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[Link to the German Version]

Transparency and Efficiency in Energy Trading

Focus: Systemic risk in the Swiss electricity market in the years 2021-2023

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Motivation

At the end of August 2022, **Axpo** applied to the federal government for a CHF 4 billion rescue package. Based on selected balance sheet items from the financial reports of **Alpiq**, **Axpo**, and **BKW**, we assess the systemic risk in the Swiss electricity market as of the balance sheet dates for the years 2021-2023. We highlight the urgency of the rescue package and the need for action under the new Federal Act on Supervision and Transparency in the Wholesale Energy Markets (BATE), aimed at providing additional capital and liquidity for energy trading activities. The need for intervention is supported by the estimated losses and outflows of CHF 24 billion for a potential liquidation of **Axpo** as of September 30, 2022. Finally, we discuss the benefits and informational value of selected time series that are critical for the monitoring and management of systemic risk by the board of directors, regulators, supervisors, and control authorities.

Disclaimer
*Our statements are based exclusively on publicly available documents and data. These include, in particular, data from **EpexSpot** and **EEX**, the financial reports of **Alpiq**, **Axpo**, and **BKW** for the financial years 2009-2023, as well as **ElCom** rulings, **ElCom** activity reports, selected **SFOE** documents, and relevant federal court rulings. Our models and methods are based on assumptions either taken directly from these documents or derived from them to reflect reality as accurately as possible. The management's discretionary powers within the context of their financial reporting allow for interpretation by the readers of the financial statements. If such interpretations result in misjudgments, this could lead to a different data basis, which in turn may lead to different conclusions.*

Abbreviations

BATE	Federal Act on Supervision and Transparency in the Wholesale Energy Markets
SFOE	Swiss Federal Office of Energy
CHF	Swiss franc
CSA	Credit Support Annexes
ElCom	Electricity Commission
EEX	European Energy Exchange
ECC	European Commodity Clearing
EBIT	Earnings before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EVU	Energy supply company
FY	Financial Year
IFRS	International Financial Reporting Standards
m.	million
bn.	billion
MWh	Megawatt hour
OTC	Over the Counter
TWh	Terrawatt hour (= 1 m. MWh)
BoD	Board of Directors

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1. Management Summary

The price distortions on the energy exchanges during 2021-2023 led to liquidity bottlenecks and posed a threat to equity. Due to the company's internal discretionary scope, estimation uncertainties in energy trading, and the incompleteness of energy markets, the fair values reported on the balance sheet may deviate from realized values. Therefore, we consider it appropriate to provide additional liquidity and capital for trading activities, contingent on their size.

At the end of August 2022, **Axpo** applied to the federal government for a CHF 4 billion rescue package. Based on selected balance sheet items from the financial reports of **Alpiq**, **Axpo**, and **BKW**, we assess the systemic risk in the Swiss electricity market as of the balance sheet dates for 2021-2023.

To mitigate systemic risks, we recommend provisions amounting to at least 5% of the gross "financial liabilities" reported under the balance sheet item "Derivative Financial Instruments." This measure is intended to address the ambiguities inherent in incomplete energy markets. We refer to this risk measure for the capital requirement as **"equity-at-risk**." The excess liabilities derived from the balance sheet item "Derivative Financial Instruments," along with four times the Initial Margin paid for the variation margin, should be maintained as additional liquidity. We refer to this risk measure for the liquidity requirement as **"trading liquidity-at-risk**."

We characterize systemic risk exposure using the measures "equity-at-risk" and "trading liquidity-at-risk," and we summarize the impact of the recommended capital and liquidity requirements on EBITDA and the financial covenants of "equity ratio" and "net debt/EBITDA" for the electricity companies **Alpiq**, **Axpo**, and **BKW** for the 2022 financial year. This analysis is based on our empirical review[1] of the electricity companies' financial reports for the financial years 2009-2023.

Capital Requirements

In FY 2021/22, **Axpo**'s "equity-at-risk" amounts to CHF 5,276 million. Equity would be reduced by the provision for systemic risk, amounting to CHF 2,156 million (7,432 - 5,276), resulting in an equity ratio of 2.7% (compared to the reported 9.4%). As a result of the recognition in profit or loss, EBITDA, according to IFRS, would amount to minus CHF 3,500 million. Since EBITDA is negative, the threshold for "net debt / EBITDA" is considered breached. The net debt reported in the Financial Report 21/22 (as of December 30, 2022) amounts to CHF 3,644 million.

In FY 2022, **Alpiq**'s "equity-at-risk" amounts to CHF 1,154 million. Equity would be lower by the provision for systemic risk, resulting in equity of CHF 2,375 million (3,529 - 1,154), with an equity ratio of 15.8% (compared to the reported 23%). If the provision had been recognized in the income statement, EBITDA adjusted for special effects would have amounted to CHF 437 million (473 - 36). The reported net debt (as of December 30, 2022) amounts to CHF 107 million, resulting in a "net debt / EBITDA" of 0.24.

In FY 2022, **BKW**'s "equity-at-risk" amounts to CHF 212 million. Equity would be lower by the provision for systemic risk, amounting to CHF 4,168 million (4,380 - 212), resulting in an equity ratio of 35% (compared to the reported 37%). As a result of recognition in profit or loss, EBITDA, according to IFRS, would amount to CHF 1,463 million (1,257 + 206). The reported net debt (as of December 30, 2022) amounts to CHF 1,224 million, resulting in a "net debt / EBITDA" of 0.84.

[1] Frauendorfer K. (2024): Effizienz und Effektivität im Energiehandel, Seminarunterlagen zur Durchführung am 19. April 2024, ior/cf-HSG, Universität St.Gallen, S. 61-77 (Link).

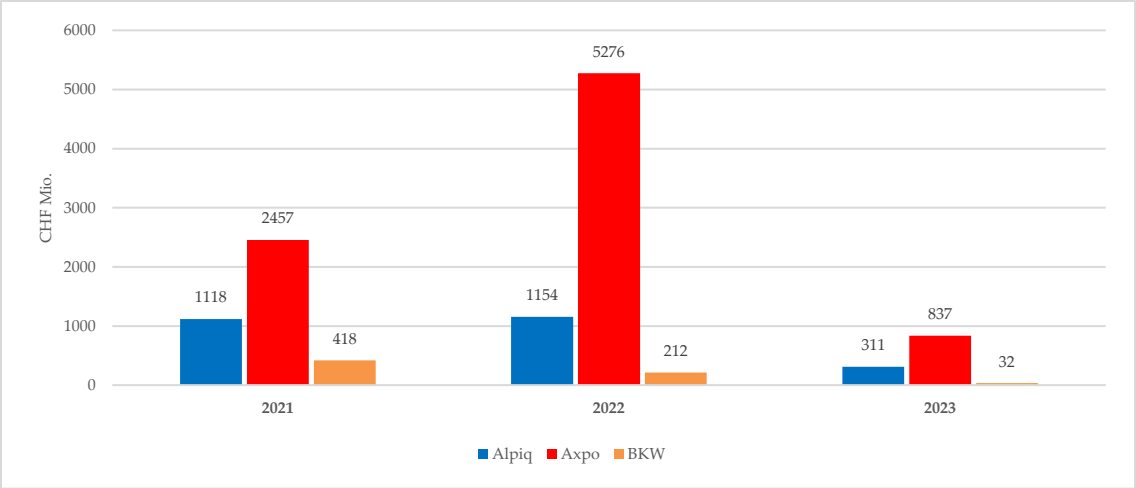


Figure I: Additional risk capital (CHF million) for equity in FY 2021-2023

Liquidity Requirements

Axpo's liquidity amounted to CHF 4,101 million as of 30 September 2022. CHF 1,093 million was paid for the Initial Margin, resulting in liquidity required for the Variation Margin being rounded to CHF 4,400 million. A liability surplus of CHF 8,466 million was reported, leading to a deficit of CHF -8,766 million [= 4,101 - 4,400 - 8,466]. Given that unutilized loans amount to CHF 1,572 million, additional liquidity of CHF 7,194 million [= 8,766 - 1,572], potentially through an extension of credit facilities, would have been required by the balance sheet date. Utilization of the existing credit limit and the extension of credit facilities would have increased net debt by CHF 8,766 million [= 1,572 + 7,194], bringing total net debt to CHF 12,410 million [= 3,644 + 8,766]. To maintain a "Net debt/EBITDA" threshold of 3, an EBITDA of at least CHF 4,137 million [= 12,410 ÷ 3] would have been necessary.

Alpiq and **BKW** do not disclose the payments made for the Initial Margin as of the balance sheet date in their financial reports, likely due to the presumably low volumes of own production hedged with futures as of that date. Based on the liquidity reported in the financial reports of **Alpiq** and **BKW** as of the balance sheet date, we do not observe any need to deposit additional liquidity for energy trading during FY 2021-2023. We consider the trading liquidity-at-risk for **Alpiq** and **BKW** to be negligible as of the balance sheet date.

Costs in the event of a liquidation of Axpo

Axpo's liquidity figures as of September 30, 2022, demonstrate the urgency of a rescue package. The federal government acknowledged this and made CHF 4,000 million available starting from September 5, 2022. On the balance sheet date, the liquidity shortfall amounted to CHF 3,194 million [= 7,194 - 4,000], taking into account the cash and cash equivalents provided by the federal government. In our view, the data for FY 2020/21 and FY 2021/22 published in **Axpo**'s Financial Report 2021/22 show that there was a significant risk of **Axpo** being wound up. We estimate below the losses and outflows that a liquidation would have entailed as of the reporting date of September 30, 2022.

If **Axpo** management had been unable to meet its margin payments on the due dates, the futures portfolio would have been closed out by ECC. This closing out would have resulted in the realization of hedging losses, which would not have been included in the annual result as a liquidity outflow not affecting net income. Instead, it would have realized a loss of CHF 6,735 million for the variation margin, plus estimated closing-out costs of CHF 1,093 million, corresponding to the reported payment for the Initial Margin. The margin payments to OTC counterparties, amounting to CHF 4,901 million, would

also have been recognized in profit or loss. A total loss of CHF 12,729 million [= 6,735 + 1,093 + 4,901] would have turned the equity of CHF 7,432 million negative (to CHF -5,297 million), breaching financial covenants and likely resulting in the termination of the committed credit line of CHF 2,868 million by the bank consortium.

Without the provision of the federal government's rescue package, the company's ability to continue operating would have been called into question in September 2022. In the event of liquidation, the excess liabilities of CHF 8,466 million, reported as of the balance sheet date of September 30, 2022, and derived from the balance sheet item "Derivative Financial Instruments," would also have had to be covered. This resulted in losses and outflows of total CHF 24,063 million [= 12,729 + 2,868 + 8,466], relating to the annual result per reporting date of September 30, 2022. These costs do not include any impairment of derivative financial instruments due to a potential loss of the company's investment-grade rating.

Monitoring the systemic risk exposure

The systemic risk exposure emanating from an energy company is measured using "equity-at-risk" and trading liquidity-at-risk. The basic components for quantifying the systemic risk of systemically important energy suppliers are the Initial Margin Account, liquidity, and the gross values of the balance sheet item "Derivative Financial Instruments" for both assets and liabilities, as well as the resulting liability surplus.

The Initial Margin Account, liquidity, and the gross values of "financial assets" and "financial liabilities" of the balance sheet item "Derivative Financial Instruments," along with their netting volumes and liability surpluses, should be managed as time series data in daily granularity. The development of "equity-at-risk" and "trading liquidity-at-risk" can be observed on a daily basis. Trading activities, as well as the timing and extent of portfolio compression, can be inferred from these trends. Many analyses can be conducted using these time series, which must be disclosed to the Board of Directors. Specific questions may include whether the volatility of "equity-at-risk" can be sufficiently explained by market price volatility or whether other factors, such as the timing or extent of portfolio compression, trigger the volatility. Portfolio compression leads to the realization of previously unrealized trading transactions, affecting liquidity and impacting both the balance sheet item "derivative financial instruments" as well as netting volumes and excess liabilities. The volatility of "trading liquidity-at-risk" can be determined based on the performance of the Initial Margin Account. The development of volatilities and correlations between "equity-at-risk" and "trading liquidity-at-risk" provides the Board of Directors with better insight into systemic risk development throughout a financial year and forms the basis for continuous monitoring.

We view portfolio compression as a "black box," where the contribution to systemic risk remains a significant unknown. Portfolio compression eliminates OTC trading volumes, resulting in lower systemic risk for the derivative financial instruments recognized on the balance sheet at the reporting date compared to earlier trading days. Based on financial literature[2], we estimate that portfolio compression reduces the recognized volume of interest rate swaps by 25-30%. This implies that "equity-at-risk" could be underestimated by 25-30%. Therefore, we consider it essential that, in connection with the new Federal Act on Supervision and Transparency in the Wholesale Energy Markets (BATE), the development of selected time series related to equity and liquidity-determining balance sheet items be disclosed at a daily granularity, not only to the Board of Directors of systemically important energy suppliers but also to the regulator, supervisor, and control authority.

We believe that the recommended capital and liquidity requirements will protect the competitiveness of electricity companies from excessive risk-taking. Currently, there are several misguided incentives that necessitate special internal controls: i) The choice of initial sale improves the result in energy trading

[2] Gregory J. (2014): Central Counterparties: Mandatory Clearing and Bilateral Marginal Requirement for OTC-Derivatives, Wiley Finance Series, p. 130.

but comes at the expense of the production and sales business segments.
ii) Reversing hedging relationships in the event of hedging gains generates liquidity for the financial year just ended, improving the result in energy derivatives trading at the expense of future years.
iii) The management of power plants, storage facilities, energy contracts, and customer orders can conceal speculative trading transactions that entail higher risks.
iv) The choice of hedging volume can be subject to considerable management discretion, unless strict rules are established and monitored by the Board of Directors.

2. Introduction

The volatility of credit spreads in the bond markets and price distortions in the energy exchanges indicate that triggering events are unpredictable and, at best, can only be explained ex post. Empirical evidence demonstrates that market regimes of high volatility recur frequently, which implies that the balance sheet risk exposure related to the marketing, procurement, and trading of energy sources must be managed in line with the risk-bearing capacity of systemically important energy suppliers, rather than relying on management's estimates of market developments.

These price distortions resulted in liquidity bottlenecks for **Axpo** in August 2022. In that same month, **Axpo**'s request for an extension of an already committed CHF 7,784 million credit line was denied by the bank consortium. This forced **Axpo**'s management to turn to the federal government to ensure that **Axpo** could continue meeting its payment obligations and that operations would not be disrupted. Starting in the first week of September 2022, the federal government provided CHF 4 billion in liquidity for a period of three years.

Our focus is on the capitalization and liquidity requirements of the systemically important electricity companies **Alpiq**, **Axpo**, and **BKW** in relation to their trading activities. Criteria are established to estimate these companies' exposure to systemic risk. We consider systemic risk to be high if there is a threat of default or insolvency for a systemically important energy supplier. In this analysis, we rely exclusively on publicly available documents, including financial reports, media releases, and media conferences.

The second section addresses the ambiguities in energy trading, while section three quantifies the systemic risk exposure of **Alpiq**, **Axpo**, and **BKW** as of the balance sheet dates for 2021-2023. Section four presents selected time series that can be used to monitor and manage systemic risk. The conclusions in section five reflect the need for further action.

3. Ambiguities in Energy Trading

In its financial reports, **Axpo**[3] highlights significant judgments and estimation uncertainties in the application of accounting policies and specifies the affected balance sheet items. Discretionary scope arises, particularly when deciding[4] whether to recognize customer contracts in accordance with IFRS 15 or as financial instruments under IFRS 9.

IFRS 15 governs the recognition of revenue from customer contracts and ensures that revenue is recognized in accordance with the fulfillment of the performance obligations agreed upon in the contract.
IFRS 9 focuses on the recognition and measurement of financial instruments, including financial assets, financial liabilities, and derivatives. The standard aims to provide readers of the financial statements with useful information for estimating future cash flows, particularly regarding their amount, nature, timing, and uncertainty.

Within IFRS, management can exert considerable influence on whether initial sales or final sales are defined as revenue, which directly impacts energy trading performance. **Axpo** acknowledges significant discretionary decisions in its accounting for energy derivatives and estimation uncertainties in the valuation of financial instruments. The larger the volumes of customer orders recognized in accordance with IFRS 9, the greater the estimation uncertainties in the balance sheet and, consequently, in energy trading.

[3] Axpo Finanzberichte 2020/21 (S.12), 2021/22 (S..19), 2022/23 Abschnitt 3.1 des Anhangs zur Jahresrechnung (S 23).

[4] Axpo Solutions Finanzberichte 20/21, S. 4; 21/22 , S. 76; 22/23, S. 81.

To better assess systemic risk in the Swiss electricity market, we first examine the effects of various ambiguities in energy trading:

- Initial sale vs. final sale within IFRS 15
- Hedging with futures vs. forwards
- Portfolio compression
- Incompleteness of the energy markets

We base our analysis on the empirical review[5] of the financial reports of the electricity companies **Alpiq**, **Axpo**, **BKW**, and **Verbund** for the financial years 2009-2023.

3.1 Initial sale vs. final sale within IFRS 15

In its 2017/18 financial report, **Axpo** announced that "since the beginning of the 2016/17 financial year, the recognition of electricity revenue from its own power plants has changed prospectively." Now, "the initial sale is reported as revenue, and all subsequent optimization activities are regarded as hedging transactions that flow net into the income from energy trading." [6] **Axpo** described this change as a new business model and explained the decline in total operating performance from CHF 5,567 million in FY 2016/17 to CHF 4,850 million in FY 2017/18.

We would like to add clarifications to the above statements by **Axpo** to document our understanding[7]: The **initial sale** represents the hedging price achieved for own production. In the FYs 2008/09 - 2016/17 (i.e., under the old business model), we presume that **Axpo** reported the final sale as revenue. The **final sale** corresponds to the day-ahead revenue from the spot market. If the day-ahead proceeds (i.e., the final sale) are reported as revenue, the hedging result from the perspective of the trading unit corresponds to the difference [hedging price achieved minus day-ahead proceeds]. If, on the other hand, the hedging price achieved from the perspective of the trading unit (i.e., initial sale) is recognized as revenue, the hedging result corresponds to the difference [day-ahead revenue minus hedging price achieved].

We note that the hedging result from the perspective of the trading unit changes its sign with the new business model. This applies not only to **Axpo** but to all electricity companies that change the key sales indicator (initial sale vs. final sale). This also explains the change in the hedging result for **BKW**[8], which is reported for FY 2015 in the 2016 annual report: In the 2015 annual report, a profit of CHF 18.6 million is reported for the hedging result; in the 2016 annual report, the hedging result for FY 2015 is adjusted to CHF -18.6 million. In FY 2015, **BKW**'s hedging price was CHF 18.6 million higher than the day-ahead price. Hedging prices are less volatile than day-ahead revenues. As **BKW** integrates production, management, and trading within the "Energy" business segment, revenue from the energy business is less volatile. This allows **BKW** to offer shareholders greater stability in the energy business, provided that the volatility in energy trading results does not become too high. The change in business model has no impact on the result within **BKW**'s "Energy" business segment, as the trading unit is part of this segment.

The effect of the new business model on **Axpo**'s business segments, which we view as questionable, is clearly illustrated in the 2021/22 financial report[9], based on the EBITDA derived from the segment

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[5] Frauendorfer K. (2024): *Effizienz und Effektivität im Energiehandel*, Seminarunterlagen zur Durchführung am 19. April 2024, ior/cf-HSG, Universität St.Gallen. (Link)

[6] Axpo Finanzbericht 2017/18, S. 4.

[7] Frauendorfer K., Gutsche R. (2024): *Transparenz und Effizienz im Energiehandel: Erstverkauf vs. Letztverkauf, Implikationen für den Energiederivatenhandel (Case Axpo)*, White Paper, ior/cf-HSG, Universität St.Gallen, 55 Seiten

[8] BKW Gruppe Finanzbericht 2015, Tab. 35.2, S. 79; Finanzbericht 2016, Tab. 36.2. S. 81.

[9] Axpo Holding AG Finanzbericht 2021/22, S. 21. (Axpo weist den EBITDA in der Segmenterfolgsrechnung nicht explizit aus.)

income statement. The "Generation & Distribution" business segment reported EBITDA of CHF -1,984 million, while the "Trading & Sales" business segment reported EBITDA of CHF 1,203 million. The negative EBITDA in the "Generation & Distribution" segment results from a low hedging price (i.e., initial sale), which, based on our understanding of the published data[10], is CHF 3,209 million lower than the day-ahead proceeds (i.e., final sale). As a result, the "Trading & Sales" business segment avoids a hedging loss of CHF -3,209 million in the new business model, leading directly to a positive EBITDA of CHF 1,203 million. Accounting under the old business model would result in a positive EBITDA of CHF 1,225 million [= -1,984 + 3,209] for the "Generation & Distribution" business segment and a negative EBITDA of CHF -2,006 million [= 1,203 - 3,209] for the "Trading & Sales" business segment. At the group level, the change in **Axpo**'s business model has no effect on the overall result but significantly impacts the results of the business segments[11].

We identify potential false incentives[12] in the new business model for energy trading: the lower the hedging price for own production, the greater the potential for success in the "Trading & Sales" business segment. In our opinion, the more speculative decisions are embedded in the hedging strategy, the more pronounced these false incentives become. We consider speculative decisions within a hedge to exist when technical price analyses are used to determine the timing and amount of the hedge. A comparison with a deterministic hedge index can estimate whether speculative elements lead to profits or losses. Examining the period 2008/09-2022/23, it can be empirically shown, based on an auditable, deterministic hedge index[13] (generated as of the balance sheet date of September 30 for the Swiss market), that an average of CHF 18.4 per hedged MWh was included in energy trading results under the old business model (up to FY 2015/16), while under the new business model (from FY 2016/17) the average is CHF 34.2 per hedged MWh. This improves the performance of energy trading in both sub-periods, depending on the choice of business model. However, this improvement comes at the expense of the "Generation & Distribution" segment. In the first sub-period, day-ahead revenue (determining sales) was on average CHF 18.4/MWh lower than the hedging price achieved, while in the second sub-period, the hedging price achieved (initial sale) was on average CHF 34.2/MWh lower than the day-ahead price. These values are based on a deterministic hedge index that implements a selected hedging strategy without speculative components and uses futures. This allows the extent and success of speculative decisions to be quantified based on realized hedging results. The deterministic hedge index is based on futures as hedging instruments and can be classified as auditable.

Losses due to speculative decisions within a hedge could lead to speculative losses being allocated to the "Generation & Distribution" business segment through lower hedge prices.

3.2 Hedging with Futures vs. Forwards

When futures are opened on exchanges, liquidity payments for the initial margin and variation margin are collected daily by the central clearing house.

The *Initial Margin* must be paid regardless of whether short (sell) or long (buy) positions are opened. It is intended to cover additional costs if the futures portfolio needs to be closed out by the clearing house due to unpaid margin calls. The liquidity requirement[14] for the Initial Margin is primarily calculated based on futures price volatility, the time required to close out the portfolio (measured in trading days),

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[10] Axpo Holding AG Finanzbericht 2021/22, S. 23.

[11] Frauendorfer K., Gutsche R. (2024): *Transparenz und Effizienz im Energiehandel: Erstverkauf vs. Letztverkauf, Implikationen für den Energiederivatenhandel* (Case Axpo), White Paper, ior/cf-HSG, Universität St.Gallen, S. 13-24.

[12] Frauendorfer K., Gutsche R. (2022): *Geschäftsmodell der Axpo: Cui Bono?* Kommentar zu den Finanzberichten 08/09-20/21 der Axpo, ior/cf-HSG, Universität St.Gallen, 21 Seiten (Link).

[13] Frauendorfer K. (2024): *Transparenz und Effizienz im Energiehandel*, Seminarunterlagen zur Durchführung am 19. April 2024, ior/cf-HSG, Universität St.Gallen, S.40 (Link).

[14] We refer to: ECC Derivative Market Margining Version 1.6.1 (5. April 2022), Version 1.10.1 (undatiert).

and a 99% confidence level. The resulting amount covers the additional costs of closing out positions in 99% of cases.

The *Variation Margin* is charged when futures prices move against the held position: For long positions, payments are made into the *Variation Margin* account when futures prices fall; for short positions, payments are required when futures prices rise. These settlements occur daily.

The balance of the *Initial Margin* account on any trading day reflects the restricted liquidity associated with closing out current futures positions. The *Initial Margin* typically covers two trading days, within which the position can be closed out with a 99% security level. Based on this, the liquidity required per trading day for the *Variation Margin* can be estimated with a 99% confidence level from the account balance: If two trading days with 99% certainty are used to close out futures positions, four times the *Initial Margin* balance roughly corresponds to the liquidity needed to cover the *Variation Margin* over the next 32 days (approximately one month), assuming adverse market movements[15] [16].

Closing or settling futures positions removes them from the balance sheet, and any resulting profit or loss is recognized in the income statement and the cash flow from operating activities.

If futures are designated as hedging instruments for customer contracts, the payments made by the market participant into the *Variation Margin* account can be recognized directly in equity as "Receivables." The payments from the clearing house into the *Variation Margin* account represent hedging gains for the market participant, which can be recognized as "Liabilities" on the balance sheet without impacting income. In both cases, these payments affect liquidity and are reflected in the operating cash flow statement. Alternatively, the market participant could dissolve the hedging relationship and realize hedging gains through profit or loss by closing out the futures. If losses are anticipated on customer contracts due to the closing-out, provisions must be made to neutralize the result, but without affecting liquidity.

For futures not used as hedging instruments, payments into the *Variation Margin* account effectively act as provisions that impact liquidity but not profit or loss, to cover losses if the futures positions are closed out or realized.

In OTC trading, **collateral** is deposited between counterparties, with the form and amount agreed bilaterally. If the risk exposure from trading transactions exceeds the collateral, additional liquidity must be provided under Credit Support Annexes **(**CSA**)**.

Forwards are usually opened and closed with different counterparties and closed or settled forwards that remain unrealized during a financial year are reported on the balance sheet at their replacement values as "Financial Assets" or "Financial Liabilities." Gains and losses from these transactions are recognized in the financial statements but do not affect liquidity, and therefore, are not included in the operating cash flow statement. Financial reports refer to these as unrealized trading transactions. Although closed and unrealized forwards are not subject to market price risk, they carry counterparty risk, which is covered up to the amount of the deposited collateral plus any liquidity provided through the CSA. "CSAs given[17] [18]" are recognized directly in equity under "Receivables," while "CSAs received" are recognized under "Liabilities." The liquidity provided under the CSA is reflected in the operating cash flow statement, affecting liquidity.

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[15] Corresponds to the square-root-of-time rule of quantitative riskmanagement: If the holding period is quadrupled, the risk capital doubles; in this case, the holding period is increased 16-fold, which quadruples the risk capital.

[16] McNeil A. J., Frey R. Embrechts P.: Quantitative Risk Management: Concepts, Techniques and Tools; Princeton Series in Finance, revised Edition, Princeton University Press 2015 (S. 350).

[17] Axpo Holding AG Finanzbericht 2021/22, S. 51.

[18] Axpo Holding AG Finanzberichte 2021/22, S. 54.

3.3 Portfolio Compression

Risk management imposes limits on trading volumes with counterparties. In OTC trading, these limits are set or adjusted according to the counterparties' credit ratings. As credit ratings decline, OTC trading volume limits are reduced. Large trading activities may cause these limits to be reached early in a financial year, restricting energy trading's ability to manage its own production, sales contracts, and proprietary trading. **Portfolio** compression[19] helps to eliminate OTC trading transactions from the books, creating room for additional management and proprietary trading.

Eliminating OTC trading transactions requires that the involved counterparties agree on a cash flow, including potential price adjustments for open and closed transactions. The income realized through the elimination process may deviate from the original unrealized income, which was recognized as the fair value of the eliminated transactions. This can result in portfolio compression costs.

Generally, counterparties differ in creditworthiness and available liquidity, which can lead to differing interests regarding the elimination of OTC transactions. Those with lower credit ratings or liquidity constraints may be more willing to accept price discounts. OTC trading transactions that will be realized before the balance sheet date do not need to be eliminated. From this, we infer that management would prioritize eliminating OTC trading transactions expected to be realized in future financial years. Therefore, elimination may lead to the early realization of selected transactions, affecting liquidity and operating cash flow. A comparatively low operating cash flow in a financial year could be explained by possible new losses resulting from portfolio compression.

3.4 Incompleteness of the Energy Markets

Energy markets are incomplete because spot markets for commodities like electricity involve trading products related to ¼-hour deliveries for the following day, whereas futures markets offer products with standardized delivery periods of weeks, months, quarters, and years. As a result, arbitrage-free price curves must be estimated at ¼-hour granularity for the valuation and accounting of energy derivatives. These price curves are subject to subjective model assumptions, which external auditors can only verify by checking for arbitrage opportunities against futures prices. The subjective nature of these models leads to differing fair values for non-standardized delivery periods.

Regarding the incompleteness of energy markets and the partial liberalization of the Swiss electricity market[20], the Swiss Federal Supreme Court[21] ruled in 2020 that price curves used to calculate the costs of pumped energy are not permissible for determining regulated energy tariffs. The Court agreed with regulator **ElCom**, which argued that price curves are based on subjective model assumptions and could disadvantage bound end customers. Consequently, the costs of pumped energy are based on the day-ahead auction in the spot market and thus reflect realized prices for the Swiss market. Therefore, fair value calculations for derivative financial instruments carry uncertainties that pose a risk of equity loss.

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[19] Burger M, Graeber B., Schindlmayr G. (2014): Managing Energy Risk: A Practical Guide for Risk Management in Power, Gas and Other Energy Markets, 2nd Edition, Wiley (p. 1420).

[20] Frauendorfer K. (2021): *Teilliberalisierung Marktgebiet Schweiz – gefangen in der Unvollständigkeit,* in: Geiser Thomas/Hilb Martin/Pärli Kurt/Stengel Manuel/Wittmer Andreas (Hrsg.): Ein Kunstflug durch das Recht und die Governance – Festschrift zum 65. Geburtstag von Roland Müller, Zürich/St. Gallen 2021, S. 199 – 216. (Link)

[21] Bundesgericht: Urteil 2C_297/2019 (28. Mai 2020).

4. Systemic Risk Exposure in the Years 2021-2023

Systemic risk is defined as the danger that systemically important energy suppliers may no longer be able to meet their payment obligations when due, or that inadequate equity capitalization results in a loss of risk-bearing capacity, thereby jeopardizing the company's ability to continue operations. To prevent the disruption of energy supply, it is crucial to identify factors that trigger systemic risk and anticipate the costs of a potential liquidation in the event of a crisis. The inherent costs of systemic risk must be mitigated through new, effective capital and liquidity requirements, following the originator principle.

The price distortions on the energy exchanges during 2021-2023 led to liquidity bottlenecks and threatened equity. Due to internal discretion and estimation uncertainties in energy trading, coupled with the incompleteness of energy markets, the fair values reported on balance sheets may diverge from realized values. Therefore, it is deemed appropriate to provide additional liquidity and capital for trading activities based on their magnitude.

The implementation of new liquidity and capital requirements can take various forms. To provide an initial assessment of their impact on EBITDA and financial covenants, we present an approach based on the financial statements published by **Alpiq**, **Axpo,** and **BKW** for the 2021-2023 fiscal years. This approach should serve as a basis for discussion: To cover systemic risks, we recommend setting aside provisions of at least 5% of the gross "financial liabilities" reported under the "Derivative financial instruments" balance sheet item (including netting volumes). We refer to this risk measure for the capital requirement as "equity-at-risk". Additionally, excess liabilities from the same balance sheet item, combined with four times the *Initial Margin* paid for the *Variation Margin*, should be held as extra liquidity. This is the basis for the liquidity requirement measure, referred to as "trading liquidity-at-risk."

Accounting mismatches are also included in the liability surpluses of the balance sheet item "Derivative Financial Instruments." Since the accounting mismatch is not uniformly disclosed in the financial reports for balance sheet users, we have excluded it from the additional liquidity calculations. This decision assumes that the mismatch between production (long position) and sales contracts (short position) balances out.

We characterize systemic risk exposure using the risk measures "equity-at-risk" and "trading liquidity-at-risk," which quantify the additional capital and liquidity required. Below, we outline the effects of these new capital and liquidity requirements on EBITDA and financial covenants such as the equity ratio and net debt/EBITDA for **Alpiq**, **Axpo,** and **BKW**. We use a threshold of 25% for the equity ratio and 3 for net debt/EBITDA. Falling below a 25% equity ratio or exceeding a 3:1 net debt/EBITDA ratio may result in interest surcharges, or the termination of committed credit lines based on loan agreements. Alternatively, syndicated loan banks might agree to a temporary suspension.

4.1 Provision of Additional Capital for Axpo

In FY 2020/21, the "equity-at-risk" was CHF 2,457 million, requiring a provision of the same amount for systemic risk in FY 2020/21. As a result, equity would have been CHF 4,771 million (=7,228-2,457), with a new equity ratio of 10.7% (compared to the reported 16%). Due to the recognition of the provision for systemic risk in the income statement, EBITDA in accordance with IFRS would have been *minus* CHF 1,365 million (=1,092-2,457). Since EBITDA is negative, the net debt/EBITDA threshold would have been breached. The reported net debt in FY 2020/21 was CHF 223 million.

In FY 2021/22, the "equity-at-risk" was CHF 5,276 million, requiring an additional CHF 2,819 million (=5,276-2,457) in provisions for systemic risk. Equity would have been reduced to CHF 2,156 million (=7,432-5,276), resulting in an equity ratio of 2.7% (compared to the reported 9.4%). The recognition of this provision in the income statement would have resulted in EBITDA of *minus* CHF 3,500 million (= -681-2,819). Net debt reported for FY 2021/22 was CHF 3,644 million.

In FY 2022/23, the "equity-at-risk" amounted to CHF 837 million, allowing for a reversal of CHF 4,439 million (= -837 + 5,276) in provisions for systemic risk. Equity would have been CHF 10,728 million (=11,565-837), resulting in an equity ratio of 25.9% (compared to the reported 28%). The reversal of the systemic risk provision would have resulted in EBITDA of *plus* CHF 9,611 million (= 5,172+4,439). The net debt reported for FY 2022/23 was *minus* CHF 390 million.

For completeness, the "equity-at-risk" for the years 2008/09-2019/20 is *summarized* as an average of CHF 158 million per year. In FY 2017/18, the provision for systemic risk would have peaked at CHF 464 million.

4.2 Provision of Additional Capital for Alpiq

In FY 2021, the "equity-at-risk" was CHF 1,118 million, necessitating a provision for systemic risk. Equity would have been reduced to CHF 2,440 million (=3,558-1,118), with an equity ratio of 18% (compared to the reported 26%). After recognizing the systemic risk provision, EBITDA adjusted for special effects would have been *minus* CHF 806 million (=312-1,118). The net debt reported at 31.12.2021 was CHF 675 million.

In FY 2022, the "equity-at-risk" was CHF 1,154 million, necessitating an additional provision of CHF 36 million (=1,154-1,118). This would have reduced equity to CHF 2,375 million (=3,529-1,154), with an equity ratio of 15.8% (compared to the reported 23%). EBITDA adjusted for special effects[22] would have been plus CHF 437 million (=473-36). The net debt reported at 31.12.2022 was CHF 107 million, resulting in a net debt/EBITDA ratio of 0.24.

In FY 2023, the "equity-at-risk" was CHF 311 million, allowing for the reversal of CHF 843 million (= -311 + 1,154) in provisions for systemic risk. Equity would have been CHF 3,968 million (=4,811-843), with an equity ratio of 37.9% (compared to the reported 46%). EBITDA adjusted for special effects would have been *plus* CHF 2,027 million (=1,184+843), and net debt as of 31.12.2023 was minus CHF 348 million.

Summarizing the "equity-at-risk" for 2009-2020, an average of CHF 117 million per year would have been required. In FY 2018, the systemic risk provision for **Alpiq** would have peaked at CHF 249 million.

4.3 Provision of Additional Capital for BKW

In FY 2021, the "equity-at-risk" was CHF 418 million, necessitating a provision for systemic risk. Equity would have been CHF 3,808 million (=4,226-418), with an equity ratio of 31.5% (compared to the reported 35%). After recognizing the systemic risk provision, EBITDA would have been *plus* CHF 168 million (= 586-418). The reported net debt at 31.12.2021 was CHF 1,031 million, resulting in a net debt/EBITDA ratio of 0.95.

In FY 2022, the "equity-at-risk" was CHF 212 million, allowing for the reversal of CHF 206 million (= -212 +418) in provisions for systemic risk. Equity would have been CHF 4,168 million (=4,380-212), with an equity ratio of 35% (compared to the reported 37%). EBITDA would have been *plus* CHF 1,463 million (=1,257+206), and net debt as of 31.12.2022 was CHF 1,224 million, resulting in "net debt / EBITDA" = 0.84.

In FY 2023, the "equity-at-risk" amounts to CHF 32 million, meaning that CHF 180 (= - 32 +212) million in provisions for systemic risk could have been reversed. Equity would be lower by the amount of the reported provision for systemic risk and would have amounted to CHF 5,015 (=5,047-32) million, resulting in an equity ratio of 45.5% (compared to the reported 46%). Due to a reversal of provisions for systemic risk recognized in the income statement, EBITDA according to IFRS amounted to *plus* CHF

[22] Alpiq Finanzbericht 2022, S. 70.

1,133 (= 953+180) million. The reported net debt (as at 31.12.2023) amounts to CHF 952 million, resulting in "net debt / EBITDA" = 0.84.

In conclusion, the "equity-at-risk" for the years 2009-2020 is *summarized* below: An average of CHF 36 million (p.a.) would have to be allocated as a provision for systemic risk. In FY 2018, the provision for systemic risk would have been required, with the provision for systemic risk peaking at CHF 63 million in FY 2018.

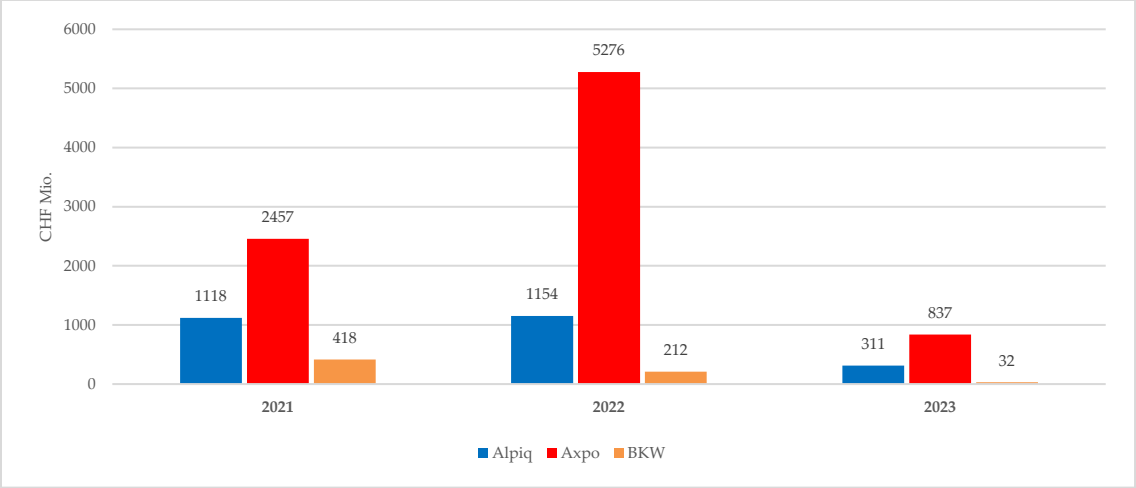


Figure I: Additional risk capital (CHF million) for equity in FY 2021-2023

Figure 1 shows the comparison of the additional risk capital to be deposited for **Alpiq**, **Axpo** and **BKW**.

4.4 Provision of Additional Liquidity for Axpo, Alpiq, and BKW

We focus on two key factors for determining the additional liquidity required for energy trading: *liability surplus* and *provision for* the *variation margin*.

Liability and asset surpluses in the balance sheet item "Derivative Financial Instruments" are recognized as cash and cash equivalents when the underlying trading transactions are realized in subsequent years. Liability surpluses will negatively impact future liquidity, while asset surpluses will have a positive impact. Therefore, liability surpluses are the relevant component for determining additional liquidity needs.

The *Initial Margin* account reflects the costs associated with closing out open futures positions. The amount of the *Initial Margin* is determined by how many trading days it would take to close a position with a 99% security level. This allows us to estimate the liquidity needed for the *Variation Margin* at a 99% certainty level based on the account balance. If two trading days are used with 99% certainty, then, according to the square-root-of-time rule [23], four times the Initial Margin account balance is approximately the liquidity needed to cover the *Variation Margin* for the next 32 days (approximately one month) under adverse market developments.

In our view, additional liquidity must be provided as soon as current liquidity falls below the sum of the liability surplus from the "Derivative Financial Instruments" balance sheet item and the liquidity

[23] McNeil A. J., Frey R. Embrechts P.: Quantitative Risk Management: Concepts, Techniques and Tools; Princeton Series in Finance, revised Edition, Princeton University Press 2015 (p. 350).

required for margin payments. Any shortfall would have to be addressed by extending credit facilities accordingly.

Axpo's financial reports disclose the *Initial Margin* and *Variation Margin* payments for FY 2019/20, 2020/21, 2021/22, and 2022/23 as of September 30. Below, we apply our approach for calculating **Axpo**'s additional liquidity requirements as of the balance sheet dates for FY 2020/21, 2021/22, and 2022/23.

Balance sheet date September 30, 2021:

- **Axpo**'s liquidity**:** CHF 4,268 million
- **Initial Margin paid:** CHF 979 million
- **Required** liquidity for the *Variation Margin***:** CHF 4,000 million **(rounded)**
- **Liability** surplus**:** CHF 2,892 million
- **Resulting** deficit**:** CHF **-**2,624 million **[= 4,268 - 4,000 - 2,892]**
- **Unutilized** credit facilities**:** CHF 1,440 million
- **Additional** liquidity **required:** CHF 1,184 million **[= 2,624 - 1,440]**
- **Total increase in** net debt**:** CHF 2,624 million **[= 1,440 + 1,184]**
- **New** net debt**:** CHF 2,847 **million [=** 223 + 2,624**]**

If a threshold of 3 is applied for net debt/EBITDA, **Axpo** would need to achieve EBITDA of at least CHF 949 million [= 2,847 ÷ 3].

According to the 2020/21 financial report, **Axpo's** management realized hedging gains for sales contracts totaling CHF 527 million and, in turn, allocated provisions for those sales contracts. While the corresponding settlement of futures affected liquidity, the creation of provisions did not. Without this management action, the liquidity shortfall would have been CHF 527 million higher, reaching CHF 1,711 million [= 1,184 + 527], resulting in net debt of CHF 4,558 million [= 2,847 + 1,711].

Balance sheet date September 30, 2022:

- **Axpo**'s liquidity**:** CHF 4,101 million
- **Initial Margin paid:** CHF 1,093 million
- **Required** liquidity for the *Variation Margin***:** CHF 4,400 million **(rounded)**
- **Liability** surplus**:** CHF 8,466 million
- **Resulting** deficit**:** CHF -8,766 million **[= 4,101 - 4,400 - 8,466]**
- **Unutilized credit facilities:** CHF 1,572 million
- **Additional liquidity required:** CHF 7,194 million **[= 8,766 - 1,572]**
- **Total increase in** net debt**:** CHF 8,766 million
- **New** net debt**:** CHF 12,410 million **[= 3,644 + 8,766]**

Applying a net debt/EBITDA threshold of 3, **Axpo** would need EBITDA of at least CHF 4,137 million [= 12,410 ÷ 3].

These figures underscore the urgency of a rescue package. The federal government made CHF 4,000 million available starting on September 5, 2022. As of the balance sheet date, the liquidity shortfall amounted to CHF 3,194 million [= 7,194 - 4,000]. Media reports indicate an additional CHF 3,000 million was provided by a bank consortium in October 2022.

According to the 2021/22 financial report, **Axpo's** management realized hedging gains totaling CHF 1,136 million for sales contracts, while also creating provisions for those contracts. The futures settlements impacted liquidity, but the creation of provisions did not. Without this management action, the liquidity shortfall would have been CHF 1,136 million higher, totaling CHF 4,330 million [= 3,194 + 1,136], even accounting for the rescue package.

Balance sheet date September 30, 2023:

- **Axpo**'s liquidity**:** CHF 7,542 million
- **Initial Margin paid:** CHF 211 million
- **Required liquidity** for the *Variation Margin*: **CHF 844 million (estimated)**
- **Asset** surplus **(ignored for consistency**[24]**):** CHF 783 million
- **Resulting** surplus**:** CHF 6,698 million **[= 7,542 - 844]**

Unused loans: CHF 6,768 million (as of September 30, 2023)

In financial reports, **Alpiq** and **BKW** do not disclose payments made for the *Initial Margin*, likely due to minimal volumes of own production hedged with futures. In January 2022, it became known that **Alpiq** had made a precautionary request to the federal government for liquidity support in Q4 2021. **Alpiq**'s 2021 financial report disclosed that financial covenants were not met as of December 31, 2021, but banks agreed to suspend covenants until December 31, 2022. Liquidity provided by shareholders improved management's ability to address liquidity issues independently of the federal government.

Based on the negative EBITDA reported in **Alpiq**'s 2021 financial report, we suspect that management closed out futures to reduce risk exposure to margin payments, which minimized the need for *Initial Margin* and *Variation Margin* payments. Similarly, **BKW** reported that it was able to manage market disruptions in its 2021 financial report.

Given the liquidity reported by **Alpiq** and **BKW** as of their respective balance sheet dates, no additional liquidity appears to be necessary for energy trading in FY 2021-2023. We consider trading liquidity-at-risk for both **Alpiq** and **BKW** negligible as **of** the balance sheet date.

4.5 Costs in the Event of a Liquidation of Axpo as of September 30, 2022

The financial data for FY 2020/21 and FY 2021/22, as published in **Axpo** 's 2021/22 financial report, indicate that **Axpo** was at significant risk of liquidation. Below, we estimate the costs that would have been incurred in the event of liquidation as of the reporting date of September 30, 2022.

If **Axpo**'s management had been unable to meet its margin payment obligations, the futures portfolio would have been closed out by the European Commodity Clearing (ECC). This close-out process would have resulted in the realization of hedging losses, which, instead of being a liquidity outflow without an effect on income, would have translated into a realized loss of CHF 6,735 million for the *Variation Margin*, plus estimated costs of CHF 1,093 million, corresponding to the reported *Initial Margin* payment. Additionally, margin payments to OTC counterparties[25] amounting to CHF 4,901 million would have also been recognized, impacting income directly. This would result in a total loss of CHF 12,729 million (= 6,735 + 1,093 + 4,901), which would turn the equity of CHF 7,432 million negative, leaving it at CHF -5,297 million.

[24] To avoid false incentives.

[25] Axpo Finanzbericht 2021/22, S. 103.

Moreover, breaching the financial covenants under these conditions would likely result in the termination of the committed credit line of CHF 2,868 million by the bank consortium.

Without the federal rescue package, **Axpo** 's ability to continue as a going concern would have been seriously questioned by September 2022. In the event of liquidation, the liability surpluses of CHF 8,466 million reported as of September 30, 2022—derived from the balance sheet item "Derivative Financial Instruments"—would also need to be covered.

Thus, the total costs of liquidation would have amounted to CHF 24,063 million (= 12,729 + 2,868 + 8,466) as of September 30, 2022. These figures do not account for any impairment of derivative financial instruments that may result from a loss of **Axpo**'s investment grade rating.

In our **May 2022** commentary[26], we estimated **Axpo**'s liquidity requirements in a crisis **to range between** CHF 12-18 billion.

5. Monitoring the Systemic Risk

At the outset, it is important to note that **Axpo** would have already reported a liquidity shortfall of CHF 1,184 million as of the balance sheet date of September 30, 2021, based on the capital and liquidity requirements related to energy trading discussed earlier. By the balance sheet date of September 30, 2022, the liquidity shortfall would have grown to CHF 5,330 million, even accounting for the rescue package. With additional debt of CHF 1,184 million in 2021 and CHF 5,330 million in 2022 to cover the shortfall, net debt would have increased significantly at both balance sheet dates. This increase would have further exacerbated the breach of financial covenants, particularly regarding net debt-to-EBITDA ratios.

Based on **Axpo**'s financial reports, it becomes clear that the costs of settlement are primarily driven by margin payments to exchanges and OTC counterparties, as well as by the "financial liabilities" reported under the balance sheet item "Derivative Financial Instruments" and the resulting liability surplus.

When comparing the key figures for "financial liabilities" in the balance sheet item "derivative financial instruments" with those reported by **Alpiq** and **BKW** and adjusting for their respective production ratios—approximately 2:4:1 for **Alpiq**, Axpo, and **BKW** —we observe significant differences in systemic risk exposure relative to their own production capacities.

If the "equity-at-risk" per MWh produced is derived for the period 2009-2020, a comparison of the "equity-at-risk" as at the balance sheet date between **Axpo** and **BKW** provides the following ratios: **Axpo**'s "equity-at-risk" for the period 2009-2020 is, on average, 1.5 times higher than that of **BKW**. In FY 2018, which marks the highest reported value for both electricity companies until 2020, **Axpo** reported an "equity-at-risk" that was 2.5 times higher than that of **BKW**. In the years affected by market distortions, the factor was 2.0 in FY 2021, 8.0 in FY 2022, and 9.0 in FY 2023, each time to **Axpo**'s disadvantage.

The systemic risk exposure of the three electricity companies is assessed using the "equity-at-risk" and "trading liquidity-at-risk" at the balance sheet date. The core components of the approach used to quantify the systemic risk of systemically important energy suppliers are the Initial Margin Account, liquidity, and the gross values of the balance sheet item "derivative financial instruments" for assets and liabilities, as well as the liabilities derived from these surpluses. With these gross values, the netting volumes are also *de facto* relevant for the balance sheet item "Derivative Financial Instruments." These netting volumes depend on market prices and are, therefore, exposed to volatility across various commodities and contract maturities.

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[26] Frauendorfer K., Gutsche R. (2022): *Geschäftsmodell der Axpo: Cui Bono?* Kommentar zu den Finanzberichten 08/09-20/21 der Axpo, ior/cf-HSG, Universität St.Gallen, S. 11 (Link).

Figure 2 provides a comparative analysis of these financial liabilities across the three companies, relative to their production ratios.

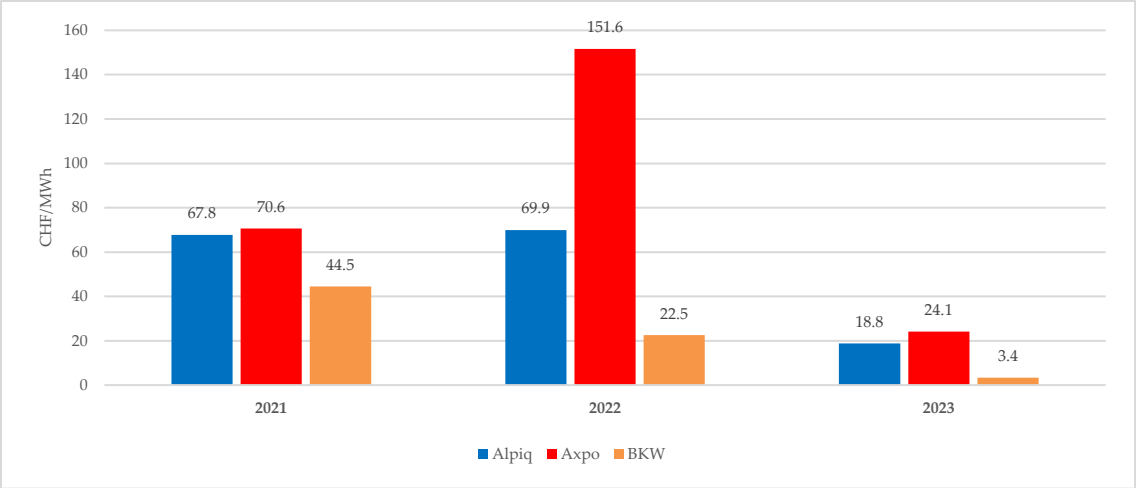


Figure 2: Additional risk capital (CHF/MWh) per MWh produced for equity (2021-2023)

As audits become increasingly risk-oriented[27], the collaboration and information exchange between internal audit and risk control become critical. This cooperation forms the foundation for the Board of Directors (BoD) to fulfill its supervisory responsibilities. To continuously monitor systemic risk exposure, certain data must be recorded and analyzed: the initial margin account, liquidity, gross values for "financial assets" and "financial liabilities" from the balance sheet item "derivative financial instruments," netting volumes, and liability surpluses. These must be disclosed to the BoD as daily time series data. From these series, the development of "equity-at-risk" and "trading liquidity-at-risk" can be monitored daily. These trends can also reveal the timing and extent of portfolio compression and the trading activities involved. Numerous analyses can be conducted based on these time series, which must be provided to the BoD. Specific questions may arise, such as whether the volatility of "equity-at-risk" can be sufficiently explained by market price volatility or if other factors, such as portfolio compression, are driving it. Portfolio compression involves realizing unrealized trading transactions, which impact liquidity, the balance sheet item "Derivative Financial Instruments," netting volumes, and liability surpluses. The volatility of "trading liquidity at risk" can be evaluated based on the performance of the *Initial Margin* account.

Understanding the volatilities and correlations of "equity-at-risk" and "trading liquidity-at-risk" throughout the year allows the BoD to gain better insights into systemic risk development and identify the linear and non-linear dependencies of certain factors over a financial year.

It is also essential to assess whether hedging transactions or speculative trading activities have caused liquidity bottlenecks. This can be examined using internal company data during the financial year. Let us briefly outline which data would need to be disclosed to the BoD:

We assume that the hedge targets the net energy position rather than production. If an energy volume linked to open futures positions differs from the net energy position on the balance sheet date, the resulting figure represents the speculative energy volume. The sign of this speculative volume indicates whether it represents a long or short position, signaling a bet on rising or falling prices. The financial risk exposure can be calculated using the ECC method for Initial Margin calculation and scaled to the desired holding period using the root-out-of-T rule.

For illustration, assume an electricity company reports annual production of 12 TWh (long) and contracted sales volume of 9 TWh (short) for the upcoming year. The net energy position would then

[27]Schwintowski, Scholz, Schuler (2018): *Handbuch Energiehandel*, 4. Auflage, Erich Schmidt Verlag, S. 437-444.

be 3 TWh long as of the balance sheet date. If short futures covering 3 TWh are reported on the balance sheet date, the sum of 3 TWh long and 3 TWh short results in a net energy position of zero, meaning the net energy position is fully hedged. If short futures covering 12 TWh are reported, the management may argue that the hedging volume is intended for the company's annual production. However, from a balance sheet perspective, the residual short futures volume of 9 TWh (12-3) would effectively represent speculation on falling prices. This would document an energy speculation volume of 9 TWh (short) for the first year following the balance sheet date.

Similarly, speculative energy volumes and their associated financial risks could be determined for the second and third years following the balance sheet date and reported separately for each market area and commodity, as needed.

The question of whether liquidity bottlenecks are the result of hedging transactions or speculative trading can be determined based on internal company data during the financial year. We will briefly explain which data must be made available to the Board of Directors:

We start from the principle that it is not the production but the net energy position that is to be hedged. If an energy volume of open futures positions is reported on the balance sheet date that is either greater or smaller than the net energy position, this value represents the speculative energy volume. The sign of this value shows whether the speculative volume corresponds to a long or short position, i.e., whether it is betting on rising or falling prices. The financial risk exposure resulting from this can be determined using the ECC method for calculating the *Initial Margin* and scaled to the desired holding period using the root-out-of-T rule.

To explain this, let us assume an energy supply company that reports an annual production of 12 TWh (long) and a contracted sales volume of 9 TWh (short) for the following year as of the balance sheet date. The net energy position, therefore, amounts to 3 TWh long on the balance sheet date.

- If short futures for 3 TWh are reported as of the balance sheet date, the sum of 3 TWh long and 3 TWh short results in 0 (= +3 – 3), meaning that the net energy position is fully hedged.
- If short futures for **12 TWh** are reported, the management can argue that the hedging volume relates to the annual production for the next year. However, in balance sheet terms, the remaining short futures of 9 **TWh** (=12 – 3) de facto represent speculation on falling prices. Thus, an energy speculation volume of 9 TWh short would be documented on the balance sheet date for the following year.

In the same way, the **speculative** energy volume and the associated financial risk exposure could be determined for the second and third subsequent years and, if necessary, also reported separately by market area and commodity.

To assess the extent of speculation during the financial year, the development of the **energy speculation volumes** across the trading days is of interest. If the curve deviates from the zero line, the sign shows the Board of Directors whether and to what extent speculative short or long positions are determining the risk exposure in energy trading.

The liquidity risk from hedging is also influenced by the **size** of the hedging volume in the execution of the hedging strategy. Let's assume an electricity company has an annual production of 24 TWh and the Board of Directors mandates securing the entire production for the next **three** years. The volume to be hedged could therefore range between 36 TWh and 72 TWh, depending on operational management's decisions. This implies that the liquidity risk could be **double what is actually** necessary.

If we further assume that over the three front years, a total of 27 TWh (divided as 13 TWh, 8 TWh, and 6 TWh over the three years) is already hedged through sales contracts, this would leave a net long position of 9 **TWh** (=36 TWh – 27 TWh) to be hedged. This further reduces the liquidity risk by a factor of **four**.

This example illustrates that the liquidity risk associated with hedging could, in essence, be up to **eight** times **greater** than necessary, depending on how the hedging strategy is implemented. The operational management's decisions on the execution of this strategy play a crucial role in determining the liquidity risk and must be closely monitored by the Board of Directors (BoD).

The liquidity risk is determined by two key factors: the volatility of futures prices and the hedging volume. These factors together define the risk of an additional **margin call**. In August 2022, this very risk materialized for **Axpo**, leading to a threat of insolvency.

6. Lessons Learned

In addition to the liquidity requirements for operational business, additional capital and liquidity must be set aside for risks in energy trading that have not yet been sufficiently taken into account. We primarily see the energy derivatives balance sheet item as a key risk carrier for equity, with the excess liabilities derived from it being a risk carrier for liquidity. Additionally, sufficient liquidity must be held for open futures positions to meet any margin payments in case the market moves against the futures position.

The balance sheet item "derivative financial instruments" is subject to imprecision, which arises from:

1. Significant discretionary powers of management,
2. Estimation uncertainties,
3. Unforeseeable shocks to credit ratings and prices,
4. The incompleteness of energy markets, and
5. Any price adjustments as part of portfolio compression (i.e., the elimination of trading transactions).

Fair value calculations of derivative financial instruments are therefore subject to imprecision, which can represent a risk of loss to equity and cause liquidity bottlenecks.

For the fair values of derivative financial instruments, we apply an *overall* uncertainty margin of at least 5%. This margin models the risks from discretionary decisions by management, estimation uncertainties, unforeseen shocks to credit ratings and prices, and negative price adjustments due to portfolio compression within an incomplete energy market. If the "financial liabilities" of the derivative financial instruments are weighted accordingly by 5%, we derive the "equity-at-risk" as the risk capital to be deposited to absorb the potential negative effects on equity due to these uncertainties. In order to account for the credit spreads of an energy trader and their volatilities, an upward adjustment to the 5% weighting might be justified. The same logic applies when the trading volumes of an energy trader approach the limits of its own risk-bearing capacity or start to impair market liquidity.

Empirical analysis[28] shows us that the more risks taken in energy trading, the weaker the performance tends to be compared to a deterministic index that excludes speculative elements.

To determine the additional liquidity to be allocated for energy trading ("trading liquidity at risk"), we take the liability surplus from the balance sheet item "Derivative Financial Instruments" and the necessary provision for the *Variation Margin* as the basis. The latter is derived from the *Initial Margin* account.

The recommended capital and liquidity requirements are based on revised data published in the respective financial reports. Capital requirements are recognized as provisions for systemic risks. The impact of these provisions on EBITDA and other selected financial covenants of the electricity groups is documented as of the balance sheet date for FY 2021, 2022, and 2023. We summarize as follows:

[28] Frauendorfer K., Gutsche R. (2024): *Transparenz und Effizienz im Energiehandel: Erstverkauf vs. Letztverkauf, Implikationen für den Energiederivatenhandel (Case Axpo),* White Paper, ior/cf-HSG, Universität St.Gallen, S. 37-40.

For **BKW**, the capital and liquidity requirements only marginally affect its financial covenants on the balance sheet dates. **BKW**'s equity ratio will remain above 30% in FY 2021, 2022, and 2023; the net debt/EBITDA ratio will range between 0.84 and 0.95. Due to its sufficiently high liquidity, there is no need to allocate additional liquidity.

For **Alpiq**, the equity ratio is projected to fall from 26% to 18% in FY 2021, from 23% to 15.8% in FY 2022, and from 46% to 37.9% in FY 2023. The EBITDA for **Alpiq** would shift from a positive CHF 312 million to a negative CHF 806 million in FY 2021 under the capital requirement. In FY 2022, EBITDA would fall from CHF 473 million to CHF 437 million under the capital requirement, with a net debt/EBITDA ratio of 0.24. By FY 2023, net debt would be negative.

For **Axpo**, the equity ratio will decline from 16% to 10.7% in FY 2020/21, from 9.4% to 2.7% in FY 2021/22, and from 28% to 25.9% in FY 2022/23. Axpo's EBITDA would switch from CHF 1,092 million to *minus* CHF 1,365 million in FY 2020/21 under the capital requirement. Additionally, under the liquidity requirement, **Axpo** would need to raise an additional CHF 1,184 million in FY 2020/21. In FY 2021/22, the capital requirement would reduce EBITDA from *minus* CHF 681 million to *minus* CHF 3,500 million. To comply with the liquidity requirement in FY 2021/22, **Axpo** would need to raise an additional CHF 3,194 million, including the CHF 4,000 million provided by the federal government. A press release from October 2022 indicates that the syndicated loan banks agreed to extend credit facilities totaling EUR 3,000 million following the approval of the rescue package by the federal government. In FY 2022/23, Axpo reported negative net debt, and there is no need to allocate additional liquidity due to sufficient reserves.

It should be noted that under the new liquidity requirement, **Axpo** would have needed to procure additional liquidity of CHF 1,184 million as of the balance sheet date of September 30, 2021. **Axpo**'s FY 2020/21 was largely unaffected by price distortions in the energy exchanges up to the balance sheet date. Based on **Axpo**'s financial report for FY 2021/22, we confirmed the urgency of the rescue package and determined that **Axpo**'s ability to continue operating was at risk without the short-term liquidity provision of CHF 4 billion. We have estimated the cost of liquidating **Axpo** as of September 30, 2022, at CHF 24 billion. This emphasizes the importance of macroprudential authorities in protecting the Swiss energy market.

The above statements apply to the balance sheet dates. To fully assess the systemic risk exposure of Swiss electricity companies throughout a financial year (FY), it is necessary to track the figures for "equity-at-risk" and "trading liquidity-at-risk" for each trading day. Since price curves are generated daily based on futures prices for different market areas, the "financial assets" and "financial liabilities" related to the balance sheet item "Derivative Financial Instruments" are available on a daily basis. The same applies to netting volumes and liability surpluses. *Initial Margin* and *Variation Margin* are also determined daily by ECC. These elements provide the foundation for analyzing the time series for "equity-at-risk" and "trading-liquidity-at-risk" on a daily basis.

The development of trading volumes, as well as the timing and extent of portfolio compressions, can be observed from the trends in "equity-at-risk" and trading-liquidity-at-risk. Portfolio compression results in the realization of previously unrealized trading transactions, impacting liquidity, the volume of the balance sheet item "Derivative Financial Instruments," the netting volume, and the liability surplus. These time series offer the possibility for multiple analyses, helping to answer questions posed by the Board of Directors (BoD). Specifically, they allow investigation into management decisions and the effects of misguided incentives within energy trading, distinguishing between efficiencies and inefficiencies. Trends in the volatilities and correlations of "equity-at-risk" and trading-liquidity-at-risk over specific periods provide systemically important energy companies with insights into the evolution of systemic risk, highlighting both linear and non-linear dependencies throughout the financial year.

The daily time series mentioned above cannot be replaced simply by reporting trading transactions. While trading transactions allow conclusions regarding the gross margins of unrealized trading transactions, uncertainties in energy trading, such as portfolio compression, can affect the ability to

realize these gross margins. Portfolio compression may also lead to costs that reduce the gross margins of unrealized trades. Therefore, to assess the systemic risk of an electricity company, it is crucial to track the daily development of the fair values of derivative financial instruments. These fair values significantly impact equity due to their share of total assets. Since the fair values of derivative financial instruments are recalculated daily, based on fluctuating price curves, they represent a direct impact on equity and are subject to considerable uncertainty.

Portfolio compression is perceived as a "black box" whose contribution to systemic risk remains largely unknown. Portfolio compression reduces OTC trading volumes, and derivative financial instruments shown in the balance sheet typically have a lower systemic risk on the balance sheet date compared to the trading days before the compression. Based on research in finance literature[29], we estimate that portfolio compression reduces the recognized volume of interest rate swaps by approximately 25-30%. Consequently, our approach suggests that "equity-at-risk" is underestimated by 25-30%. Therefore, we find it essential that, in line with the new Federal Act on Supervision and Transparency in the Wholesale Energy Markets (BATE), selected time series related to equity and liquidity-determining balance sheet items are disclosed at daily granularity not only to the Board of Directors of systemically important energy suppliers but also to the regulator, supervisor, and control authority.

We believe that the planned legal amendment will help protect the competitiveness of electricity companies by mitigating the risks of excessive risk-taking. Currently, there are several misguided incentives that necessitate stronger internal controls:

(i) The choice of initial sale can artificially improve the appearance of energy trading results, often at the expense of production and sales business segments. (ii) Reversing hedging relationships when there are hedging gains generates liquidity for the expiring financial year but improves the result in energy derivatives trading at the expense of subsequent years. (iii) Managing power plants, storage facilities, energy contracts, and customer orders can obscure speculative trading transactions, which carry higher risks. (iv) The discretion afforded in setting the hedging volume can allow for considerable management flexibility, which requires strict oversight and monitoring by the board of directors.

In our view, appropriate additional capital and liquidity requirements would provide incentives to keep balance sheet items and trading transactions at low volumes, reducing excessive liability overhangs. It would also encourage a focus on managing the net energy position, ensuring that hedging volume, and thus futures positions, remain minimal.

If negative equity and insolvency are imminent, immediate action must be taken to assess whether a systemically important counterparty can continue as a going concern. If insolvency risks extend to other systemically important counterparties, similar analyses should be applied to them. This would help quantify any potential domino effects and assess the stability of infrastructures in the Swiss energy markets, as well as in interconnected or neighboring markets, in a timely manner.

For example, during the near insolvency of Credit Suisse in early 2022, media reports indicated that the governors of the US and UK central banks contacted the Swiss Federal Council. They warned that if the solution was too focused on Switzerland, systemic risks might be transferred to the US and UK. Our understanding is that an overly Switzerland-centric solution to a "too-big-to-fail" scenario could have hurt the competitiveness of the Swiss economy due to potential international responses.

These explanations highlight which aspects of energy trading, or the implementation of a hedging strategy, could turn existing liquidity bottlenecks into insolvency risks. Such scenarios could jeopardize the stability of both national and international energy market infrastructures, threatening long-term energy security and economic stability.

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