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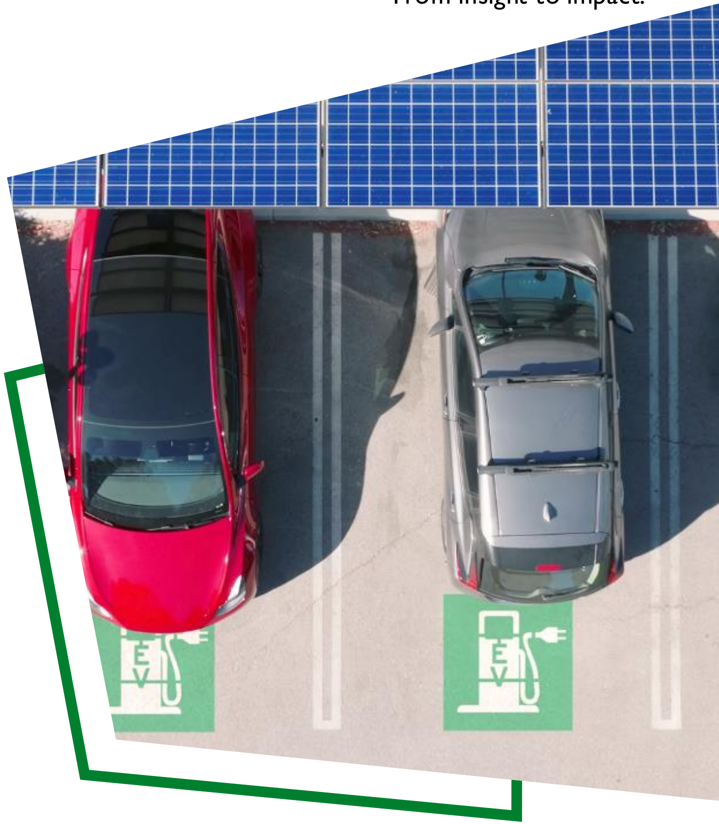
From insight to impact.



GRID INTEGRATION OF SOLAR PV & ELECTRIC VEHICLES

Analysing the economic benefits of smart charging for corporate energy prosumers

46th IAEE Intl. Conference

Paris – 18.06.2025

ROLLING SOLAR STORAGE

Dr. Cristian Pons-Seres de Brauwer

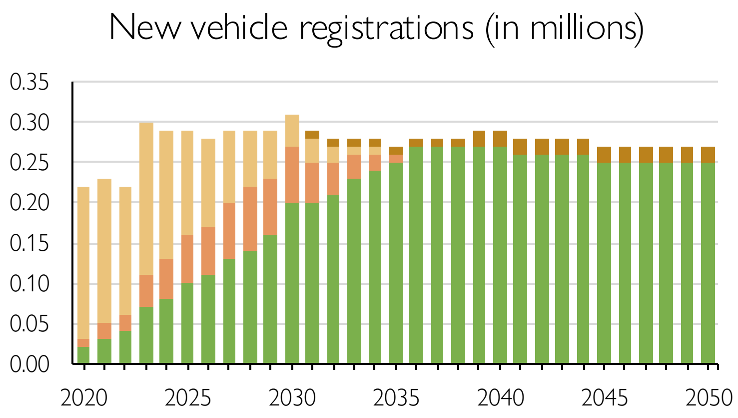
Agenda for today

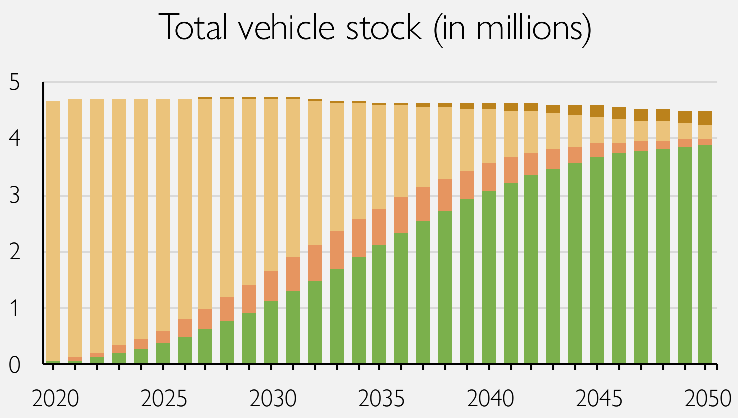
- Empirical background: Switzerland's transition to a RES-powered (road) electromobility system.
- Research aim and guiding questions.
- Data sources & methodological protocol.
- Work-in-Progress & preliminary results
- Wrap-up & next steps

Switzerland´s goals to decarbonize road transport

- Swiss Gov. targets at least **90%** share of plug-in EVs for **new car sales** by 2035
- *In 2025: share of 30%*
  *→ **'adoption gap' of 60%***

- **9-fold increase** to reach total volume of 2.8 million EVs in 2035
- In 2024: 303,448 EVs





Battery electric | Plug-in hybrid | Internal combustion engine | Hydrogen fuel cell

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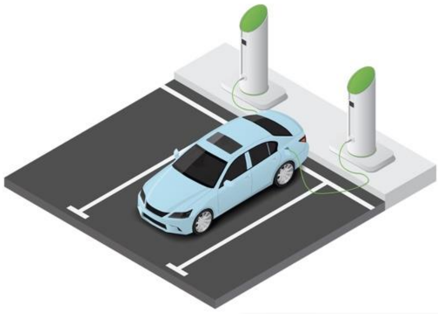
*BFE (2023). Verständnis Ladeinfrastruktur 2050 Wie lädt die Schweiz in Zukunft?

EV charging requirements: implications

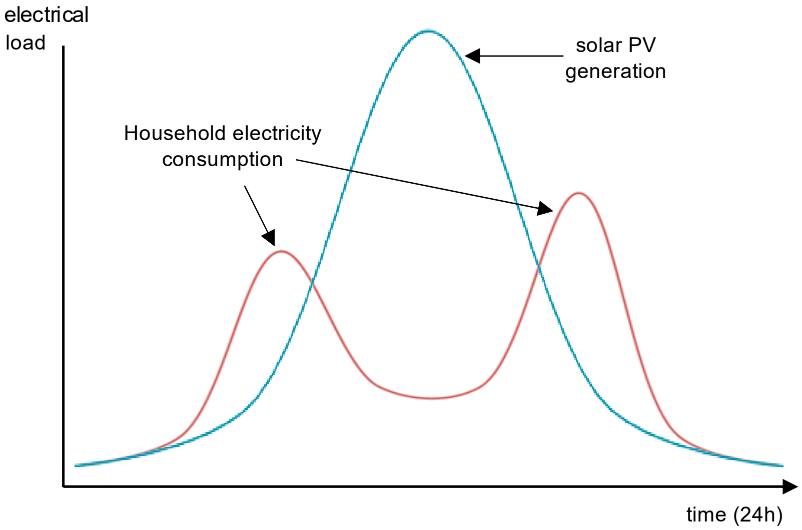
- To charge future EVs in a **user-friendly** manner, Government is promoting:
  - *Build-out of 2 million homeplace charging points by 2035.*
  - *6-fold increase of public EV charging stations throughout next 10 years.*

(15,250 in 2024 → 84,000 in 2035)



EV charging requirements: implications

- +7.3 TWh increase in electricity demand by 2035 **+** 30 TWh increase in solar PV by 2035 → **Grid integration of VRE emerges as bottleneck.**



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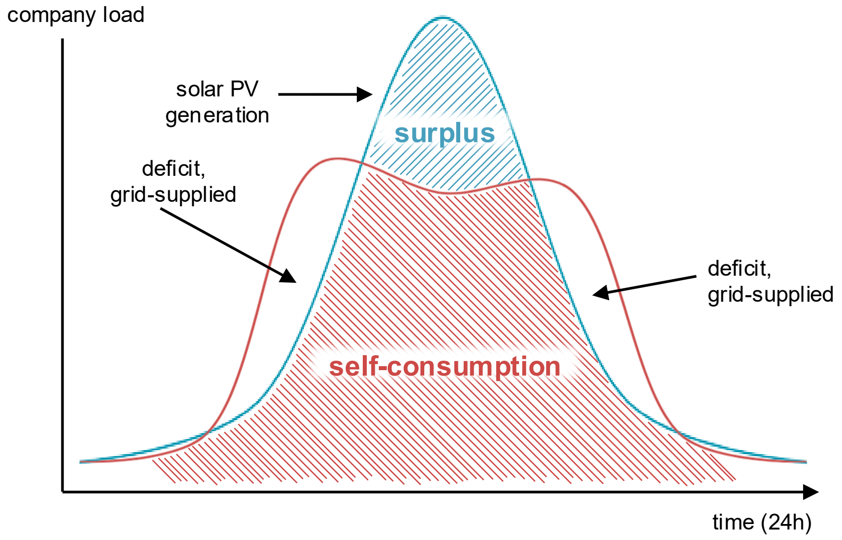

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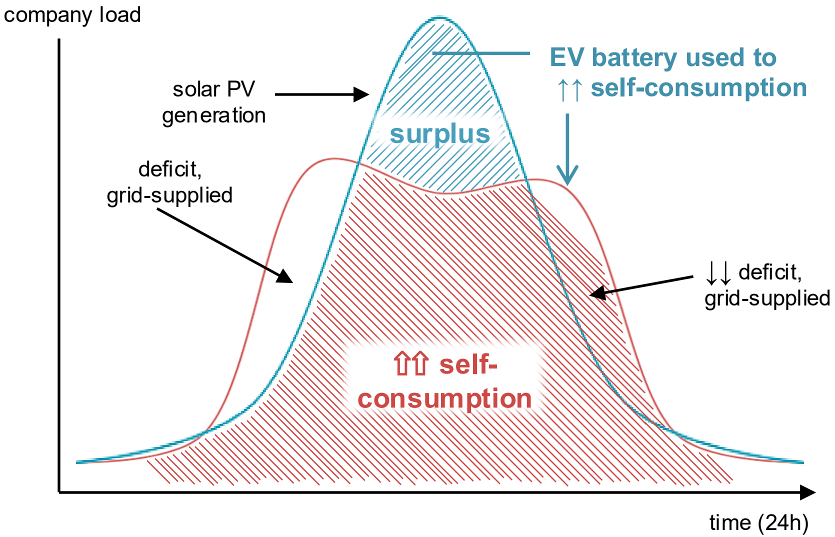

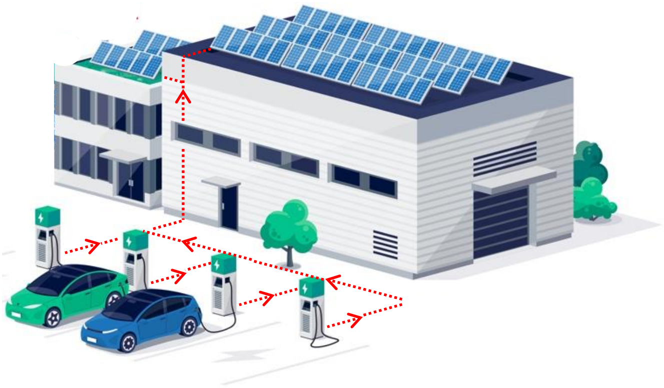

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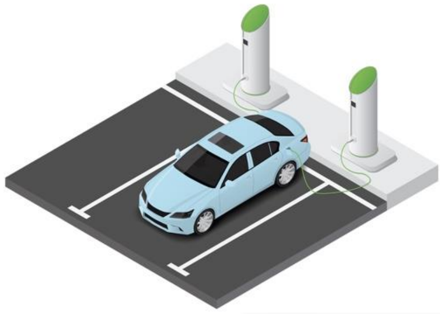
- **Workplace charging** emerges as third pillar of Swiss EV charging strategy


Switzerland has suitable conditions supporting widespread uptake of workplace EV charging

~50%

of Switzerland's active workforce commutes by car

<14km

avg. commuting distances

+73%

of workforce has car parking at the workplace

23 h/day

(5.3 hours@work)

cars parked on average

~6%

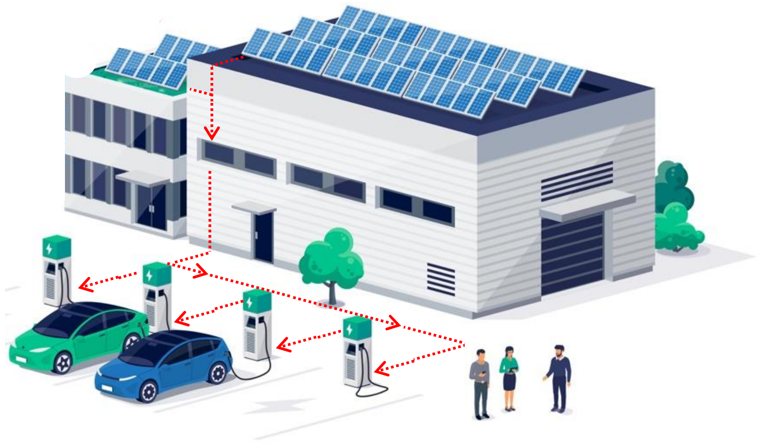
of time cars used for mobility purposes

~10%

of workforce commuting by car has EV charging available @ workplace

Research aim and guiding questions

Examine the **economic performance** and **financial viability** of company investments on workplace smart EV charging powered by solar PV.



Guiding questions

1) Do a **company**'s grid electricity cost-savings from increased solar self-consumption justify the investment on smart EV charging infrastructure?

2) To what extent could the **business case** be enhanced by policy support schemes?

Data sources & methodological protocol

Input: Annual solar PV generation & electricity consumption profiles of 22 Swiss companies in 15-minute intervals

Financial modelling of 6 different scenarios per company = 132 scenarios

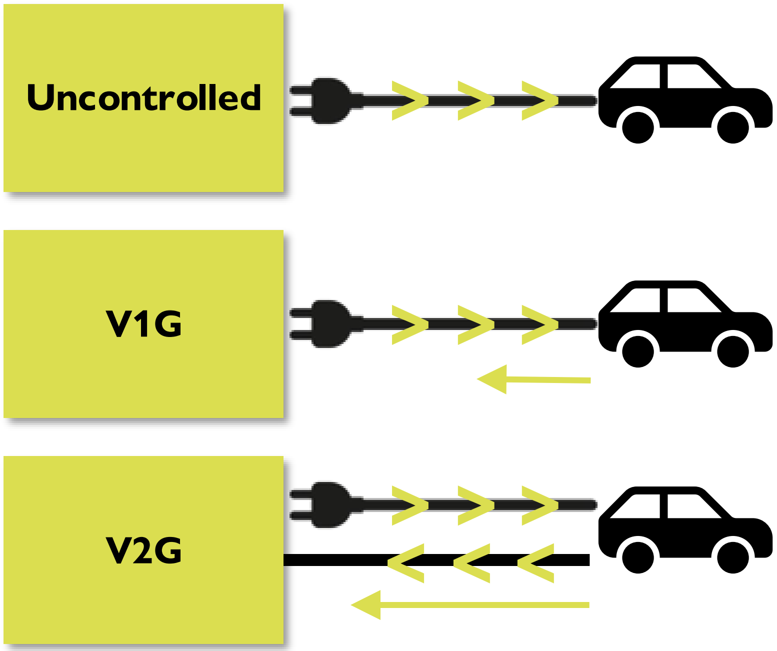
	Static TOU Tariffs	Dynamic Tariffs
Uncontrolled		
V1G		
V2G		

Output: Life-cycle cost & financial assessment from maximized self -consumption of solar PV

General assumptions of the LCCA & financial model

Viability	**Financial viability compared** to a 'baseline' scenario with 100% grid-supplied electricity (no PV). **Layered order of priorities**: 1) Max. self-consumption, 2) Charge EVs, 3) Feed-in excess to grid.
Commuter behavior	Charging occurs at the **workplace only**, no add. homeplace charging. **Daily commute** of ~14km one-way assumed, **10% buffer** applied for extra travel each day.
State of charge	Certain **state of charge guaranteed** every day (min. equal to state of charge at time of arrival). 'V2G' scenarios: No discharge below **20%** to avoid 'range anxiety' reaction. All scenarios: Maximum state of charge set at **80%** to prioritize battery health in all scenarios.
Cost distribution	All scenarios: Employees bear the **costs of EV purchase.** 'V2G' scenarios: Bidirectional charging stations in Switzerland **priced at ~15k CHF.** 'Uncontrolled charging' scenarios: Charging costs are covered **by employees.** 'V1G' & 'V2G' scenarios: Charging costs covered **by employer.**

Cost distribution varies with the exchange of value between the company and employees



No value exchange,
employee pays for charging

Value to company in **increased flexibility** of when charging can occur

Full value exchange through **charging & discharging flexibilities**

Preliminary Results: Average grid purchases for company operations (and EV charging)

	Avg. grid purchases (in MWh)		Cost of avg. grid purchases (in thsnd. CHF)	
	Static TOU Tariffs	Dynamic Tariffs	Static TOU Tariffs	Dynamic Tariffs
Baseline (no PV, no EV)	74.8	74.8	21.2	17.3
Uncontrolled	53.0 (-29%)	53.0 (-29%)	14.7 (-31%)	12.7 (-27%)
V1G	59.4 (-21%)	59.4 (-21%)	16.8 (-21%)	14.3 (-17%)
V2G	59.1 (-21%)	61.0 (-18%)	16.7 (-21%)	14.5 (-16%)

Preliminary Results: Average feed-in after self-consumption and EV charging

	Avg. feed-in (in MWh)		Revenue from avg. feed-in (in thsnd. CHF)	
	Static TOU Tariffs	Dynamic Tariffs	Static TOU Tariffs	Dynamic Tariffs
Baseline (no PV, no EV)	0		0	0
Uncontrolled	25.2		2.9	1.1
V1G	22.6		2.6	1.0
V2G	22.1	22.7	2.5	1.0

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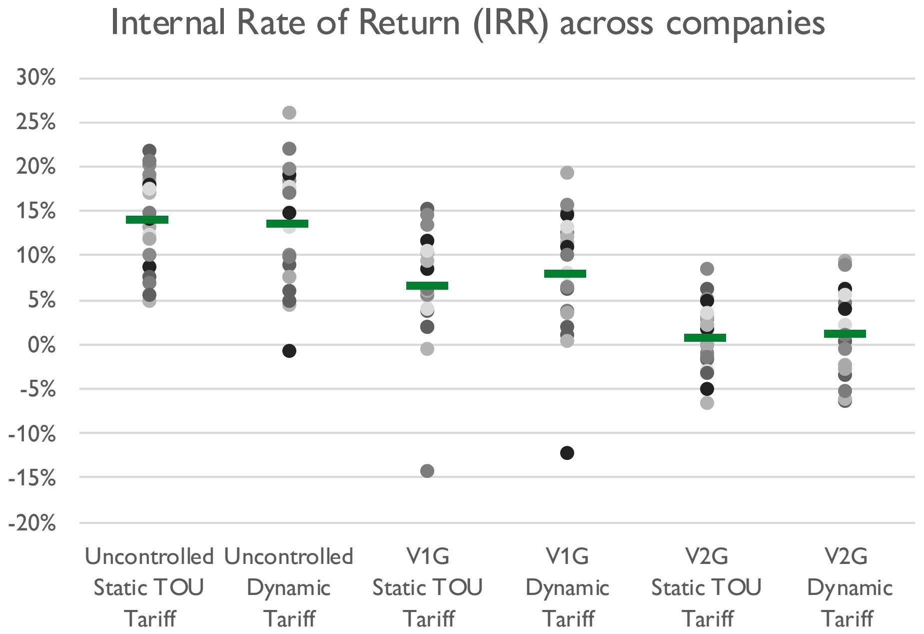
Preliminary Results: IRR



	Uncontrolled Static TOU Tariff	Uncontrolled Dynamic Tariff	V1G Static TOU Tariff	V1G Dynamic Tariff	V2G Static TOU Tariff	V2G Dynamic Tariff
Average	14.0%	13.5%	6.7%	8.0%	0.7%	1.2%

IRR decreases across scenarios as investments into charging stations increase

Dynamic prices provide slightly improved conditions under V1G and V2G charging, due to charging flexibilities and price arbitrage effects

Effects of purchase **subsidies** and **cost-reflective networks tariffs** to be assessed next

Thank you!

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