate practices are communicated to regulators through business experts, private standards, or third-party reports. The important role of business experts implies that expertise is not a monopoly of scientists as other case studies might suggest (e.g., P. M. Haas 1989; Lidskog and Sundqvist 2002; Rietig 2014; cf. Jasanoff 1998). Regarding private standards, my findings raise doubts about the claim that voluntary industry standards necessarily preempt public regulation (Malhotra, Monin, and Tomz 2019). Instead, they support the view that corporate social responsibility activities can serve as a blueprint for international regulation (Gjølberg 2011) and that private regulation can ratchet up public regulation through technological change (Schmid et al. 2020). An area that deserves more attention in the future are reports about corporate practices prepared by consultancies, media, and other actors. Especially the role of consultancies merits closer examination as they are involved in different stages of the policy cycle and may have international organizations, states, and business actors among their clients (Bouteligier 2011).

Furthermore, my findings disconfirm the suspicion that business actors cannot be constructive partners in international environmental politics. I do not dispute that business interests and practices follow material motives, even in the area of sustainability (cf. Dauvergne and Lister 2013). However, the case studies have revealed various constellations under which these material motives can lead to the adoption of progressive business practices (cf. Ougaard 2006, 236–42; van Leeuwen 2010, 99–100). Progressive corporate practices strengthen arguments about the feasibility of more stringent regulation. This constructive effect has been overlooked by critical assessments of corporate social responsibility and corporate environmental management (Clapp 1998; D. L. Levy and Newell 2005, 59; Pegg 2006). The case studies have shown that frontrunner practices constitute particularly strong evidence that tips the balance in negotiations, sometimes even unintendedly. Analysts should therefore not only look for tipping points in political strategies and policy positions of business (Vormedal 2011; 2012) but also in corporate practices. Another implication of this is that business conflict does not necessarily reduce business influence as suggested by some neo-pluralist scholars (Falkner 2008, 196; Orsini 2012).

On broader state-society relations, my findings stress that business is a crucial partner for states in the development of international regulations. This central role of the corporation reflects a neoliberal governmentality in international politics (Harrod 2006, 43–46; Sending and Neumann 2006). In both case studies, I observed that states generally aimed at developing regulation that works for business as the regulatory target. At the same time, state representatives relied on business for the technological and operational knowledge needed to achieve this goal. This knowledge is a powerful resource of business influence. I would therefore disagree that business power merely reflects state power (Gilpin 1975, 4; Krasner 1978, 20, 31–34). For different reasons, I am also skeptical about the assessment that business power has increased at the expense of state power (Strange 1996, 14). Admittedly, it seems very plausible that, when assuming business away from regulatory negotiations, state actors would have more influence on the final regulatory output. However, my findings suggest that states would then likely develop regulations that either fall short of or go beyond what is technically feasible. In that sense, business practices and expertise eventually enable the effective exercise of regulatory state power.

An interesting question in this respect is whether state-owned companies assume a special role in argumentative coproduction. This question emerges from the case study on HFO use in the Arctic where practices of state-owned companies like Arctia (Finland) and Sovcomflot (Russia) received political attention. Argumentative coproduction suggests that, thanks to their close ties with state administrations, state-owned companies may be particularly important sources of expertise on the technological feasibility of more stringent regulation. Yet, the direction of their influence hinges on debates in economics about the performance of private and public companies. Neoclassical economists have long argued that state-owned enterprises are less innovative and therefore greater polluters than private companies (Meyer and Pac 2013; World Bank 1995, 38–40). More recent research suggests that public enterprises are not per se less innovative than private companies and perform better in environmental terms (Belloc 2014; Clò, Ferraris, and Florio 2017; Thurber and Tangen Istad 2012, 601–2). Thus, it remains an open question whether environmental practices of state-owned companies inhibit or facilitate more stringent regulation.

On power debates in international relations, my dissertation adds the notion of argumentative power sitting at the intersection of technological and discursive power. On the one hand, it acknowledges that technology has a material dimension. New technology can create new options for pollution abatement and thus also environmental regulation. On the other hand, argumentative power stresses that technology and corporate practices do not exist independently of their discursive representation. An innovative sewage treatment plant or the use of distillate fuel were not physically present in negotiations at the IMO. Rather, delegates used words in the form of arguments and evidence to grasp these technologies and practices as well as their implications for regulation. Power in this context is the ability to present arguments and evidence that make others change their position. These changes can result from preference change through sincere persuasion, from preference amplification (or attenuation) through argumentative (de-)-mobilization, or from rhetorical coercion without preference change. As my empirical observations stem from institutions that strive for consensus, a question for future research is whether these modes of technological arguing differ in other institutional contexts.

On a more abstract level, argumentative coproduction is a model capturing processes of arguing over which policy solutions work. Such processes of arguing may take place in many different contexts: from international to domestic levels; in political, administrative, and business organizations; and on issues ranging from the environment to health, safety, and the economy. What limits should the EU set for emissions of particulate matter and other air pollutants from cars (cf. A. R. Young and Wallace 2000, 34–55)? What is the right strategy to deal with diseases like malaria (cf. Eckl 2017)? And how could a chemical company further increase plant safety (cf. Zwetsloot and Askounes Ashford 2003)? The contexts in which these questions are raised may differ in the kind of on-the-ground practices that inform discussions and the factors that intervene into this relationship. However, my suspicion is that it might be useful to conceive of such discussions as argumentative contests between proponents and opponents that seek to garner support among a consistency-seeking audience. In these contests, first-mover practices or prototypes can provide evidence that strengthens the argumentative power of proponents in decisive ways. Experts play a crucial role in bringing these practices from the outside world into the room where decisions are made. The recognition of who possesses authoritative expertise in this respect—business representatives, scientists, civil society actors, or certain professionals—depends on the governance object at hand (Sending 2015, 27–29).

A final implication of all this is a more nuanced understanding of the relationship between regulation and regulated behavior. My research suggests that the frequently evoked dichotomy of technology-forcing and technology-following regulation is oversimplifying (Faiz, Weaver, and Walsh 1996, 1; Sherman 1998, 45; van Leeuwen 2010, 92). The examined processes of nutrient and HFO regulation neither represented top-down policy interventions nor bottom-up codifications of dominant practices. Instead, business practices and regulation have been in a dialectic relationship. Regulation that codifies non-dominant practices of a few first movers and generalizes them across an entire segment or sector is best understood as technology-reinforcing.

Five Lessons for Practitioners

One of the pragmatic goals of this dissertation was to generate insights of practical value for enhancing the protection of our oceans and the environment in general. Regarding the future of international environmental regulation, my research findings suggest five lessons for policymakers, business, environmental NGOs, and international organizations. These lessons apply to externalities that can be effectively reduced by means of enhanced technologies or practices, and not to those that would call for greater sufficiency. First, policymakers can create favorable conditions for more stringent regulation by providing financial incentives for businesses to green their practices. One element here is funding for research and development of advanced environmental technology. Another element are financial incentives for technology adoption. For instance, in the context of shipping, public port authorities can grant discounts on port fees for less polluting ships or add surcharges for more polluting ones. This instrument is not new (Gibbs et al. 2014, 343–45; Lam and Notteboom 2014, 175–81) but could be used more strategically. Once policymakers begin to perceive a need for regulating a certain externality, they should review and adapt the portfolio of public incentives for relevant first-mover business practices. Ideally, new regulatory requirements should also come with market incentives for innovation beyond compliance to create a basis for more stringent regulation in the future (Porter and Van der Linde 1995, 111–13).

Second, it is equally important that policymakers grasp the progressive corporate practices facilitated by public incentives and proactively tackle remaining feasibility barriers. Domestic support schemes for environmental technology and practices are usually not handled by the officials taking part in international regulatory negotiations. Yet, knowledge about corporate environmental practices may not travel well across bureaucratic silos like policy units or departments (Duffy and Cook 2019, 1193–94). This obstacle could be addressed by creating agile teams responsible for both domestic policies and international representation on specific environmental issues. Moreover, to reduce persistent techno-economic constraints on regulatory decisions, states could set up domestic or international technology programs. International technology-oriented agreements are considered a useful complement to international environmental regulation (de Coninck et al. 2008). The model of argumentative coproduction suggests that such technology agreements cannot only be used to support policy implementation but also to create favorable conditions for more stringent regulation.

Third, environmentally progressive companies should come to appreciate and exploit the political dimension of their practices. The theory of argumentative coproduction suggests that the choice of a wastewater treatment system with nutrient removal or of a cleaner fuel are not politically neutral business decisions. Instead, it echoes the assertion that, in companies, "all strategy is political" (D. L. Levy and Newell 2005, 58). Companies with progressive practices should align their operational and political strategies (cf. Reinhardt 2000, 240–41). This is crucial when competitive disadvantages or potential benefits from progressive practices can only be evened out or harnessed by codifying these practices in regulation. Companies in green niches need to find ways to communicate their practices and policy preferences effectively to delegations. Direct contacts are helpful as exemplified by the sewage treatment manufacturers from Finland and Norway but may not always be available. Creation of business associations has been a longstanding option, but the more flexible form of issue-specific campaigns may better suit the limited resources of niche businesses. Strengthening ties with environmental NGOs, like Hurtigruten did with the Clean Arctic Alliance on HFO, is yet another way for progressive firms to get visibility in regulatory processes.

Fourth, to create the preconditions for more stringent regulation, environmental NGOs should devote resources to pushing for and identifying progressive business practices. My findings support the insight that, by framing the need for regulation, environmental NGOs and scientists prepare the ground for policy action (e.g., Allan and Hadden 2017; Selin and Eckley 2003). However, once this need is widely recognized by states, environmentalists should also contribute to developing viable regulatory solutions. They can do so indirectly by pressuring companies to adopt more progressive environmental practices that can later inspire regulation. As the two case studies have shown, environmental NGOs already apply this strategy. A complement to this strategy would be to expand their own technological expertise in partnership with progressive companies. For instance, in the shipping context, environmental NGOs like the Clean Shipping Coalition have built up technical knowledge on air pollution control, but their arguments often lack solid evidence from business practices. I suggest that NGOs, possibly in collaboration with research institutes like the ICCT, could invest more resources into identifying hidden environmental champions in the business landscape and making their progressive practices visible to decision-makers. Where environmental champions are not adequately represented by industry associations, environmental NGOs could help translating their practices into regulatory blueprints.

Fifth, to translate technological innovation into environmental regulation, international organizations should give greater access and visibility to businesses with progressive environmental practices. Currently, business is mainly represented through large industry associations and through observers and experts in state delegations. Limited material resources of companies operating in green niches may inhibit their effective representation. Therefore, international organizations like the IMO should consider granting consultative status to smaller industry associations or ad-hoc groupings representing green frontrunners. These include suppliers of environmental equipment, such as sewage treatment plants or air pollution control devices, and companies exposed to high consumer pressures, like expedition cruise operators or shippers. Where formal representation is impossible, greater ad-hoc involvement of business experts in stocktaking activities is a second-best solution. Stocktaking can be carried out by secretariats of international organizations and should consist of monitoring environmental technologies and corporate practices throughout regulatory negotiations. Regional organizations like HELCOM and the Arctic Council seem particularly suited to carry out such monitoring as they are closer to the field. Recent initiatives like the Arctic Shipping Best Practice Information Forum, which accompanies the implementation of the IMO Polar Code (cf. Fedi 2019, 129–30), point in the right direction but need to be systematically embedded into regulatory processes.

My findings about the mechanism of argumentative coproduction also raise difficult governance questions for international organizations. Involving as many business experts as possible risks creating a cacophony in which somehow all regulatory options seem both feasible and infeasible. Involving only selected business experts raises questions about the justification and criteria for giving some experts more access than others. Furthermore, international organizations have come under increasing pressure to adopt procedures in line with principles like transparency, participation, and democracy (Dingwerth et al. 2019).[77] Greater civil society involvement may be conducive to identifying needs for regulation but may reduce the weight of feasibility aspects in the development of regulation, potentially causing serious problems for implementation of future regulation. While the question of which nonstate actors should get which degree of access to international organizations is not new (Grigorescu 2015, chap. 6; Kronsell and

[77] For reform proposals on increasing the transparency of the IMO, cf. Psaraftis and Kontovas (2020).

Bäckstrand 2010, 40; Woods 1999, 41–45), argumentative coproduction offers a distinct perspective on it. According to this perspective, the big unresolved question is how to democratize international environmental negotiations while maintaining and bringing in the business expertise that enables regulatory progress.

To return to the initial puzzle outlined in the introduction, my dissertation showed that international maritime environmental regulations develop dynamically not despite but because of business involvement in negotiations. I demonstrated that a sizeable share of shipping regulations requires major improvements in corporate environmental practices and aims at eliciting corporate compliance with these requirements. Stringent regulations that are ambitious in substance and tight in form are no rare exceptions. Exploring the sources of increasingly stringent shipping regulation, I found that corporate environmental practices can tip the scales in contentious regulatory choices. Business practices provide evidence for or against the technological feasibility of more stringent regulation, thereby strengthening or weakening the argumentative power of its proponents. The somewhat paradox implication is that the future of international environmental regulation lies in the current practices of its regulatory targets. Successful environmental protection thus presupposes economic and societal incentives for businesses to go green—not to substitute for regulation, but to facilitate it.

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Appendix I: Overview of Empirical Material

This appendix lists the meetings in which I participated as an observer and for which I compiled protocols based on available audio records. It also provides information on the formal interviews and relevant informal conversations conducted throughout the research process. For all entries, the relevance for contextual observations ("contextual"), the Baltic Sea nutrient case ("case 1"), and/or the Arctic HFO case ("case 2") is noted.

Table 25: Availability of negotiation documents for the two case studies

	International organization	Bodies	Documents analyzed	Availability of documents
Case 1: Nutrients in the Baltic Sea	HELCOM	Ministerial, HELCOM, HOD, MARITIME	138	Almost complete (very few submissions missing)
	IMO	MEPC, DE	70	Complete (all minutes and all submissions)
Case 2: Use of HFO in the Arctic	Arctic Council	Ministerial, SAO, PAME	75	Limited (all minutes, but almost no submissions)
	IMO	MEPC, BLG, DE, PPR	245	Complete (all minutes and all submissions)

Note: All relevant subsidiary expert groups and correspondence groups of the bodies listed were considered as well. For case 1, the documents of the HELCOM Cooperation Platform on Port Reception Facilities were not analyzed in detail and are therefore not included in the document count.

Source: Author.

Table 26: Participant observation

Date	Body and meeting	Attendance	Relevance
22-25 Jan 2017	Arctic Frontiers	22-27 Jan 2017	Contextual; case 2
3-7 Jul 2017	IMO: MEPC 71	3-7 Jul 2017	Contextual; case 2
9-13 Apr 2018	IMO: MEPC 72	9-13 Apr 2018	Contextual; case 2
22-26 Oct 2018	IMO: MEPC 73	22-26 Oct 2018	Contextual; case 2
13-17 May 2019	IMO: MEPC 74	13-15 May 2019	Contextual; case 2

Note: Participation in IMO meetings in London as member of Swiss delegation. Participant in Arctic Frontiers as conference participant (conference included policy conference and launch of Arctic Commitment by Clean Arctic Alliance and Hurtigruten).

Source: Author.

Table 27: Available audio records of IMO meetings

Date	Body and meeting	Relevance case 1	Relevance case 2
Feb 2013	BLG 17		X
Mar 2013	DE 57		X
May 2013	MEPC 65		X
Feb 2014	PPR 1		X
Apr 2014	MEPC 66		X
Oct 2014	MEPC 67	X	X
Jan 2015	PPR 2		X
May 2015	MEPC 68	X	X
Feb 2016	PPR 3		X
Apr 2016	MEPC 69	X	X
Oct 2016	MEPC 70		X
Jan 2017	PPR 4		X
Jul 2017	MEPC 71		X
Feb 2018	PPR 5		X
Apr 2018	MEPC 72		X
Oct 2018	MEPC 73		X
Feb 2019	PPR 6		X
May 2019	MEPC 74		X
Feb 2020	PPR 7		X

Source: Author.

Table 28: Interview references in the text

Interview number	Type of interviewee organization
1	State actor
2	State actor
3	State actor
4	State actor
5	Nonstate actor
6	Nonstate actor
7	Nonstate actor
8	Nonstate actor
9	Nonstate actor
10	State actor
11	State actor
12	Nonstate actor
13	Nonstate actor
14	Nonstate actor

Table 29: List of formal interviews and informal conversations

Organizational affiliation of interviewee (former)	Focus	Duration	Date	Medium	Format	Recording, documentation
State actors						
Antigua and Barbuda, delegation to IMO	C;2	~1.5 h	Recurring (2018-2019)	In person (London, UK)	Informal	Notes
Bahamas, delegation to IMO/HELCOM	1	10 min	Apr 10, 2018	In person (London, UK)	Informal	Notes
Canada, delegation to Arctic Council	C	10 min	Jan 24, 2017	In person (Tromsø, NO)	Informal	Notes
Canada, delegation to Arctic Council	C	05 min	Jan 25, 2017	In person (Tromsø, NO)	Informal	Notes
(Denmark, delegation to HELCOM)	1	20 min	Nov 30, 2018	Phone call	Formal	Audio record and protocol
Finland, delegation to IMO/HELCOM	1	20 min	Apr 12, 2018	In person (London, UK)	Formal	Notes
Finland, delegation to IMO/HELCOM	1;2	50 min	Nov 27, 2018	Phone call	Formal	Audio record and protocol
Germany, delegation to IMO/HELCOM	1	10 min	Apr 9, 2018	In person (London, UK)	Informal	Notes
Germany, delegation to IMO/HELCOM	1	45 min	Nov 26, 2018	Phone call	Formal	Audio record and protocol
Germany, delegation to IMO	2	25 min	Dec 12, 2019	Phone call	Formal	Audio record and protocol
HELCOM, secretariat	1	40 min	Nov 27, 2019	Phone call	Formal	Audio record and protocol
IMO, secretariat	C;2	10 min	23 Jan 2017	In person (Tromsø, NO)	Informal	Notes
Netherlands, delegation to IMO	2	35 min	Nov 22, 2019	Phone call	Formal	Audio record and protocol
Norway, delegation to IMO	1	05 min	Apr 11, 2018	In person (London, UK)	Informal	Notes
Russia, delegation to IMO/HELCOM	1;2	10 min	Apr 12, 2018	In person (London, UK)	Informal	Notes
Switzerland, delegation to IMO	C;2	~2.5 h	Recurring (2017-2019)	In person (London, UK)	Informal	Notes

Nonstate actors						
Association of Arctic Expedition Cruise Operators (AECO)	2	30 min	Nov 13, 2019	Video call	Formal	Audio record and protocol
Clean Arctic Alliance	2	45 min	Nov 27, 2019	Video call	Formal	Audio record and protocol
Cruise Lines International Association (CLIA), delegation to IMO	1	10 min	Oct 25, 2018	In person (London, UK)	Informal	Notes
(CLIA, delegation to IMO), cruise company, Europe	1	45 min	Nov 23, 2018	Phone call	Formal	Audio record and protocol
Danish Shipowners Association	2	50 min	Dec 2, 2019	Video call	Formal	Audio record and protocol
Hurtigruten, Norway	2	10 min	Apr 10, 2018	In person (London, UK)	Informal	Notes
Interferry, delegation to IMO/HELCOM	1	35 min	Nov 30, 2018	Video call	Formal	Audio record and protocol
International Chamber of Shipping (ICS), delegation to IMO	C;1	40 min	Jul 7, 2017	In person (London, UK)	Informal	Notes
ICS, delegation to IMO	1	45 min	Dec 17, 2018	Phone call	Formal	Audio record and protocol
International Association of Oil and Gas Producers (IOGP), delegation to IMO	C	20 min	Oct 26, 2018	In person (London, UK)	Informal	Notes
Royal Association of Netherlands Shipowners	C	15 min	Jul 3, 2017	In person (London, UK)	Informal	Notes
Swiss Trading & Shipping Association, Swiss delegation to IMO	C	~40 min	Recurring (2017-2019)	In person (London, UK)	Informal	Notes
WWF, delegation to IMO	1	20 min	Apr 19, 2018	In person (London, UK)	Informal	Notes
Equipment manufacturer, Germany	1	40 min	Nov 21, 2019	Phone call	Formal	Audio record and protocol
Equipment manufacturer, Europe	1	35 min	Jan 7, 2019	Phone call	Formal	Audio record and protocol

C: Contextual information; 1: Baltic Sea nutrient case; 2: Arctic HFO case. Other informal conversations that did not deliver any new insights and/or were not documented with notes are not listed.

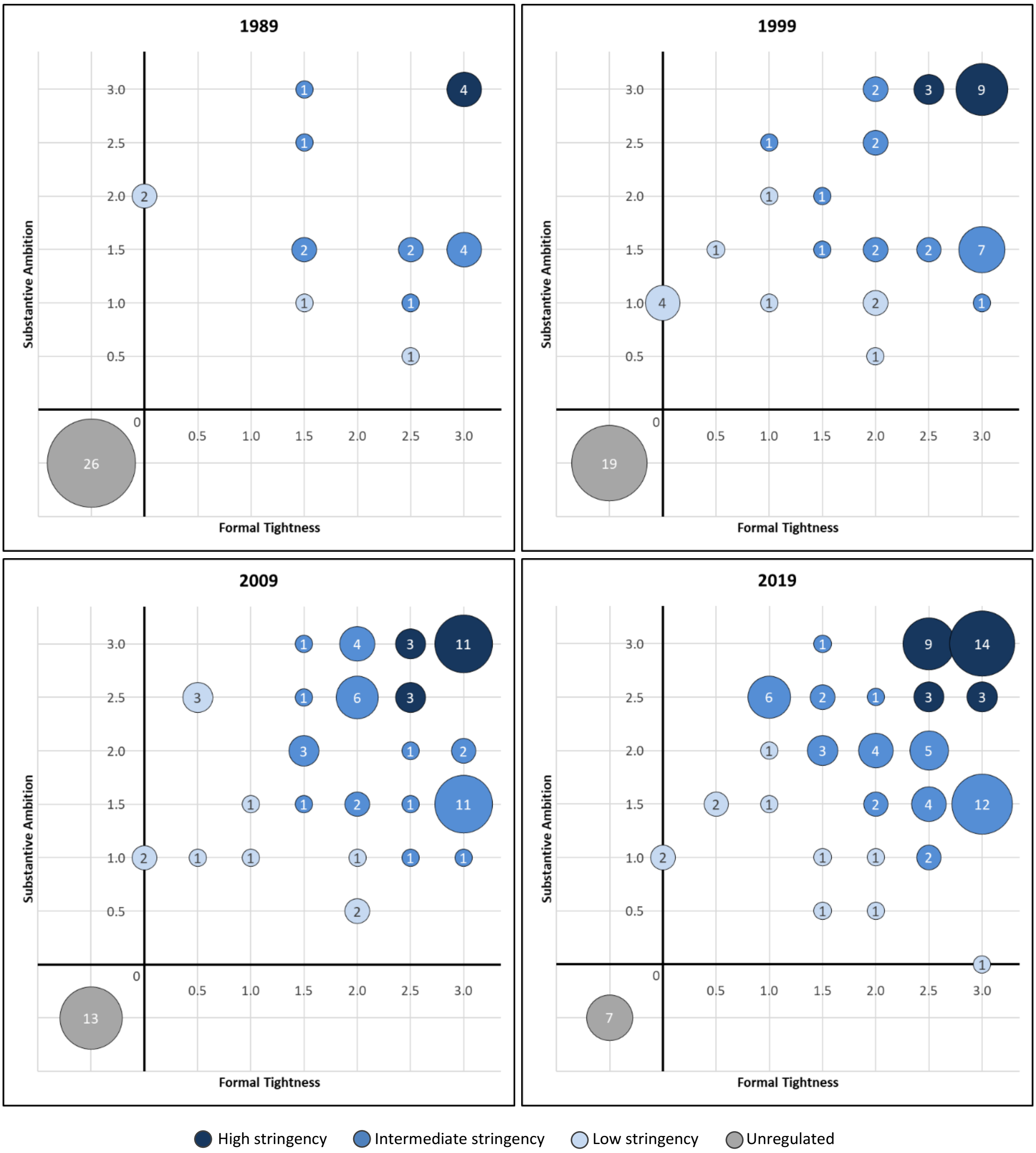
Interviews with German-speaking interviewees conducted in German (in-text quotes are my own translations). All other interviews conducted in English.

Note: In the text, I only quote or reference formal interviews listed in Table 28. All interviewees were guaranteed anonymity. Informal conversations were used as background information only.

Source: Author.

Appendix II: Additional Regulation Data and Visualizations

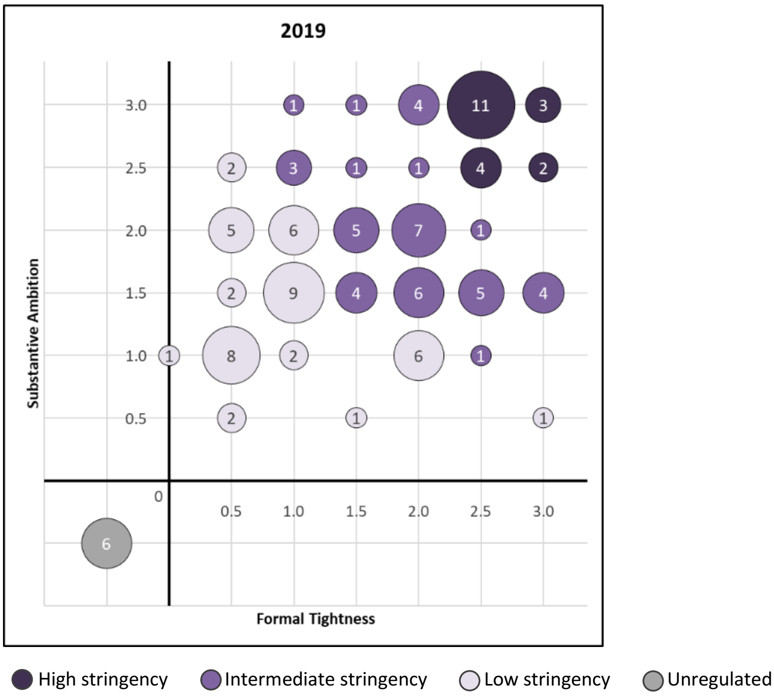
Figure 21: Form and substance of regulation in maritime shipping, 1989-2019



Note: Figure shows count of all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas). The number of unregulated externalities refers to externalities that are not subject to international regulation in any sea area.

Source: Author.

Figure 22: Form and substance of regulation in offshore oil and gas production, 2019



Note: Figure shows count of all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas). The number of unregulated externalities refers to externalities that are not subject to international regulation in any sea area.

Source: Author.

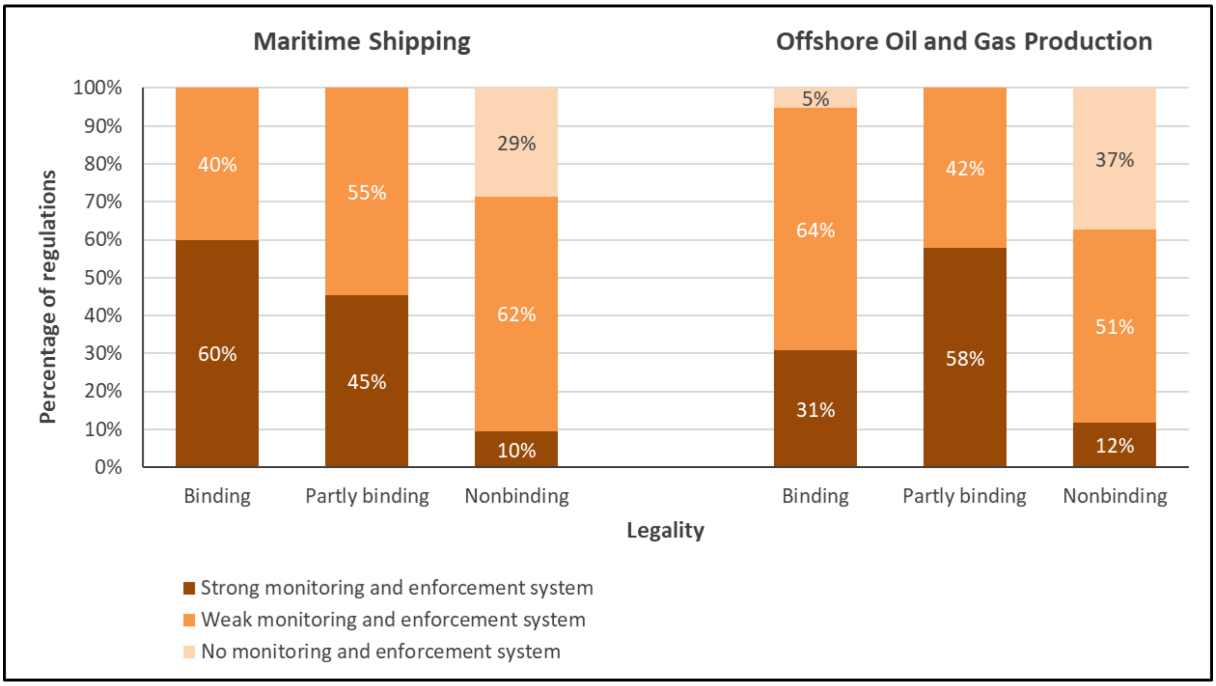
Table 30: Requirement levels of regulations by level of formal tightness, total numbers, 2019

			Formal tightness		
			High	Intermediate	Low
Maritime shipping	**Required externality reduction**	High	23	4	0
		Medium	27	11	10
		Low	3	2	2
Offshore oil and gas	**Required externality reduction**	High	15	7	2
		Medium	16	20	30
		Low	1	9	9

Note: Table considers all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas).

Source: Author.

Figure 23: Monitoring and enforcement system by legal status of regulation, 2019



Note: Figure considers all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas).

Source: Author.

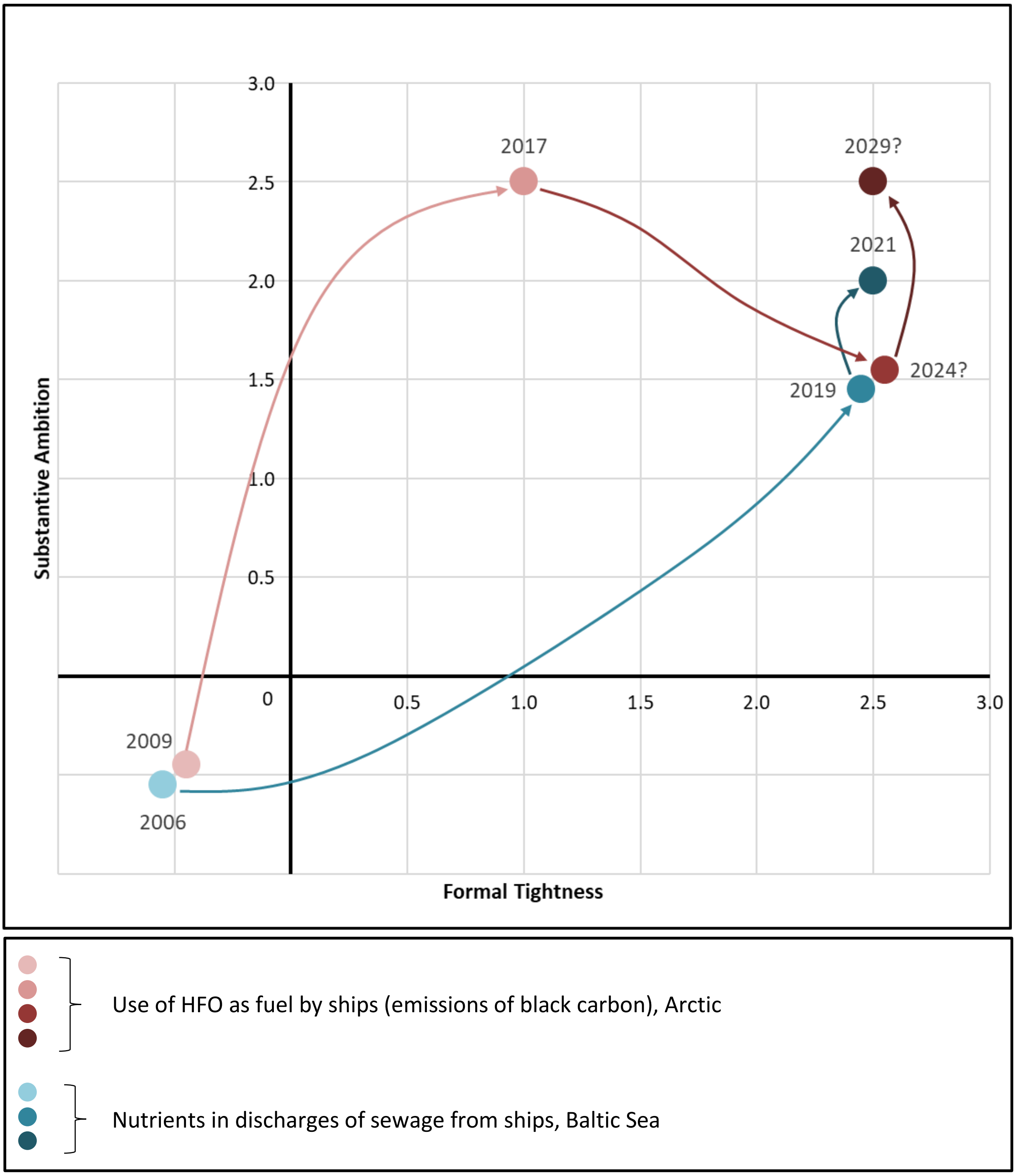
Table 31: Monitoring and enforcement system by legal status of regulation, total numbers, 2019

			Legality		
			High	Partly binding	Low
Maritime shipping	**Monitoring and enforcement system**	Strong	30	5	2
		Weak	20	6	13
		None	0	0	6
Offshore oil and gas	**Monitoring and enforcement system**	Strong	12	11	6
		Weak	25	8	26
		None	2	0	19

Note: Table considers all regulations in all sea areas (one externality may be subject to multiple regulations in different sea areas).

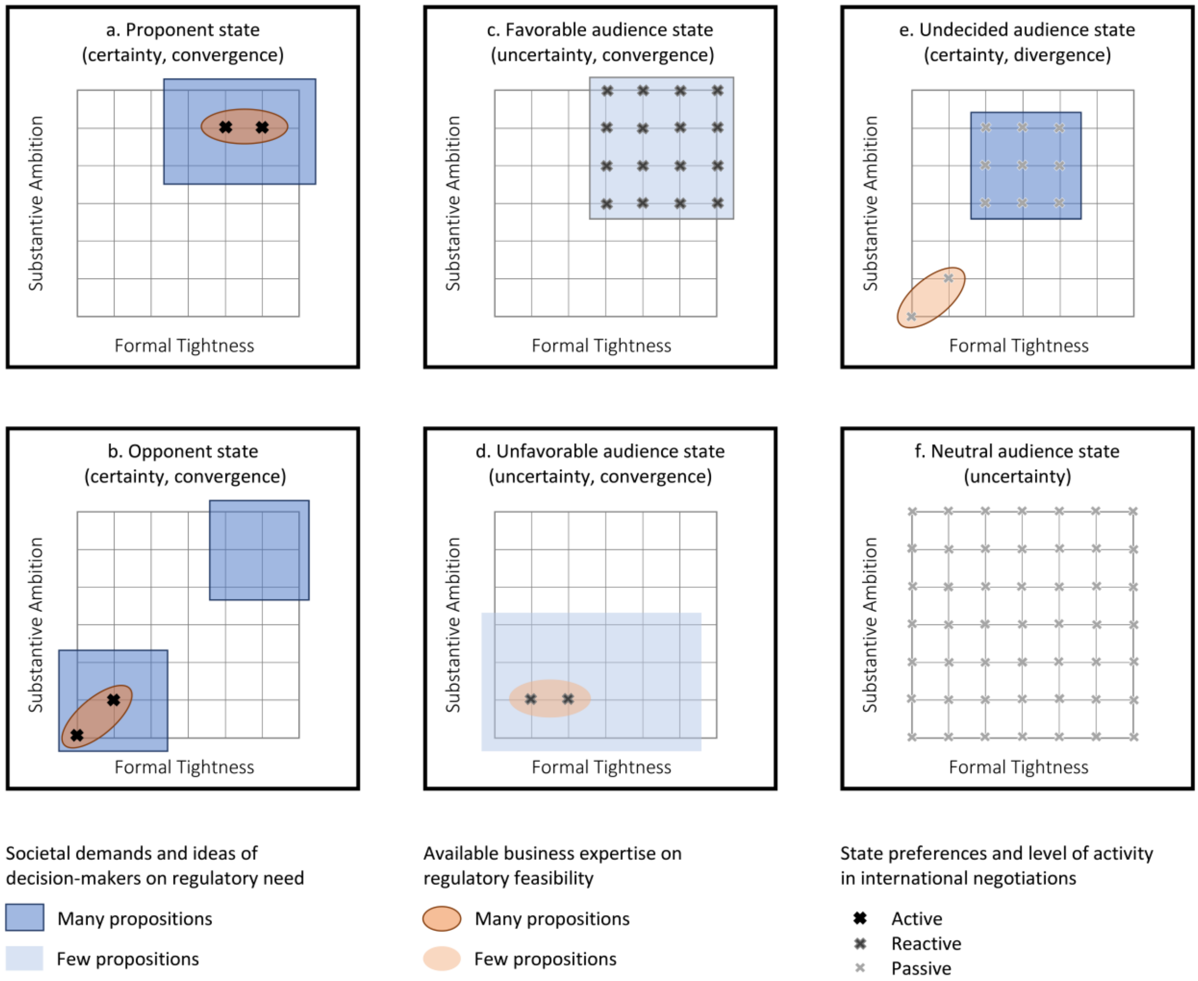
Source: Author.

Figure 24: Form and substance of regulatory outcomes in the case studies



Source: Author.

Figure 25: Certainty, convergence, and roles of states



Note: Very stringent regulation is located in the upper right corner of each diagram; very lax regulation in the lower left corner.

Source: Author.

Appendix III: IMER Database Protocol

The International Maritime Environmental Regulation (IMER) Database contains design data for the international regulation of the operational environmental impacts of commercial maritime shipping and offshore oil and gas production in selected years. The years selected for shipping are 1989, 1999, 2009, and 2019, and for offshore oil and gas 2019. This protocol outlines the structure of the database and the coding criteria.

Database Architecture

The database is structured around five dimensions: industry, year, externality, sea area, and international regulatory body. Table 32 summarizes the coverage of the database. The different elements are outlined in subsequent sections.

Table 32: Coverage of IMER Database

Industries	Maritime shipping	Offshore oil and gas production
Externalities	35	45
Years	4	1
Sea areas	28	
Int'l regulatory bodies	24	

Source: Author.

Industries and Years

The dataset covers two industries: commercial maritime shipping and offshore oil and gas production. Table 33 explains how the two industries are delineated for the purpose of data collection. Other maritime industries, like seabed mining, offshore renewables, or fisheries, are excluded.

For maritime shipping, four years in four decades are coded to allow for comparisons over time. For offshore oil and gas production, one year is coded to allow for a punctual comparison with maritime shipping. The coding of international regulatory stringency in these anchor years often provides a picture that goes beyond a single year. It usually reflects regulations adopted over the past decade and captures a good part of the regulations that will apply to ships and platforms in the years ahead.

Table 33: Industries covered by IMER Database

Code	Industry	Included	Excluded	Years coded
MS	Maritime shipping	All commercial, seagoing ships (cargo, passenger, fishing)	Military vessels, pleasure boats, and inland barges	1989, 1999, 2009, 2019
OG	Offshore oil and gas production	All offshore drilling units, with a focus on fixed platforms. Many of these regulations also apply to mobile offshore drilling units (MODUs).	Other offshore structures, like Floating Storage and Offloading units (FSOs) and Floating Storage Units (FSUs), onshore facilities, and oil and gas transport (pipelines, tankers)	2019

Source: Author.

Externality

The dataset covers regulations of operational environmental externalities and excludes regulations that only reduce accidental pollution or resource use. For instance, provisions for the design of double hull tankers that address accidental spill risks are excluded. The regulation of the use of heavy fuel oil (HFO) as fuel is included because, besides reducing accidental spill risks, it also reduces emissions of black carbon (Comer et al. 2017). The database treats externalities as combinations of effects and operational sources whenever these combinations have been regulated differently. For instance, operational oil pollution from ships can occur through discharges of bilge water, fuel residues (sludge), ballast water, cargo residues, and the use of lubricants.

Externalities were identified in two ways: inductively from the population of existing regulations; and deductively from environmental reports of international organizations or national administrations (AMAP 2010; Arctic Council 2009a; GESAMP 1993; IMO 2015c; OSPAR Commission 2009a; 2010b; 2016; US EPA 2008) and other relevant studies (Cordes et al. 2016; Patin 2018; Transportation Research Board and National Research Council 2003; Wills 2000). I make the simplifying assumption that all externalities have existed from the beginning of the observation period.[78]

Unregulated externalities reflect the present state of knowledge and are subject to change as research progresses. In addition, there is an element of social construction

[78] Empirically, this has not always been the case. For instance, water pollution from exhaust gas treatment has not existed prior to the introduction of such technology onboard ships. Researchers primarily interested in how long externalities have remained unregulated should disentangle this complexity.

in the identification of environmental problems (Mitchell 2010, 21). For these reasons, my list of environmental externalities may not always be a fair benchmark for regulation in the past and will certainly be regarded as incomplete a few years down the road.[79]

The database generally focuses on the operational externality primarily addressed by a regulation. It does not consider co-benefits in the reduction of other operational impacts. For example, regulations on the sulfur content of fuel are coded regarding their effect on emissions of sulfur oxides but not of other air pollutants, such as particulate matter. In some cases, externalities originating from a single operational source cannot be easily disentangled and are thus treated as a bundle. For instance, flaring of gas on offshore platforms produces different kinds of air pollution.

In total, the dataset covers 53 external effects of which 27 are relevant in both industries covered. The remainder of externalities only occurs in one of the industries (shipping: 8; oil and gas: 18). Externalities are grouped into four types according to their main environmental impact. Table 34 provides the numbers of coded externalities by type and industry. Table 35 list the externalities covered for each industry.

Table 34: Number of externalities covered by IMER database, by type and industry

	Maritime shipping	**Offshore oil and gas production**
Oil pollution	7	11
Chemical and other water pollution	10	14
Air pollution	13	15
Other ecosystem impacts	5	5

Source: Author.

[79] For instance, recent research has begun to assess the ecological impacts associated with surfactants and other contaminants in discharges of treated bilge water from ships, which is so far only regulated with respect to oil content (Magnusson et al. 2018; Tiselius and Magnusson 2017).

Table 35: Externalities covered by IMER Database

Type	Code	Externality	Relevance Maritime Shipping	Relevance Offshore Oil & Gas
Oil pollution	O.BAW	Discharges of oily ballast water	●	
	O.BDW	Discharges of oily ballast and displacement water		●
	O.CAT	Discharges of oil from cargo areas of tankers	●	
	O.CUP	Release of oil from cutting piles		●
	O.DED	Discharges of oily deck drainage		●
	O.ERB	Discharges of oily bleed-off water from exhaust gas recirculation	●	●
	O.ERR	Discharges of oily residues from water treatment in exhaust gas recirculation	●	●
	O.LUH	Pollution from lubricants on underwater hull (e.g., propeller)	●	
	O.MSB	Discharges of oil in machinery space bilges	●	●
	O.NAD	Discharges of non-aqueous drilling fluids and cuttings (diesel-, oil-, and synthetic-based)		●
	O.PDW	Discharges of oil in produced water		●
	O.PSS	Discharges of oil in produced sand and scale		●
	O.SDG	Discharges of oil sludge/residues	●	●
	O.WLT	Discharges of oil from well-testing		●
Chemical and other water pollution	C.CDS	Leakage from carbon dioxide sequestration and storage		●
	C.DSB	Discharges of desalination brine		●
	C.ECR	Discharges of washwater residues from exhaust gas cleaning	●	●
	C.ECW	Discharges of washwater from exhaust gas cleaning	●	●
	C.GPO	Discharges of plastic, other solid, and most other garbage	●	●
	C.GSP	Discharges of specified garbage (food wastes, cargo residues, cleaning agents, animal carcasses)	●	●
	C.HSP	Pollution from jettisoning of harmful substances in packaged form	●	
	C.NLS	Discharges of noxious liquid substances from tankers	●	
	C.NOR	Discharges of naturally occurring radioactive materials		●
	C.OCH	Pollution from use of offshore chemicals (including lubricants)		●
	C.PWD	Hazardous substances in discharges of produced water		●
	C.SBW	Discharges of black water (sewage from toilets)	●	●
	C.SGW	Discharges of gray water (sewage from sinks, bath, kitchens)	●	●
	C.SNU	Nutrients in discharges of sewage	●	●

	C.TAF	Pollution from use of toxic anti-fouling systems	●	●
	C.WBD	Discharge of water-based drilling fluids and cuttings		●
Air pollution	A.BLC	Exhaust emissions of black carbon from use of Heavy Fuel Oil	●	●
	A.CDD	Exhaust emissions of carbon dioxide based on energy efficiency in design	●	●
	A.CDO	Exhaust emissions of carbon dioxide based on operational energy efficiency	●	●
	A.CMO	Exhaust emissions of carbon monoxide	●	●
	A.FLA	Emissions from flaring		●
	A.HFC	Emissions from use of hydrofluorocarbons and other refrigerants	●	●
	A.ISW	Emissions from incineration of ship- or platform-generated wastes	●	●
	A.NOX	Exhaust emissions of nitrogen oxides	●	●
	A.ODE	Deliberate emissions of ozone depleting substances	●	●
	A.ODI	Emissions from use of ozone depleting substances in installations	●	●
	A.PAM	Exhaust emissions of particulate matter, including heavy metals and polycyclic aromatic hydrocarbons	●	●
	A.SOX	Exhaust emissions of sulfur oxides	●	●
	A.VDH	Emissions from venting and dehydration		●
	A.VOE	Exhaust emissions of volatile organic compounds	●	●
	A.VOF	Fugitive emissions of volatile organic compounds	●	●
Other ecosystem impacts	E.COM	Ecological impacts from field/platform commissioning		●
	E.COW	Discharge of cooling water		●
	E.DEC	Ecological impacts from field/platform decommissioning		●
	E.IBF	Invasive species from biofouling	●	
	E.IBW	Invasive species in ballast water and sediments	●	
	E.LGT	Light impacts	●	●
	E.PDM	Physical disturbance of marine mammals (strikes, icebreaking)	●	
	E.UWN	Underwater noise	●	●

Source: Author.

Sea areas

The dataset covers global and regional regulations in 28 sea areas. The list of regulatory sea areas was compiled based on the list of UN Regional Seas programs (UNEP 2017), the regulatory regions defined in Annexes I-VI of the International Convention for the

Prevention of Marine Pollution from Ships (MARPOL), and the geographic scope of other relevant regulatory documents.

The delineation of regulatory sea areas does not strictly follow geographic boundaries and may vary across international organizations and industries. Where boundaries of one region differ markedly, two variants of it are listed. For example, the IMO Polar Code defines the Arctic region much more narrowly than the Arctic Offshore Oil and Gas Guidelines by the PAME working group of the Arctic Council (Hofmann 2019). Table 36 lists all the sea areas covered, including their legal foundations for international maritime regulation.

Table 36: Sea areas covered by IMER Database

Ocean area	Regulatory sea area	Basis for international regulation and source of area definition (conventions, declarations, etc.)	Nested in other sea area
All	Global	International Convention for the Prevention of Marine Pollution from Ships (MARPOL), International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention), International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)	-
Arctic Ocean	IMO Arctic	IMO Polar Code, MARPOL	PAME Arctic
	PAME Arctic	Declaration on the Establishment of the Arctic Council (Ottawa Declaration), Arctic Offshore Oil and Gas Guidelines	Global
Atlantic Ocean	Baltic Sea	Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention), MARPOL	Global
	Black Sea	Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention), MARPOL	Global
	Wider Caribbean	Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention), MARPOL	Global
	US Caribbean	MARPOL	Wider Caribbean
	Mediterranean Sea	Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention), MARPOL	Global
	North American waters	MARPOL	Global
	North-East Atlantic	Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention)	Global
	North Sea	MARPOL	North-West European waters, North-East Atlantic

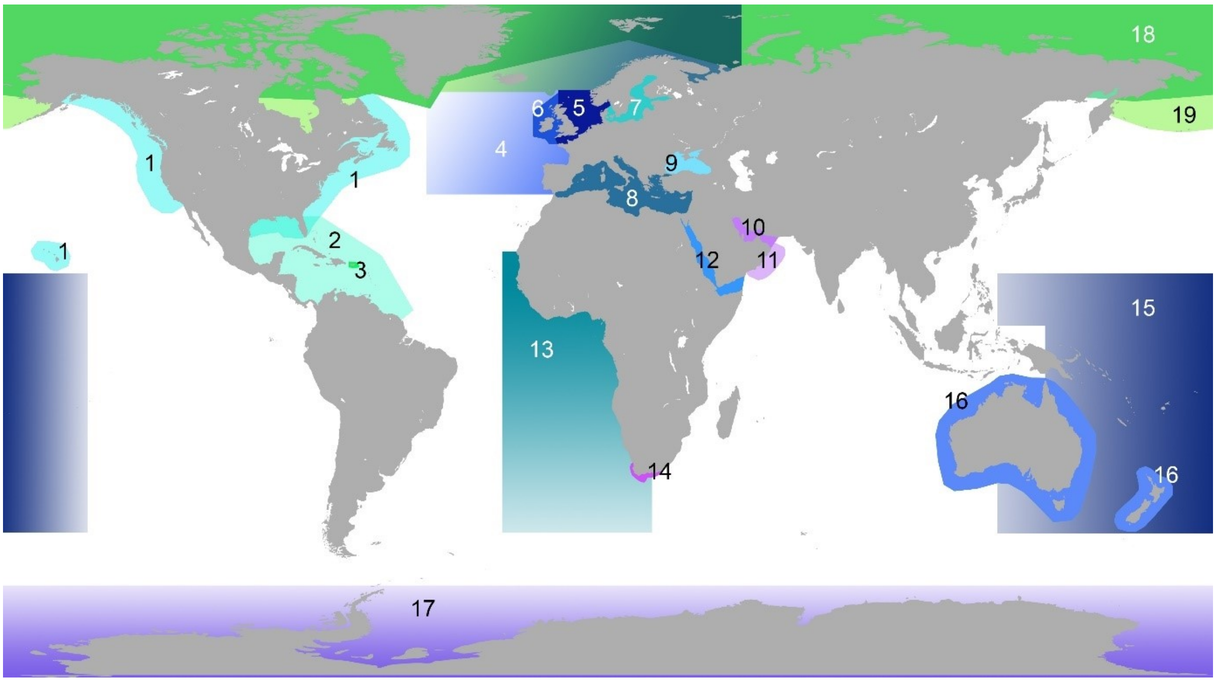
	North-West European waters	MARPOL	North-East Atlantic
	Southern South African waters	MARPOL	Global
	Western Africa	Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern Africa Region (Abidjan Convention)	Global
Indian Ocean	ROPME sea area: Persian Gulf and Oman coastal sea	Regional Convention for Co-operation on the Protection of the Marine Environment from Pollution (Kuwait Convention)	Global
	Gulfs area: Persian Gulf	Kuwait Convention ("special area"), MARPOL	ROPME sea area
	Red Sea and Gulf of Aden	Regional Convention for the Conservation of the Red Sea and Gulf of Aden (Jeddah Convention), MARPOL	Global
	South Asian Seas	Declaration on the South Asia Co-operative Environment Programme (Colombo Declaration)	Global
	Southern South African waters	MARPOL	Global
	Western Indian Ocean	Convention for the Protection, Management and Development of Coastal and Marine Environment of the Western Indian Ocean (Nairobi Convention)	Global
Pacific Ocean	Australia and New Zealand	Bilateral cooperation: Anti-fouling and in-water cleaning guidelines	Global
	East Asian Seas	Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the East Asian Seas Region (the East Asian Seas Action Plan)	Global
	North American waters	MARPOL	Global
	North-East Pacific	Convention for Cooperation in the Protection and Sustainable Development of Marine and Coastal Environment of the Northeast Pacific (Antigua Convention)	Global
	North-West Pacific	Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region (NOWPAP)	Global
	Pacific	Convention for the Protection of the Natural Resources and Environment of the South Pacific region (Noumea Convention)	Global
	South-East Pacific	Convention for the Protection of the Marine Environment and Coastal Areas of the South-East Pacific (Lima Convention)	Global
Southern Ocean	Antarctic area	Antarctic Treaty, MARPOL	Global
Inland	Caspian Sea	Framework Convention for the Protection of the Marine Environment of the Caspian Sea (Teheran Convention)	Global

Note: Sea areas not listed here do not have any international conventions, declarations, action plans, or the like that could form a basis for regional regulations as defined in the IMER Database. Two additional, multi-region agreements covering sea areas of the Atlantic are ASCOBANS and ACCOBAMS (see Table 37).

Source: Author.

Regulatory sea regions can be nested or overlapping. For example, the North-East Atlantic as defined in the OSPAR Convention comprises two smaller sea areas defined under MARPOL shipping regulation (North-West European waters and the North Sea) and partly overlaps with the Arctic region. For purposes of overview, the sea areas have been assigned to the ocean in which they are mainly located. A few regulatory sea areas cannot be assigned to a single ocean (e.g., the North American waters as defined by MARPOL Annex VI are in the Atlantic and Pacific Ocean). Figure 26 shows the geographic location of the sea areas. International regulations applying to smaller areas, such as local routeing measures, are not considered.

Figure 26: Map of sea areas with international maritime environmental regulations



1	North American waters	11	Oman area of the Arabian Sea*
2	Wider Caribbean	10+11	ROPME sea area
3	US Caribbean	12	Red Sea and Gulf of Aden*
4+5+6	North-East Atlantic	13	Western Africa*
5	North Sea	14	Southern South African waters
5+6	North-West European waters	15	Pacific
7	Baltic Sea	16	Australia and New Zealand
8	Mediterranean	17	Antarctic area
9	Black Sea	18	IMO Arctic
10	Gulfs area	18+19	PAME Arctic

* Regional regulation exists but is not in effect yet.

All boundaries displayed are approximate. Sea areas without maritime regulations are not shown.

Source: Author. Base map without sea areas from Crates, Creative Commons Attribution-Share Alike 4.0 license, https://commons.wikimedia.org/wiki/File:World_map_blank_without_borders.svg

International regulatory bodies

The dataset covers 24 international regulatory bodies through which states can control environmental externalities of maritime shipping or offshore oil and gas production. These bodies were identified through a review of institutional structures established by relevant international conventions, declarations, and action plans, and additional web and literature research (cf. also Tetzlaff 2015). They can be full-fledged international organizations with own secretariats (e.g., IMO and OSPAR Commission) or comprise intergovernmental conferences and action plans administered by the UN Environment Programme (e.g., Abidjan Convention). The European Union (EU) and the transposition of its regulations in the European Economic Area (EEA)[80] were excluded from the list as the EU is a contracting party to some of the relevant international agreements and transcends the typical distinction between the state and international organizations (Risse-Kappen 1996). A few non-maritime international bodies and instruments have been excluded as they are less targeted with respect to shipping and offshore oil and gas production than maritime law instruments and/or difficult to relate to specific sea areas.[81] Table 37 lists the international regulatory bodies reviewed by the database and the sea areas they regulate.

Table 37: International organizations covered by IMER Database

Code	International regulatory body	Regulatory sea area
AC	Arctic Council	PAME Arctic
ABC	Abidjan Convention	Western Africa
ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	Black Sea, Mediterranean Sea, (and small part of the Atlantic)
[ANC	Antigua Convention, not in force yet]	North-East Pacific
ANZ [**ANZECC**	Australia-New Zealand bilateral cooperation Australia and New Zealand Environment and Conservation Council, until 2001]	Australia and New Zealand

[80] The EEA extends EU regulation to Iceland, Liechtenstein, and Norway in a "quasi-automatic" way which leaves limited to no room for negotiation (Gould 2004, 188).

[81] This mostly concerns instruments under the UNECE, including Protocols and technical guidance of the Convention on Long-range Transboundary Air Pollution and the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention). These instruments mention ships and offshore hydrocarbon production alongside other pollution sources and sectors (Lindau, Jagusiewicz, and Kovacs 2004, 51; MAP 2013, 30; Széll, Keizer, and Kuokkanen 2004, 128). However, for controlling specific externalities in entire sea areas, they appear less relevant than maritime law instruments under the IMO and regional conventions. Also excluded are the broad, multi-sector General Environmental, Health, and Safety (EHS) Guidelines and the Thermal Power Plants EHS Guidelines of the World Bank.

ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas	Baltic Sea, North Sea, North West European Waters, (and parts of the North-East Atlantic)
ATS	Antarctic Treaty System	Antarctic area
BLC	Barcelona Convention	Mediterranean Sea
BSC	Black Sea Commission	Black Sea
CEP/CC	Caribbean Environment Programme/Cartagena Convention	Wider Caribbean
CEP/TC	Caspian Environment Programme/Teheran Convention	Caspian Sea
COBSEA	Coordinating Body on the Seas of East Asia	East Asian Seas
CPPS	Permanent Commission for the South Pacific	South-East Pacific
HELCOM	Helsinki Commission	Baltic Sea
IMO	International Maritime Organization	Global, IMO Arctic, Antarctic area, Black Sea, Baltic Sea, Wider Caribbean, US Caribbean, Gulfs area, Mediterranean Sea, North American waters, North Sea, North-West European waters, Southern South African waters
LC	London Convention	Global
NC	Nairobi Convention	Western Indian Ocean
NOWPAP	Northwest Pacific Action Plan	North-West Pacific
OSPAR [OSCOM [**PARCOM**	OSPAR Commission Oslo Commission, until 1998] Paris Commission, until 1998]	North-East Atlantic
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden	Red Sea and Gulf of Aden
ROPME	Regional Organization for the Protection of the Marine Environment	ROPME (Persian Gulf and Oman), Gulfs area (Persian Gulf)
SACEP	South Asia Co-operative Environment Programme	South Asian Seas
SPREP	Secretariat of the Pacific Regional Environment Programme	Pacific
WB	World Bank (International Finance Corporation)	Global

In bold: International bodies that have regulated shipping or offshore oil and gas impacts in observed years.

Source: Author.

Coding Criteria, Examples, and Sources

This section outlines the coding of whether or not an externality is regulated in a given year, industry, and sea area (REG) and the six design elements of regulation: legality (X_T), precision (Y_T), monitoring and enforcement system (Z_T), substantive scope (X_A), the requirement level in relation to externality (Y_A), and the requirement level in relation to other international regulation (Z_A). For each variable, the coding criteria, additional considerations, the sources used, and coding examples are provided. The examples cover a broad range of externalities, sea areas, and regulatory bodies from different years in both industries.

Regulation (REG)

Variable Description

Is there international regulation in effect that controls the externality in the given industry, year, and regulatory sea area?

Coding

1=	Yes Formally effective international regulation present. International regulations are explicit formal rules, standards, or guidelines adopted by two or more states to control an operational externality of business activity on the natural environment.
0=	No No formally effective international regulation present. Policy documents that merely stipulate intended state action are not considered to be regulations. Also excluded are strategies, programs, and projects that exclusively aim at assessing rather than controlling operational externalities. Provisions that do not apply globally but cannot be related any specific sea area(s) either are excluded as well.

Notes

International regulations may consist of provisions contained in a single document or in several different, connected documents. One document may contain several regulations on different externalities. Ministerial declarations and action plans merely outlining what states intend to do in the future are generally not considered to constitute regulations but rather precursors to international regulation. Documents adopted in the context of ministerial declarations or action plans qualify as regulations only when their provisions directly seek to control business externalities. Guidelines or recommendation contained in study-like reports are not considered regulations.[82]

A regulation can consists of complementary provisions adopted by two international bodies. I note the second body only when its provisions increase the value of at least one design element. For instance, a regional body may develop provisions that increase the strength of the monitoring system of a regulation developed by the global regulator. The database references all documents containing regulatory provisions relevant for the coding. The coding is always based on the consolidated versions of these documents which comprise all amendments that had entered into effect until the given year.

Regulations are formally effective when they have entered into force in accordance with applicable ratification or similar requirements in international law. This does not necessarily require consent and ratification by all states in the relevant sea area. Regulations are considered to have been in effect for a given year when they entered into force until December 31 of that year. This requirement ensures that moribund regulations, i.e., regulations on which states only agree because they do not intend to ratify them (Marcoux and Urpelainen 2012), are excluded. For regulations with phased application, only the provisions applicable as of December 31 of the given year are coded. For regulations without a formal entry into force date, especially recommendations or guidelines, the effective year is the year of adoption.

Sources

International Environmental Agreements Database (Mitchell 2020), International Regimes Database (Breitmeier, Young, and Zürn 2006b), websites of international regulatory bodies, regulatory documents, and secondary literature (Kao and Gao 1998; Lyons 2015; Mitchell 1994a; Molenaar 2015; Tan 2006; van Leeuwen 2010).

[82] An example is the guidance on noise mitigation from different sources, including platforms, which is contained in a report in the framework of the Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS 2010).

Examples

1= **Example 1: Discharges of oil from cargo areas of tankers (MS_O.CAT), North West European waters, 1999**

As of 1999, this externality was subject to regulation by the IMO under MARPOL Annex I (in force since 1983). Annex I contained global requirements and requirements for special areas. The IMO had decided in Resolution MEPC.77(41) "that the requirements of regulation 10 of MARPOL Annex I concerning the North West European Waters special area shall take effect on 1 August 1999" (IMO 1998, para. 1). Therefore, the special area requirements are coded as a regional regulation.

Example 2: Emissions from flaring on platforms (OG_A.FLA), PAME Arctic, 2019

As of 2019, this externality was subject to regulation by the Arctic Council in its Arctic Offshore Oil and Gas Guidelines (in effect since 2009). The guidelines state, inter alia, that: "There may be a need for specific licenses or permits covering flaring of gas. Flaring permits can be issued after a thorough assessment of environmental considerations and evaluations in accordance with technology, economy, resources, safety, infrastructure, jurisprudence etc. The regulators should early in the process of awarding licenses specify what the operators must expect with regard to limiting flaring of associated gas. Some gas may be utilized for power production at the installation, but if a large amount of gas is produced, possible solutions may be injection into the reservoir or export through pipelines. Every effort should be made to flare only where necessary for safety purposes" (Arctic Council 2009b, 35–36). While these provisions are not very precise and partly speak to regulators, they also address operators with the aim to control the externality. Thus, they represent a regional regulation.

Example 3: Discharges of oil in produced water from platforms (OG_O.PDW), Baltic Sea, 2019

As of 2019, this externality was subject to regulation by HELCOM in the Helsinki Convention Annex VI (in force since 2000), Recommendation 18-2 (in effect since 1997), and the Action Plan for the protection of the environment from offshore platforms (in effect since 2007). Although labelled as an action plan, the latter directly controls operational impacts of business as it states that: "all operators shall apply the 'zero-discharge' principle for polluted substances and materials not later than 1 January 2010, which means that: […] from 1 January 2010 any discharge of oil-containing water shall be prohibited" (HELCOM 2007e, 100). This requirement differs from those of earlier documents. The coding of the regional regulation considers the contents of all three documents from newest to oldest.

0= **Example 1: Discharges of oil from machinery spaces of ships (MS_O.MSC), Red Sea and Gulf of Aden, 1989**

As of 1989, this externality was subject to regulation by the IMO under MARPOL Annex I (in force since 1983). Annex I contained global requirements and requirements for special areas. The Red Sea and the Gulf of Aden had been defined as special areas in MARPOL Annex I in 1973 and 1987, respectively (IMO 1987, 3; MARPOL 1973, Annex I, regulation 10). However, due to the lack of a notification of adequate port reception facilities by the coastal states, the special areas had not taken effect by 1989 (IMO 2020c). Therefore, no regional regulation is coded for the sea area.

Example 2: Underwater noise from platforms (OG_E.UWN), North-East Atlantic, 2019

As of 2019, the only policy document mentioning this externality in the North-East Atlantic was Agreement 2015-05 of the OSPAR Commission (OSPAR Monitoring Strategy for Ambient Underwater Noise). The agreement "elaborates a proposed approach for the monitoring of underwater ambient noise" (OSPAR Commission 2015, 4) and does not contain any requirements on reducing underwater noise from offshore platforms. Hence, it does not qualify as a regional regulation.

Example 3: Nutrients in discharges of sewage from ships (MS_C.SNU), Baltic Sea, 2009

As of 2009, this externality was not subject to any international regulation. International regulatory bodies for discharges of sewage from ships in the Baltic Sea were the IMO and HELCOM. In the realm of the IMO, neither MARPOL Annex IV (in force since 2003) nor the Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants (in effect since 2006) mentioned nutrients. A complementary MEPC circular stated that the committee had "agreed to encourage all passenger vessels navigating in semi-closed and closed sea areas which are threatened by eutrophication, to refrain from discharging their waste water into the sea, and to dispose of it only in port reception facilities, if available" (IMO 2009e, sec. 1.2). While the language here is regulatory, the relevant semi-closed and closed sea areas are not identified in any IMO publication. As it thus remains unclear to which sea areas the provision applies, it is not considered a regulation (the IMO refers to an "understanding"; IMO 2009b, para. 14.6). In the realm of HELCOM, the Baltic Sea Action Plan had been adopted by the Baltic Sea states in 2007 with a paragraph stating: "WE AGREE to have in 2009 a joint submission by HELCOM Contracting States to IMO in order to elaborate relevant new regulations for ships covered by the existing Annex IV to MARPOL 73/78, including further consideration of designation of the Baltic Sea as a special area, with the aim to eliminate the discharge of sewage from ships, especially from passenger ships and ferries" (HELCOM 2007e, 26). This agreement declared an intent to develop a regulation instead of controlling the externality as such. Therefore, this statement does not qualify as a regulation either.

Legality (X_T)

Variable Description

What legal status does the regulation have for states in the regulated sea area and for the business actors under their jurisdiction?

Coding

1=	Binding Expressed state consent to be bound by the regulatory provisions. This is typically the case if the regulation is contained in a: • convention, • protocol, • mandatory code, or • decision of an international organization.
0.5=	Partly binding Regulation consists of binding and nonbinding provisions both of which are relevant as they increase the value of at least one other design element.
0=	Nonbinding No expressed state consent to be bound by the regulatory provisions. This is typically the case if the regulation is contained in a: • standard, • voluntary code, • guideline, or • recommendation of an international organization.

Notes

International regulations which legally bind contracting or member states are assumed to be mandatory for the business actors under their jurisdiction. Recommendations of international organizations are coded as 1=binding when they legally amend a binding document (e.g., HELCOM uses recommendations to amend the Helsinki Convention and its annexes).

Sources

International Environmental Agreements Database (for binding agreements) (Mitchell 2020), title of regulatory document, provisions on legal status of documents in underlying conventions, and other relevant decisions of international regulatory bodies on their legal framework (e.g., IMO 2001).

Examples

1= **Example 1: Discharges of noxious liquid substances from tankers (MS_C.NLS), Global, 1989**

As of 1989, the externality was subject to regulation by the IMO under MARPOL Annex II (in force since 1983). The 1978 Protocol to MARPOL 1973 states that: "the Parties to the present Protocol agree that they shall not be bound by the provisions of Annex II of the Convention for a period of three years from the date of entry into force of the present Protocol or for such longer period as may be decided by a two-thirds majority of the Parties to the present Protocol in the Marine Environment Protection Committee" (MARPOL 1978, art. II). Later, the committee in Resolution MEPC.17(22) "decided in accordance with Article II of the 1978 Protocol that Parties shall be bound by the provisions of Annex II of MARPOL 73/78 as amended as from 6 April 1987" (IMO 1985, 2). The regulation was thus binding on member states and mandatory for operators under their jurisdiction.

Example 2: Ecological impacts from field/platform decommissioning (OG_E.DEC), North-East Atlantic, 2019

As of 2019, the externality was subject to regulation by the OSPAR Commission in Decision 1998/3 (in force since 1999). The OSPAR Convention states that: "A decision shall be binding on the expiry of a period of two hundred days after its adoption for those Contracting Parties that voted for it and have not within that period notified the Executive Secretary in writing that they are unable to accept the decision, provided that at the expiry of that period three-quarters of the Contracting Parties have either voted for the decision and not withdrawn their acceptance or notified the Executive Secretary in writing that they are able to accept the decision" (OSPAR Convention 1992, art. 13). According to the OSPAR Commission, Decision 1998/3 was not subject to reservations or non-acceptance by any contracting party in 2019 (OSPAR Commission 2019, 5). Therefore, the regulation was binding on member states and thus mandatory for operators under their jurisdiction.

0.5= **Example 1: Exhaust emissions of carbon dioxide based on operational energy efficiency of ships (MS_A.CDO), Global, 2019**

As of 2019, the externality was subject to regulation by IMO under MARPOL Annex VI and Resolution MEPC.282(70). The legally binding amendments on energy efficiency regulations for ships to MARPOL Annex VI had entered into force in 2013 (IMO 2020h, 178). In regulation 22, this annex requires each ship to have a Ship Energy Efficiency Management Plan (SEEMP) on board. Resolution MEPC.282(70) contains Guidelines for the development of a Ship Energy Efficiency Management Plan. The part of the guidelines relevant for reducing the energy consumption of ships "provides a possible approach for monitoring ship and fleet efficiency performance over time and some options to be considered when seeking to optimize the performance of the ship" (IMO 2016e, para. 1.2). Thus, while the existence of a SEEMP is mandatory, there are no mandatory measures that must be contained therein.

Example 2: Discharges of non-aqueous drilling fluids and cuttings from platforms (OG_O.NAD), ROPME sea area, 2019

As of 1999, the externality was subject to regulation by ROPME under the 1989 Protocol concerning Marine Pollution resulting from Exploration and Exploitation of the Continental Shelf (in force since 1990) and the 1990 Guidelines on the Voluntary Regulation of the Disposal of Drill Cuttings on the Sea Bed. The Protocol, which is based on the Kuwait Convention, follows the typical approach of international treaty law as it states that it "shall be subject to ratification, acceptance, approval or accession by the States parties to the Convention" (Continental Shelf Protocol to the Kuwait Convention 1989, art. XV). Provisions on the externality contained in art. IX of the Protocol are complemented by additional requirements in the Guidelines. The Guidelines state that "In some circumstances damage to the environment can be done by the deposit of drill cuttings, it would be prudent to ask the Contracting States to accept a voluntary scheme of control based on what is presently known. These Guidelines have been produced to form the basis of that voluntary scheme. […] Under this scheme, each Contracting State is asked to take steps to see that these Guidelines are observed by operators within its jurisdiction, in the disposal of their drill cuttings" (ROPME/MEMAC 1990, 2). Therefore, the externality is subject to a mix of binding and nonbinding regulatory provisions.

0= **Example 1: Pollution from use of toxic anti-fouling systems (MS_C.TAF), Global, 1999**

As of 1999, the externality was subject to regulation by the IMO under Resolution MEPC.46(30) on measures to control potential adverse impact associated with use of tributyl tin compounds in anti-fouling paints. In this resolution, it was agreed "to recommend that Governments adopt and promote effective measures within their jurisdictions to control the potential for adverse impacts to the marine environment associated with the use of tributyl tin compounds in anti-fouling paints, and as an interim measure specifically consider actions as follows: […]" (IMO 1990, 1). Thus, the provisions for controlling the externality only have the status of nonbinding recommendations for states.

Example 2: Invasive species from biofouling on ships (MS_E.IBF), Pacific, 2019

As of 2019, the externality was subject to regulation by SPREP under the 2014 Model Marine Pollution Prevention Bill complementing global guidelines. In the instructions to the model law, it is stated that: "This law has been prepared to facilitate the making of necessary legislation to effectively implement the relevant international and regional Conventions, programs and arrangements, but does require appropriate modifications to effectively implement its provisions in the particular country which intends to use it as the basis of its marine pollution law" (SPREP 2014, 1). Thus, member states are not bound to implement the model law as adopted by SPREP.

Precision (Y_T)

Variable Description

What level of precision do the substantive provisions of the regulation have?

Coding

1=	High Regulation leaves little room for ambiguity about compliant behavior by featuring the following elements (possibly contained in comprehensive technical appendices or the like): • (a) concrete limit values or performance targets, • (b) detailed pre- or proscriptions of well-defined practices, • (c) specific standards referencing, and/or • (d) detailed provisions on exemptions.
0.5=	Medium Regulation leaves some room for ambiguity about compliant behavior by featuring the following elements (possibly contained in short technical appendices or the like): • (a) incomplete limit values or performance targets, • (b) somewhat vague pre- or proscriptions of partly ill-defined practices, • (c) vague standards referencing, and/or • (d) incomplete provisions on exemptions.
0=	Low Regulation leaves much room for ambiguity about compliant behavior by featuring the following elements (technical appendices usually lacking): • (a) no limit values or performance targets, • (b) vague pre- or proscriptions of ill- or non-defined practices, • (c) no standards referencing, and/or • (d) very broad statements on exemptions.

Notes

If provisions with different levels of precision co-exist in one regulation, the coding focuses on those elements that are most directly relevant for reducing the externality. The order of relevance among the elements listed in the coding criteria will typically be (a)>(b)>(c)>(d).

Sources

Substantive provisions, provisions on exemptions, definitions of key terms, and technical annexes in regulatory documents.

Examples

1=	**Example 1: Exhaust emissions of carbon dioxide based on energy efficiency in design of ships (MS_A.CDD), Global, 2019** As of 2019, the externality was subject to regulation by the IMO under MARPOL Annex VI as amended by Resolution MEPC.203(62). It stipulates that, for each ship covered by the provisions, "the attained EEDI shall be as follows: Attained EEDI ≦ Required EEDI = (1-X/100) × Reference line value where X is the reduction factor specified in Table 1 for the required EEDI compared to the EEDI Reference line" (IMO 2011c, regulation 21). The table referred to contains reduction rates (in percentage) for different ships types (defined in regulation 2) and sizes of ships (in deadweight tonnage). Thus, the provisions do not leave any room for ambiguity about the externality reduction required from each regulated ship. **Example 2: Discharge of water-based drilling fluids (WBDF) and cuttings from platforms (OG_C.WBD), Global, 2019** As of 2019, the externality was subject to regulation by the World Bank under its Environmental, Health, and Safety (EHS) Guidelines for Offshore Oil and Gas Development. The Guidelines prescribe the preferred practices and limit values for the externality in a technical table: "1) WBDF: Reinject or ship-to-shore, no discharge to sea except: In compliance with 96 hr. LC-50 of Suspended Particulate Phase (SPP)-3% vol. toxicity test first for drilling fluids or alternatively testing based on standard toxicity assessment species […] (preferably site-specific species). 2) WBDF cuttings: Reinject or ship-to-shore, no discharge to sea except: Facilities located beyond 3 miles (4.8 km) from shore; Hg: 1 mg/kg dry weight in stock barite; Cd: 3 mg/kg dry weight in stock barite; Maximum chloride concentration must be less than four times the ambient concentration of fresh or brackish receiving water; Discharge via a caisson (at least 15 m below sea surface is recommended whenever applicable; in any case, a good dispersion of the solids on the seabed should be demonstrated)" (World Bank 2015, 28). These provisions are unambiguous regarding what level of the externality is acceptable.
0.5=	**Example 1: Exhaust emissions of carbon dioxide based on operational energy efficiency of ships (MS_A.CDO), Global, 2009** As of 2009, the externality was subject to regulation by the IMO as set out in circulars MEPC.1/Circ.683 on Guidance for the development of a ship energy efficiency management plan and MEPC.1/Circ.684 on Guidelines for voluntary use of the Ship Energy Efficiency Operational Indicator (EEOI). The Guidelines in MEPC.1/Circ.684 provide a precise definition of

an energy efficiency indicator: “In its most simple form the Energy Efficiency Operational Indicator is defined as the ratio of mass of CO2 (M) emitted per unit of transport work: Indicator = MCO2/(transport work)” (IMO 2009d, 3). By contrast, the reduction measures listed in the Guidance in MEPC.1/Circ.683 are imprecise. For instance, it is stated without any further definitions or explanations that: “Use of emerging alternative fuels may be considered as a CO2 reduction method but availability will often determine the applicability” (IMO 2009c, para. 4.35). Thus, precise and imprecise provisions coexist for this externality.

Example 2: Leakage from carbon dioxide sequestration and storage from platforms (OG_A.CDS), North-East Atlantic, 2019

As of 2019, the externality was subject to regulation by the OSPAR Commission under the OSPAR Convention and Decisions 2007/1 and 2007/2. The OSPAR Convention permits carbon dioxide sequestration and storage provided that: “i. disposal is into a sub-soil geological formation; ii. the streams consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture, transport and storage processes used; iii. no wastes or other matter are added for the purpose of disposing of those wastes or other matter; iv. they are intended to be retained in these formations permanently and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area” (OSPAR Convention 1992, annex II, art. 3). While provisions i. to iii. are largely unambiguous, it is unclear what amount of leakage would qualify as a significant adverse consequence according to provision iv. Therefore, the regulation falls in between high and low precision.

0= **Example 1: Exhaust emissions of sulfur oxides from ships (MS_A.SOX), Global, 1999**

As of 1999, the externality was subject to regulation by the IMO under Resolution A.719(17). The resolution urged “Governments to take the necessary steps, […], to implement the following measures for prevention of air pollution from ships: […] Emissions of sulphur oxides and nitrogen oxides in exhaust gases shall be reduced” (IMO 1991, para. 2). The necessary amount of reduction and possible or required measures remained entirely unspecified. Thus, the regulation created considerable ambiguity.

Example 2: Discharges of oil from well-testing from platforms (OG_O.WLT), Mediterranean Sea, 2019

As of 2019, the externality was regulated by the Barcelona Convention under the Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil. The Protocol states that: “All the necessary precautions shall be taken to minimize losses of oil into the sea from oil collected or flared from well testing” (Offshore Protocol to the Barcelona Convention 1994, annex V, para. A.3). No further details are provided on what level of oil losses would correspond to the objective of minimization and how this should be achieved. Thus, the substantive provision on the externality leaves considerable room for ambiguity.

Monitoring and enforcement system (Z_T)

Variable Description

What level of strength does the monitoring and enforcement system of the regulation have?

Coding

1= Strong

Regulation coerces compliance through one or more of the following mechanisms:

- equipment and certification requirements with regular surveys or inspections,
- continuous monitoring and systematic prosecution of noncompliance,
- reporting schemes with mandatory improvement measures,
- permit schemes with regular and systematic controls, and
- major financial incentives for (over-)compliance.

0.5= Weak

Regulation deters noncompliance or incompletely coerces compliance through one or more of the following mechanisms:

- equipment and certification requirements without regular surveys or inspections,
- punctual monitoring and prosecution of noncompliance,
- loose reporting schemes without mandatory improvement measures,
- permit schemes without regular and systematic controls, and
- minor financial incentives for (over-)compliance.

0= None

Regulation lacks a monitoring and enforcement system because

- it does not feature any provisions on monitoring and enforcement,
- only requires contracting parties to report on legislative implementation without industry monitoring, or
- only recommends industry self-monitoring without involvement of state administration (or agents thereof).

Notes

General provisions on compliance monitoring by states that do not specify mechanisms are coded as 0.5=weak. The system of port state control, according to which port states have the right to inspect ships, is coded as 1=strong or 0.5=weak, depending on whether it is combined with mechanisms that facilitate monitoring (e.g., equipment requirements) or not (e.g., performance standards that cannot be verified in port). Equipment requirements whose effectiveness strongly depends on operational aspects, such as maintenance and training of personnel, are only coded 1=strong if there are additional monitoring and enforcement provisions (e.g., operational monitoring or financial incentives). Monitoring and enforcement provisions that are strong but do not apply to major externality sources within the scope of the regulation are coded as 0.5=weak.

Major financial incentives are those that render (over-)compliance at least cost-neutral in the entire regulated sea area compared to undetected noncompliance. Financial incentives offered by individual ports do not meet this criterion.

Sources

Provisions on monitoring and enforcement in regulatory documents, monitoring reports or other relevant documents from international regulatory bodies, and secondary sources.

Examples

1= **Example 1: Discharges of oil in machinery space bilges from ships (MS_O.MSB), Black Sea, 1999**

As of 1999, the externality was subject to regulation by the IMO under MARPOL Annex I as last amended by Resolution MEPC.51(32) and others. In the Black Sea special area, a discharge limit of 15 parts per million applied and ships of 400 gross tonnage and above were required to be equipped with oil filtering equipment. The design of this equipment "shall be such as will ensure that any oily mixture discharged into the sea after passing through the system or systems has an oil content not exceeding 15 parts per million. It shall be provided with alarm arrangements to indicate when this level cannot be maintained. The system shall also be provided with arrangements such as will ensure that any discharge of oily mixtures is automatically stopped when the oil content of the effluent exceeds 15 parts per million" (IMO 1992a, reg. 16(5)). Thus, the performance standard was continuously monitored and enforced through an equipment requirement.

Example 2: Pollution from use of offshore chemicals on platforms (OG_C.OCH), North-East Atlantic, 2019

As of 2019, the externality was subject to regulation by the OSPAR Commission under Decision 2000/2, Recommendation 2017/1, Agreement 2002-6, and others. Decision 2000/2 had established a Harmonised Mandatory Control System for offshore chemicals. It stated that this "shall be applied to any regulatory action, such as the granting of permits or approvals by authorities, concerning the use of, or the discharge of, chemicals from offshore sources. In the territory of those Contracting Parties where the use and discharge of offshore chemicals are regulated by frame permits based on internal (in-company) environmental control and where specific elements of the procedures required by the programmes and measures stipulated below are carried out by the companies themselves, the authorities shall be responsible for effective enforcement and control by a system of regular auditing, inspection or monitoring" (OSPAR Commission 2000, para. 2.2). The Decision requires that a pre-screening procedure be conducted before the use of an offshore chemicals. Based on the results of this pre-screening, authorities may generally or temporarily permit its use, request its substitution, or refuse a permit. This is a permit scheme with systematic control.

0.5= **Example 1: Discharges of plastic, other solid, and most other garbage from ships (MS_C.GPO), Global, 2009**

As of 2009, the externality was subject to regulation by the IMO under MARPOL Annex V as amended by Resolution MEPC.65(37) and others. It stipulates that "The competent authority of the Government of a Party to the Convention may inspect the Garbage Record Book on board any ship to which this regulation applies while the ship is in its ports or offshore terminals […]" (IMO 1995, reg. 9(5)). The Garbage Record Book is meant to document all discharge operations. It allows for some punctual monitoring and prosecution of noncompliance, but not for continuous monitoring. In addition, the Annex requires that "every ship of 12 metres or more in length overall shall display placards which notify the crew and passengers of the disposal requirements of regulations 3 and 5 of this Annex, as applicable" (IMO 1995, reg. 9(1)(a)). Placards encourage compliance but do not force it. Hence, the monitoring and enforcement provisions primarily seek to deter noncompliance.

Example 2: Discharges of oily ballast and displacement water from platforms (OG_O.BDW), ROPME sea area, 2019

As of 2019, the externality was subject to regulation by ROPME under the 1989 Protocol concerning Marine Pollution resulting from Exploration and Exploitation of the Continental Shelf. It requires that the oil content in discharges of ballast and displacement water has a monthly average of maximum 40 mg/l and does not at any time exceed 100 mg/l. The Protocol further states that: "Each Contracting State shall ensure that the operator may be required to conduct surveys of environmental conditions in the vicinity of his offshore installation, periodically or on such occasions as the Competent State Authority may reasonably require. The State itself may conduct or have conducted such a survey. If, without apparent reason, the result of that survey shows a significant difference from the results of the operator's most recent survey, without prejudice to any other legal action, the State may charge the cost of its own survey to the operator" (Continental Shelf Protocol to the Kuwait Convention 1989, art. IX, para. 3). This is a loose reporting scheme with punctual monitoring by state authorities.

0= **Example 1: Underwater noise from ships (MS_E.UWN), Global, 2019**

As of 2019, the externality was subject to regulation by the IMO under the Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life in circular MEPC.1/Circ.833. The Guidelines list various measures for reducing noise from ships. With respect to monitoring, they state that: "When efforts have been made to mitigate underwater noise, as far as reasonable and practical, evaluation should be undertaken to determine the success or otherwise of ship noise reduction efforts and to guide and enhance future activities at noise reduction. Such evaluation can include forms of radiated-noise measurements, simulations or other ways of data gathering" (IMO 2014f, para. 1.3). This provision is understood to recommend industry self-evaluation and does not explicitly require monitoring by state authorities. This is not considered a monitoring and enforcement system as defined here.

Example 2: Emissions from venting and dehydration on platforms (OG_A.VDH), Global, 2019

As of 2019, the externality was subject to regulation by the World Bank under its Environmental, Health, and Safety (EHS) Guidelines for Offshore Oil and Gas Development. The Guidelines contain provisions on the practice of venting of gas. With respect to monitoring, they state for all the externalities covered that: "Environmental monitoring programs for this sector should be implemented as required to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. […] Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards, so that any necessary corrective actions can be taken" (World Bank 2015, paras. 138–139). This provision is understood to focus on intra-industry monitoring as it does not mention state authorities and their role in monitoring and enforcement.

Substantive scope (X_A)

Variable Description

How large is the scope of the substantive provisions of a regulation in terms of covering the relevant externality sources (ships or offshore platforms) in the given sea region and industry?

Coding

1=	Large Substantive requirements of the regulation apply to all new units and average-aged existing units of the major externality sources, with limited or no exemptions. E.g., both new offshore platforms and platforms of average age are regulated.
0.5=	Medium Substantive requirements of the regulation apply to new and existing units of the major externality sources but feature major exemptions. E.g., large new ships regulated but average-aged existing large ship exempted.
0=	Narrow Substantive requirements of the regulation only apply to new or existing units of the largest externality sources, or only to externality sources producing a minor share of the externality. E.g., only small ships are regulated.

Notes

For shipping, large ships are considered the largest externality sources. Large ships of 400 gross tonnage and above, which is the threshold used in MARPOL, produce greater absolute pollution than small ships as they generally consume more fuel and produce more waste. For a few issues, the largest externality sources can be specified even further (e.g., focus on tankers for oil discharges from cargo areas). New ships are those that are less than five years old, which is when the first renewal survey by the classification society takes place (IACS 2011, 6). Existing ships are defined to be five or more years old. The coding thus assesses whether regulations applied to ships built before 1985 (for coding year 1989), 1995 (for 1999), 2005 (for 2009), and 2015 (for 2019). The average age of ships was 13 years in 1989, 14 years in 1999, 14 years in 2009, and 11 years in 2019 (UNCTAD 1990, 21; 2000, 19; 2009, 41; 2019, 31). The coding assesses whether the regulation applies to existing ships constructed in and after 1976 (for 1989), 1985 (for 1999), 1995 (for 2009), and 2008 (for 2019).

For offshore oil and gas platforms, no differentiation of platform sizes is necessary as this is generally not found in existing regulations. Where necessary, the largest externality sources are further specified. For instance, as for air emissions from platforms, engines for the exploration, exploitation and associated offshore processing of sea-bed mineral resources are considered the largest pollution source. In analogy to shipping, new offshore platforms are those that are less than five years old and existing ones are five years and older. The coding thus considers whether regulations applied to platforms built before 2015. Given a lack of recent data on the average age of existing platforms, an average age of 15 years is assumed based on older data (Pulsipher and Daniel IV 2000, 991). This means that the coding considers whether regulations in 2019 applied to platforms installed in and after 2004.

Limited exemptions are those that relate to minor externality sources (e.g., small ships or individual platforms) or safety aspects (e.g., discharges of oil allowed in emergency). Major exemptions apply to sources that may cause large parts of the externality (e.g., ships flying the flag of countries outside of the regulated sea area or ships on domestic voyages). Regulations that only apply to ships flying the flag of states in a certain region are considered to provide major exemptions for all those ships with other flags.

New ships and offshore platforms take a more central role in the coding criteria than existing units above the average age because the former are more important for externality levels in the long run. Regulations may apply to all externality sources but contain differentiated requirements for different subgroups. Differentiated requirements are generally considered in the coding of element Y_A. If major exemptions apply to the more demanding of these requirements, this is considered in the coding of scope.

Sources

Regulatory documents, especially provisions on application, exemptions, and delayed implementation.

Examples

1= **Example 1: Exhaust emissions of black carbon from use of Heavy Fuel Oil by ships (MS_A.BLC), Antarctica, 2019**

As of 2019, the externality was subject to regulation by the IMO under MARPOL Annex I as amended by Resolution MEPC.189(60). The relevant provisions states that: "With the exception of vessels engaged in securing the safety of ships or in a search and rescue operation, the carriage in bulk as cargo or carriage and use as fuel of the following: .1 crude oils having a density at 15'C higher than 900 kg/m^3; .2 oils, other than crude oils, having a density al 15°C higher than 900 kg/m^3 or a kinematic viscosity at 50°C higher than 180 mm^2/s ; or .3 bitumen, tar and their emulsions, shall be prohibited in the Antarctic area, as defined in Annex I, regulation 1.11 .7" (IMO 2010d, reg. 43, para. 1). By applying to both new and existing ships, the regulation covers all major pollution sources, while the exemptions for safety and rescue operations are very limited.

Example 2: Pollution from use of toxic anti-fouling systems on platforms (OG_C.TAF), Global, 2019

As of 2019, the externality was subject to regulation under the AFS Convention. The convention prohibits the application or re-application of organotin compounds which act as biocides in anti-fouling systems of ships from 2003 (AFS Convention 2001, annex 1). According to the convention, a ship is "a vessel of any type whatsoever operating in the marine environment and includes […] fixed or floating platforms […]" (AFS Convention 2001, art. 2(9)). Based on an assumed average age of platforms of 15 years, the prohibition of anti-fouling systems with organotin compounds covers both new as well as existing average-aged offshore platforms.

0.5= **Example 1: Fugitive emissions of volatile organic compounds from ships, (MS_A.VOF), Global, 2019**

As of 2019, the externality was subject to regulation by the IMO under MARPOL Annex VI as revised by Resolution MEPC.176(58). One of its provisions is a requirement for crude oil tanker to carry a VOC Management Plan which applies to both new and existing tankers. However, the central substantive provision of the regulation is that port states are allowed to require crude oil tankers to be fitted with a vapor emission control system after prior notification: "If the emissions of VOCs from a tanker are to be regulated in a port or ports or a terminal or terminals under the jurisdiction of a Party, they shall be regulated in accordance with the provisions of this regulation. […] A Party regulating tankers for VOC emissions shall submit a notification to the Organization. This notification shall include information on the size of tankers to be controlled, the cargoes requiring vapour emission control systems, and the effective date of such control. The notification shall be submitted at least six months before the effective date" (IMO 2008, reg. 15, paras. 1-2). Until 2019, only 13 ports in the

Netherlands and the Republic of Korea had notified the IMO of such controls (IMO 2017). This greatly limits the geographical reach of this requirement. Hence, the central substantive requirement of the regulation is subject to major exemptions.

Example 2: Discharges of oil in produced sand and scale from platforms (OG_O.PSS), Global, 2019

As of 2019, the externality was subject to regulation by the World Bank under its Environmental, Health, and Safety (EHS) Guidelines for Offshore Oil and Gas Development. The guidelines identify ship-to-shore or reinjection as the preferred management option for produced sand and set an emission limit of lower than 1% oil concentration by weight on dry sand for discharges into the sea (World Bank 2015, 28). In the introductory part, however, they state that: "The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them" (World Bank 2015, para. 2). Note that no differentiation was made here between facilities built before and after the publication of earlier versions of the guidelines, which already covered the externality (IFC 2000; IFC and World Bank 2007). Thus, existing units are potentially subject to major exemptions.

0= **Example 1: Emissions from use of ozone depleting substances in installations on ships (MS_A.ODI), Global, 2009**

As of 2009, the externality was subject to regulation by the IMO under MARPOL Annex VI as revised by Resolution MEPC.176(58) which states that: "Installations which contain ozone depleting substances, other than hydro-chlorofluorocarbons, shall be prohibited: .1 on ships constructed on or after 19 May 2005; or .2 in the case of ships constructed before 19 May 2005, which have a contractual delivery date of the equipment to the ship on or after 19 May 2005 or, in the absence of a contractual delivery date, the actual delivery of the equipment to the ship on or after 19 May 2005" (IMO 2008b, reg. 12, para. 3.1). In 2009, the regulation thus only applied to new ships or equipment which was less than five years old but not to older existing ships or equipment.

Example 2: Exhaust emissions of nitrogen oxides from platforms (OG_A.NOX), Global, 2019

As of 2019, the externality was subject to regulation by the IMO under MARPOL Annex VI as revised by Resolution MEPC.176(58). It contains limit values for emissions of nitrogen oxides in engine exhaust but states with respect to engines on platforms that: "Emissions directly arising from the exploration, exploitation and associated offshore processing of sea-bed mineral resources are, consistent with article 2(3)(b)(ii) of the present Convention, exempt from the provisions of this Annex. Such emissions include the following: […] emissions from marine diesel engines that are solely dedicated to the exploration, exploitation and associated offshore processing of sea-bed mineral resources" (IMO 2008b, reg. 3, para. 3.1). By exempting this major emission source, the regulation only applied to minor externality sources.

Requirement level in relation to externality (Y_A)

Variable Description

What level of externality reduction does the regulation require for an average externality source?

Coding

1=	High Regulation virtually eliminates externality by requiring reductions of 90% or more for an unregulated average externality source. E.g., total discharge prohibitions.
0.5=	Medium Regulation significantly reduces externality by requiring reductions in the order of 30-90% for an unregulated average externality source.
0=	Low Regulations does not significantly reduce externality by requiring reductions of less than 30% or of unclear amount for an unregulated average externality source.

Notes

Where historical benchmarks for the externality size of unregulated sources are not available, early regulatory requirements or data on externality levels in case of noncompliance are used as second-best benchmarks. Wherever possible, industry-wide or averaged data of several externality sources (i.e., several ships or platforms) is prioritized over data on a single externality source (i.e., one ship or platform).

Quantification is not possible for all externality reductions. Secondary sources are used to estimate the order of the reduction, yet uncertainties remain in some cases. Regulations that contain differentiated requirements for major externality sources are coded according to the combined effect. Borderline cases are coded conservatively (i.e., lower value in case of doubt). Note that secondary impacts occurring in other sectors are not considered.[83]

Regulations that list more than one option for reducing an externality are coded according to the option requiring the smallest reduction. Regulations stating that an externality should be "minimized" without prescribing any measures to achieve this goal are coded as 0=low. The combined effect of regulations that address similar externalities (e.g., emissions of carbon dioxide, nitrogen oxides, and sulfur oxides) is not considered.

Sources

Regulatory documents, especially substantive provisions on required or prohibited behavior, other primary sources from international regulatory bodies, relevant studies, and professional sources.

Examples

1= **Example 1: Exhaust emissions of sulfur oxides from ships (MS_A.SOX), North American waters, 2019**

As of 2019, the externality was subject to regulation by the IMO under MARPOL Annex VI as revised by Resolution MEPC.176(58). For the North American Emission Control Area, it required that: "While ships are operating within an Emission Control Area, the sulphur content of fuel oil used on board ships shall not exceed the following limits: […] 0.10% m/m on and after 1 January 2015" (IMO 2008b, reg. 14, para. 4). A useful benchmark for comparison is the average global sulfur content of ship fuel in 2005, which was around 3.0%. The required externality reduction thus amounted to more than 95%.

[83] For instance, a requirement to discharge all sewage into port reception facilities would be coded as 1=high as it eliminates all discharges of sewage from ships into the sea. However, the sewage would still end up in the sea, after having been processed through a municipal wastewater treatment facility. The general assumption here is that better treatment of waste is possible on land compared to ships and offshore platforms as space constraints for equipment do not apply. Where regulations create new environmental impacts from ships or platforms (e.g., by requiring the use of filters that wash out pollutants from exhaust gas, which would then be discharged into the sea), these externalities are coded separately.

Example 2: Ecological impacts from field/platform commissioning (OG_E.COM), Antarctic, 2019

As of 2019, the externality was subject to regulation by the Antarctic Treaty System. The Environmental Protocol to the Antarctic Treaty states that: "Any activity relating to mineral resources, other than scientific research, shall be prohibited" (Antarctic-Environmental Protocol 1991, art. 7). This regulation eliminates all possible ecological impact from the commissioning of offshore oil and gas fields.

0.5= **Example 1: Pollution from use of toxic anti-fouling systems by ships (MS_C.TAF), Global, 2009**

As of 2009, the externality was subject to regulation by the IMO under the AFS Convention. On "organotin compounds which act as biocides in anti-fouling systems," it stated that "ships shall not apply or re-apply such compounds" and that they "either: (1) shall not bear such compounds on their hulls or external parts or surfaces; or (2) shall bear a coating that forms a barrier to such compounds leaching from the underlying noncompliant antifouling systems" (AFS Convention 2001, annex 1). This eliminated the use of the most toxic anti-fouling paints, especially tributyltin (TBT). The use of other, less toxic anti-fouling paints, such as copper-based paints, remained allowed though. Thus, the regulation required a substantial externality reduction.

Example 2: Pollution from use of offshore chemicals on platforms (OG_C.OCH), PAME Arctic, 2019

As of 2019, the externality was subject to regulation by the Arctic Council under the 2009 Arctic Offshore Oil and Gas Guidelines requiring that: "The operators should ensure that risk evaluations are done based on the chemicals' intrinsic properties, time, place and amounts of discharge, and also other conditions of significance for the risk. The operator should choose the chemicals which according to environmental risk evaluations poses the lowest risk of harming the marine environment. The operator should have plans to ensure that hazardous chemicals are substituted with substances which pose less risk of harm to the environment" (Arctic Council 2009b, 35). Substituting hazardous chemicals with less harmful ones substantially reduces pressures on the marine environment, but some degree of pollution continues to exist.

0= **Example 1: Exhaust emissions of carbon dioxide based on energy efficiency in design of ships (MS_A.CDD), Global, 2019**

As of 2019, the externality was subject to regulation by the IMO under MARPOL Annex VI as amended by Resolution MEPC.203(62). It required improvements in energy efficiency as expressed in the Energy Efficiency Design Index (EEDI). The year 2019 fell into EEDI phase 1, where the maximum reduction in the EEDI required for new ships was 10%. Hence, the regulation did not require more energy efficient ship design that would significantly reduce exhaust emissions.

Example 2: Release of oil from cutting piles from offshore oil and gas drilling (OG_O.CUP), North-East Atlantic, 2019

As of 2019, the externality was subject to regulation by the OSPAR Commission under OSPAR Recommendation 2006/5. It required a screening of all cutting piles potentially contaminated with organic-phase drilling fluids and other discharges. For the results of this screening, it defined two thresholds (rate of oil loss to water column: 10 tonnes/year; persistence over the area of seabed contaminated: 500 km^2year). It further stated that: "Where both the rate and persistence are BELOW the thresholds and no other discharges have contaminated the cuttings pile, no further action is necessary and the cuttings pile may be left in situ to degrade naturally. […] Where either the rate of oil loss or the persistence are ABOVE the thresholds, stage 2 should be initiated at a time to be determined by the Contracting Party, taking into account the rate of oil loss, the persistence over the area of seabed contaminated and the timing of the decommissioning of the associated installation" (OSPAR Commission 2006, para. 3.6-3.7). Stage 2 would comprise the application of technologies and practices to reduce oil pollution. However, the screenings by the member states revealed that no cutting pile exceeded the thresholds (OSPAR Commission 2009b, 4–5). Hence, the regulation did not require any externality reductions.

Requirement level in relation to other international regulation (Z_A)

Variable Description

What level of externality reduction does the regulation require in comparison to reductions required by other international regulations of the same externality?

Coding

1=	High Regulation requires either maximum externality reductions or higher externality reductions than most or all other international regulations that are in effect for the same externality. E.g., regulation entirely bans certain emissions or only allows lower emissions than all other regulations.
0.5=	Medium Regulation requires externality reductions that are neither most nor least demanding in comparison with other international regulations that are in effect for the same externality. E.g., regulation allows for emission levels that are in between those allowed by other regulations.
0=	Low Regulation requires lower externality reductions than most or all other international regulations that are in effect for the same externality. E.g., regulation allows higher emissions than all other regulations.

Notes

The main rationale of this design element is to capture whether and where the room for higher requirement levels has been fully exploited. If more than one international regulation exist, requirements are compared across all regulated sea areas.[84] If only a single international regulation of an externality exists, the following criteria apply: a global regulation that eliminates the externality is coded 1=high; a global regulation that does not eliminate the externality is coded 0=low; and a regional regulation of an externality for which there is no global regulation is coded 1=high. If regional regulations exist but their requirements are similar to those of a global regulation that does not eliminate the externality, all regulations are coded 0=low. Uncertainties from the coding of Y_A do not

[84] Sea areas in which the economic activity is entirely prohibited are not considered. An exception to this is regulations addressing the commissioning of new offshore oil and gas platforms.

translate into the coding of this element as the ranking of reduction requirements of several international regulations is usually clear.

Sources

Review of Y_A values across all regulations, and regulatory reviews with a comparative approach.

Examples

1= **Example 1: Pollution from jettisoning of harmful substances in packaged form from ships (MS_C.HSP), Global, 1999**

As of 1999, the externality was subject to regulation by the IMO under MARPOL Annex III as revised by Resolution MEPC.58(33) stating that: "Jettisoning of harmful substances carried in packaged form shall be prohibited, except where necessary for the purpose of securing the safety of the ship or saving life at sea" (IMO 1992b, reg. 7. para. 1). By banning all deliberate discharges, the regulation eliminates the environmental impact. Although no other international regulation on the global or regional level existed, this represented a maximum externality reduction.

Example 2: Discharges of naturally occurring radioactive materials by platforms (OG_C.NOR), PAME Arctic, 2019

As of 2019, the externality was subject to regulation by the Arctic Council under the 2009 Arctic Offshore Oil and Gas Guidelines. These require that: "Produced sand containing elevated levels of naturally occurring radioactive material should be reinjected, encapsulated, or removed from the site and stored in a safe and environmentally sound manner that is carefully controlled and whose risks and circumstances have been properly evaluated" (Arctic Council 2009b, 33). The only other international regulation on this externality is contained in the EHS Guidelines of the World Bank. These state that: "If removal of NORM is required, disposal options may include canister disposal during well abandonment, injection into the annular space of a well, shipment to shore for disposal in an engineered and properly operated landfill within sealed containers, and, depending on the type of NORM and in cases where no other option is available, discharge to sea with the facility drainage" (World Bank 2015, para. 69). In contrast to the Arctic Council regulations, these provisions allow for the discharge of naturally occurring radioactive materials into the sea. Thus, the Arctic regulation is more demanding than any other international regulation.

0.5=	**Example 1: Discharges of specified garbage (food wastes, cargo residues, cleaning agents, animal carcasses) from ships (MS_C.GSP), Wider Caribbean, 2019** As of 2019, the externality was subject to regulation by the IMO under MARPOL Annex V as revised by Resolution MEPC.201(62) and others. It contains discharge requirements for the global level and special areas. In the Wider Caribbean special area, the discharge of comminuted or ground food wastes, cargo residues in wash water, and cleaning agents is allowed, in most cases at a distance of at least 12 nm from the nearest land. The discharge of food wastes not comminuted or ground and of cargo residues not contained in wash water is prohibited (IMO 2011b, reg. 6). On the global level, discharges of these types of garbage are generally allowed at 12nm from land (IMO 2011b, reg. 4). In the Antarctic and IMO Arctic, additional distance requirements from sea ice apply (IMO 2015b, para. 5.2). Thus, the requirements applicable to the Wider Caribbean are in between more demanding polar requirements and less demanding global standards. **Example 2: Discharges of oil in produced water from platforms (OG_O.PDW), North-East Atlantic, 2019** As of 2019, the externality was subject to regulation by the OSPAR Commission under Recommendation 2001/1 as amended by Recommendations 2006/4 and 2011/8 requiring that "no individual offshore installation should exceed a performance standard for dispersed oil of 30 mg/l for produced water discharged into the sea" (OSPAR Commission 2001, para. 4.2.1). Other regulations of this externality existed on the global level and in the PAME Arctic, the Baltic Sea, the Mediterranean Sea, and the ROPME sea area. In the Baltic Sea, any discharges of oil were prohibited (HELCOM 2007e, 100). In the Mediterranean Sea, the same limit as in the OSPAR region applied (Offshore Protocol to the Barcelona Convention 1994, art. 10, para. 1(b)(ii); UNEP 2019, annex I, para. 24). In the ROPME sea area, discharges were allowed with an oil content of 40 mg/l monthly average and maximum 100 mg/l at any time (Continental Shelf Protocol to the Kuwait Convention 1989, art. IX, para. 1(b)). Globally, the discharge limit is 29 mg/l monthly average and 42 mg/l daily maximum (World Bank 2015, 28). Thus, the regulation by the OSPAR Commission is less demanding than the requirements for the Baltic Sea, more demanding than those for the ROPME sea area, and comparable to global and Mediterranean standards.
0=	**Example 1: Exhaust emissions of sulfur oxides by ships (MS_A.SOX), Global, 2009** As of 2009, the externality was subject to regulation by the IMO under MARPOL Annex VI as revised by Resolution MEPC.176(58). It stated that "the sulphur content of any fuel oil used on board ships shall not exceed the following limits: […] 4.50% m/m prior to 1 January 2012" (IMO 2008b, reg. 14, para. 1). It further required that "while ships are operating within an Emission Control Area, the sulphur content of fuel oil used on board ships shall not exceed the following limits: […] 1.50% m/m prior to 1 July 2010" (IMO 2008b, reg. 14, para. 4). Such

Emission Control Areas were in effect in the Baltic Sea and the North Sea. Hence, the global requirements were less demanding than all other international regulations.

Example 2: Discharge of water-based drilling fluids and cuttings from platforms (OG_C.WBD), Mediterranean Sea, 2019

As of 2019, the externality was subject to regulation by the Barcelona Convention under its Offshore Protocol stating that: “Water-based drilling fluids and drill cuttings shall be subject to the following requirements: (a) The use and disposal of such drilling fluids shall be subject to the Chemical Use Plan and the provisions of Article 9 of this Protocol; (b) The disposal of the drill cuttings shall either be made on land or into the sea in an appropriate site or area as specified by the competent authority” (Offshore Protocol to the Barcelona Convention 1994, annex V, para. B). In addition, newly adopted guidelines applied from the end of 2019. They stated that: “Effective solids control equipment shall be used to remove formation solids from the drilling fluid and to recover the used drilling fluid, so that it can be reused. Under specific circumstances, used WBM and associated drill cuttings may be disposed of by discharging into the sea” (UNEP 2019, annex I, para. 8). Other international regulations of this externality existed in the PAME Arctic, Baltic Sea, North-East Atlantic, ROPME sea area, and on the global level. The most demanding requirements were found in the Baltic Sea and North-East Atlantic where HELCOM and the OSPAR Commission required the phaseout of the most hazardous chemicals used for drilling. Moreover, HELCOM allowed discharges of cuttings outside of specifically sensitive parts of the Baltic Sea Area only if, inter alia, “the mud has been shown to be of low toxicity […]” and “the content of heavy metals in the mud is minimized; the concentration of Hg and Cd does not exceed 1 mg/kg in the whole mud” (HELCOM 1997, para. (d)). In the PAME Arctic, the Arctic Council (2009b, 32) recommended reinjection and zero-discharge or removal of toxic substances in case of disposal. On the global level, the World Bank Group (2015, 28) also favored reinjection or ship-to shore but in case of discharge allowed for higher cadmium content than HELCOM (3mg/kg). In the ROPME sea area, “water-based drilling muds discharged from offshore operations must not contain persistent systemic toxins which may continue to pose an environmental threat after the initial drilling fluid discharge” (Continental Shelf Protocol to the Kuwait Convention 1989 reg. IX, para. 4(c)). In contrast to these requirements, the regulation in the Mediterranean does not state any restrictions on toxicity in case of discharge. Thus, it demands less externality reductions than all other international regulations.

Additional Coding Sources

In many cases, coding of one or more design elements of a regulation (especially Y_A) relied on sources in addition to regulatory documents. Table 38 lists the most relevant additional primary and secondary sources used for externalities from both industries (for full bibliographic information, see list of references).

Table 38: Sources used for coding in addition to regulatory documents

Externality	**Sources for maritime shipping**
O.BAW	CE Delft and CHEW (2017), Mitchell (1994a)
O.BDW	OSPAR Commission (2010a)
O.CAT	CE Delft and CHEW (2017), Mitchell (1994a)
O.CUP	OSPAR Commission (2009b)
O.LUH	Cumberlidge (2017), *The Maritime Executive* (2017), US EPA (2011a)
O.MSB	CE Delft and CHEW (2017), MAP (2013)
O.NAD	MAP (2013), OGP (2003)
O.PDW	MAP (2013), OGP (2003), OSPAR Commission (2009a; 2010a)
O.SDG	CE Delft and CHEW (2017), Mitchell (1994a)
C.ECW	Endres et al. (2018), Fathom (2015), Turner et al. (2017), US EPA (2011b)
C.GPO	CE Delft and CHEW (2017), IMO (2013c), MAP (2013)
C.GSP	CE Delft and CHEW (2017), IMO (2013c), MAP (2013)
C.NOR	OGP (2005)
C.OCH	MAP (2013)
C.PWD	OSPAR Commission (2009a; 2013)
C.SBW	CE Delft and CHEW (2017), Hatenboer-Water (2012), MAP (2013), *Marine Insight* (2019b), Netherlands (2017)
C.SNU	Hatenboer-Water (2012), Netherlands (2017)
C.TAF	Amara et al. (2018)
C.WBD	MAP (2013), OGP (2003)
A.BLC	Comer et al. (2017), Lack (2016)
A.ISW	Division on Engineering and Physical Sciences, Commission on Engineering and Technical Systems, and Marine Board (1995), National Research Council (1996)
A.NOX	Espenes (2014), Lauer (2009), Lloyd's Register (2002), Valberg, Nerheim, and Hen-nie (2012)
A.ODI	CE Delft and CHEW (2017), Daniel and et al. (2010), Carpenter et al. (2014)
A.PAM	Turner et al. (2017)
A.SOX	EEA (2006), IMO (2009a), Kolle and Skjølsvik (2003), Topali and Psaraftis (2019)
A.VOF	Norway (2005; 2014), IMO (2017c)
E.COM	MAP (2013)
E.DEC	Jørgensen (2012), MAP (2013)
E.IBF	GISP (2008), Franmarine Underwater Services (2013)
E.UWN	Markus and Sánchez (2018), Vard Marine Inc. (2019)

Source: Author.

Data Overview

Application of the criteria outlined above yields the distribution of coding data as shown in Table 39. Based on this data, the meaningfulness of the coding thresholds can be reviewed. One useful criterion is the avoidance of empty categories. Indeed, each design element value (e.g., nonbinding for legality, X_T) accounts for 10% or more of the coded regulations in at least one of the years covered. Thus, there is no systematic error in terms of empty categories.

Table 39: Number and percentage share of regulations for all design element values

Design Element Value		Maritime Shipping								Offshore Oil and Gas	
		1989		1999		2009		2019		2019	
		No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
X_T	Binding	15	79%	29	71%	43	68%	50	61%	39	36%
	Partly binding	1	5%	1	2%	5	8%	11	13%	19	17%
	Nonbinding	3	16%	11	27%	15	24%	21	26%	51	47%
Y_T	High	13	68%	25	61%	41	65%	70	85%	53	49%
	Medium	4	21%	12	29%	19	30%	9	11%	43	39%
	Low	2	11%	4	10%	3	5%	3	4%	13	12%
Z_T	Strong	9	47%	20	49%	33	52%	37	45%	29	27%
	Weak	4	21%	15	37%	23	37%	39	48%	59	54%
	None	6	32%	6	15%	7	11%	6	7%	21	19%
X_A	Large	17	89%	37	90%	57	90%	72	88%	86	79%
	Medium	0	0%	2	5%	5	8%	4	5%	17	16%
	Narrow	2	11%	2	5%	1	2%	6	7%	6	6%
Y_A	High	5	26%	15	37%	20	32%	27	33%	24	22%
	Medium	10	53%	15	37%	34	54%	48	59%	66	61%
	Low	4	21%	11	27%	9	14%	7	9%	19	17%
Z_A	High	9	47%	21	51%	36	57%	45	55%	44	40%
	Medium	0	0%	0	0%	2	3%	8	10%	20	18%
	Low	10	53%	20	49%	25	40%	29	35%	45	41%
Total		19	100%	41	100%	63	100%	82	100%	109	100%

Total of percentage shares may slightly deviate from 100% due to rounding.

X_T: Legality
Y_T: Precision
Z_T: Monitoring and enforcement system

X_A: Substantive scope
Y_A: Required externality reduction
Z_A: Requirement level in international comparison

Source: Author.

Another useful criterion is the degree of concentration in the values assigned to each design element. Most design elements show limited degrees of concentration with no value accounting for more than 50% of all regulations across all the years covered. The only exception is the element of substantive scope (X_A), where the highest value has been assigned to more than three quarters of all regulations in all years. A more restrictive threshold for the highest value (large scope) could be the coverage of all ships or platforms with average lifetime age (instead of average age). However, average lifetime data of ships and platforms is not readily available for all coding years. Moreover, especially ships may undergo major conversions within their lifetime (e.g., installation of a new engine) which render them subject to regulations applicable to new ships. For these reasons, it was decided to stick to the original coding criteria. The coding of substantive scope may contribute to overestimating the substantive ambition of regulations. This effect is moderated though by the very restrictive thresholds for high stringency after aggregation of all design element scores.

Curriculum Vitae: Benjamin Hofmann

Experience

since 2015	Institute of Political Science, University of St.Gallen (HSG) Research Assistant for Energy Governance
2012-2015	Central Commission for the Navigation of the Rhine, Strasbourg Policy Officer to the Secretary-General (2 years) and Carlo-Schmid Fellow in Infrastructure & Environmental Policy (6 months)
2010-2011	Department of Political Science, University of Salzburg Research and Teaching Assistant in International Relations (9 months)
Internships	Ramboll Management Consulting, Hamburg (environmental policy) German Embassy Copenhagen (diplomacy) Saxon State Ministry for Economic Affairs, Dresden (industrial policy) NABU Katinger Watt, Tönning (civilian service: nature conservation)

Education

since 2015	Ph.D. in International Affairs and Political Economy, HSG
2010-2012	MA in Political Science, Minor: Economics, University of Salzburg
2009-2010	Guest Semester in Political Science and Economics, Aarhus University
2006-2009	BA in Political Science, Minor: Languages, University of Salzburg

Miscellaneous

Teaching	Certificate of Advanced Studies (CAS) in Learning and Teaching in Higher Education, 2016-2018, HSG Taught MA and BA courses in global environmental politics, energy governance, international relations, and qualitative methods
Awards etc	Wings of Excellence Award, 2nd prize, 2017, St.Gallen Symposium Carlo-Schmid scholarship, 2012/13, DAAD Excellence scholarships, 2010 & 2012, University of Salzburg
Languages	German (mother tongue), English (proficient), French (fluent), Danish (intermediate), Spanish (intermediate)