

Battery-electric ferries for resilient energy systems: A socio-technical assessment of fuel price shocks, electricity dependence and infrastructure bottlenecks



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Techno-economic assessment

Total cost of ownership

Monte Carlo sensitivity analysis

1. Introduction

Fuel shocks expose diesel-dependent ferries

Geopolitical tension, like in the Strait of Hormuz, show how conflict can transmit directly to oil markets.

Key Signals

- +160% Singapore marine gas-oil price increase¹
- +86% Rotterdam marine diesel prices (\$724 → \$1,347/t), 27.02 to 7.04.2026²
- +57.6% y/y increase in Maersk bunker costs in 2022 (\$484→\$763/t)³

Why ferries matter: Coastal passenger and freight ferries provide essential regional mobility yet remain vulnerable to fuel-price shocks.

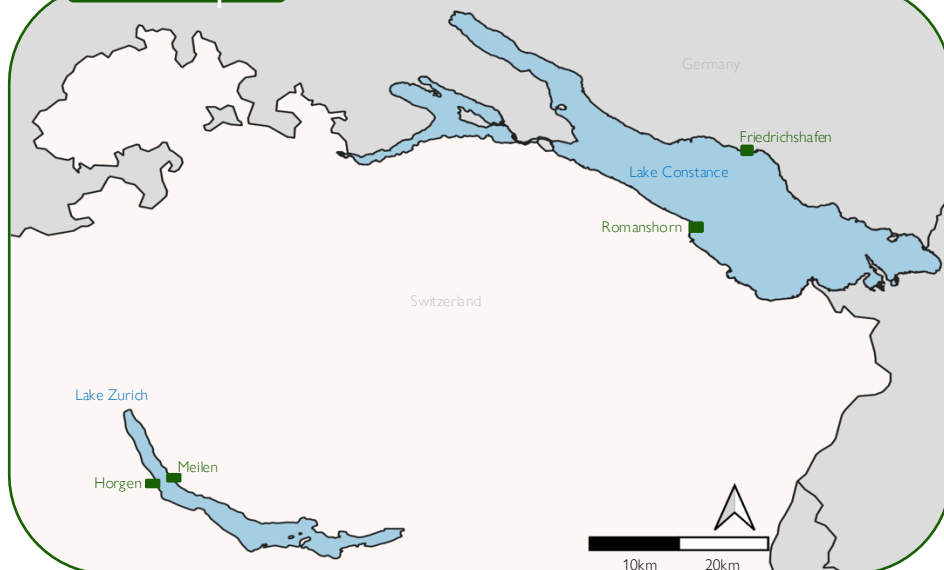
Core Insight: Electrification reduces diesel risk, but creates new dependencies on electricity, charging and infrastructure.

3. Cases & Data

Parameter	Baltic Whale (REF)	Lake Constance	Lake Zurich
Route	Rødby–Puttgarden	Romanshorn–Friedrichshafen	Horgen–Meilen
Countries	DK / DE	CH / DE	CH
Type	Freight (RoRo)	Passenger & Car	Passenger & Car
Distance	18.5 km	~13 km	3.5 km
Crossing	45 min	~41 min	~10 min
Battery	10 MWh	~6 MWh (est.)	3.4 MWh
CAPEX	€80 M (CHF 75 M)	~CHF 30 (€32 M)	~CHF 8 M (€8.5 M)
Status	In service since 10 Mar 2026	Diesel – Flagship “Euregia” retired	Diesel – e-newbuild planned, unfunded

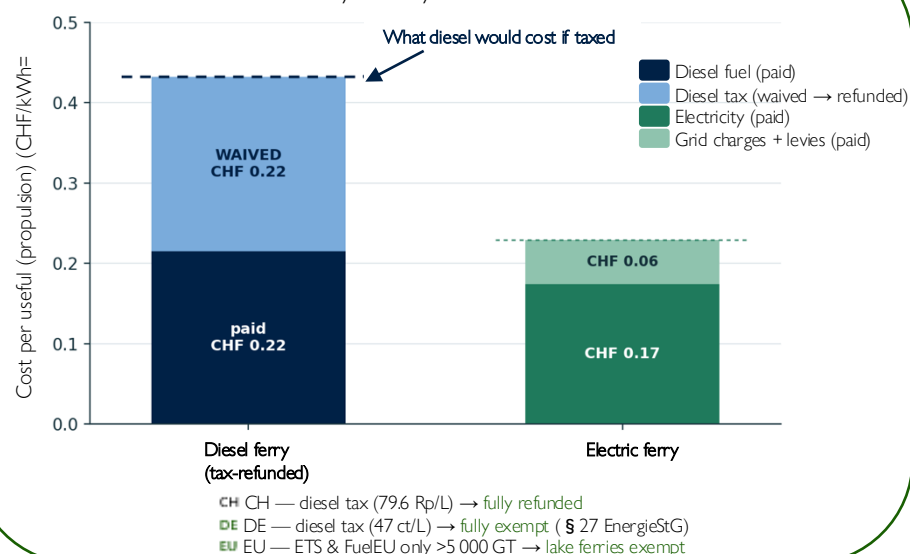
Figures marked (est.) are operator-planning values in the verification process; Battery sized for ~4–6 crossings between charges at ~70 % usable DoD; Lake Constance = operator estimate; Sandlines states €80 M and 10 MWh for the Baltic Whale.

5. Map



7. Fiscal Asymmetry – the binding constraint

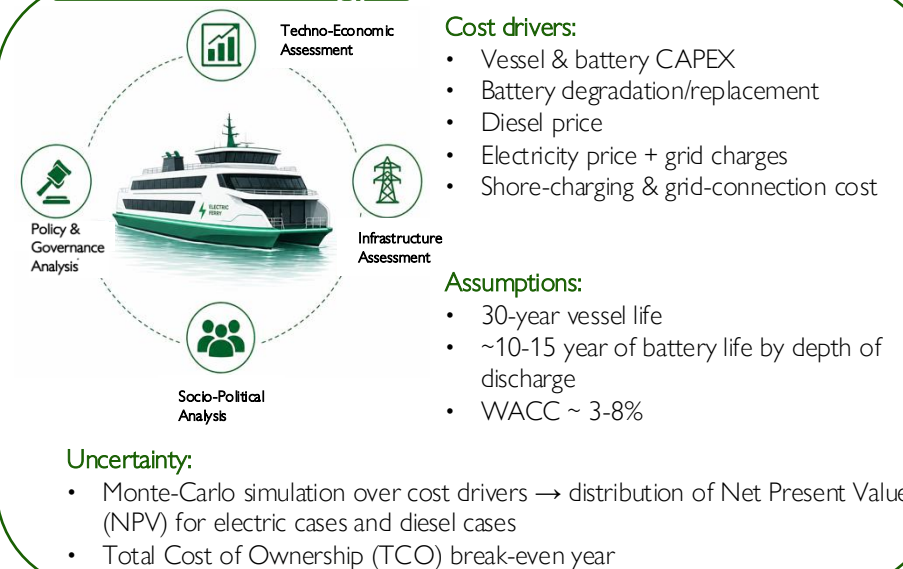
The waived diesel tax is the asymmetry



2. Research Questions

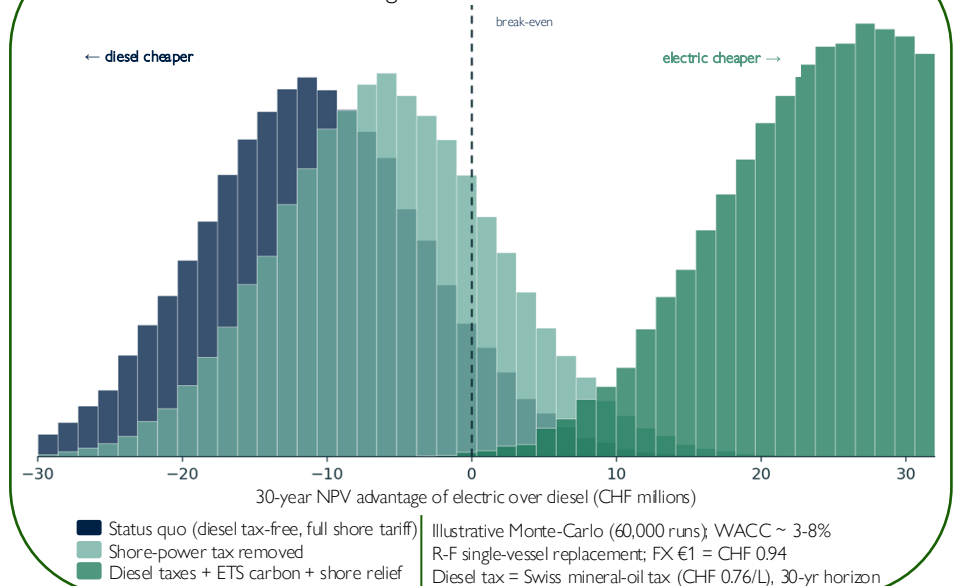
- What route conditions determine whether battery-electric propulsion is the economically rational choice for inland-lake ferries?
- Under what conditions is a battery-electric ferry economically viable versus the diesel status quo?
- How do CH/DE/EU tax asymmetries on marine diesel and shore-side electricity shape the electric-ferry business case?

4. Methodology



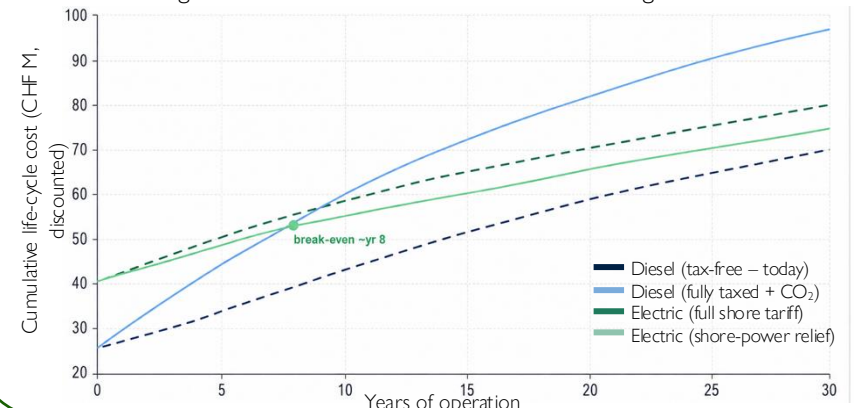
6. Monte Carlo Example

Monte-Carlo: what the fiscal regime does to the business case



8. Preliminary Results

Break-even: higher electric CAPEX vs. lower electric running cost



9. Conclusion

- Short routes are electrifiable; viability is decided by finance, fiscal rules and policy, not engineering.
- The diesel tax exemption is one of the biggest binding constraints.
- Policy levers exist. A binational investment instrument + coordinated multi-operator procurement (BSB · SBS · ZSG) could close the subsidy gap and unlock the 2040 climate-neutrality target.

Footnotes

¹The Maritime Executive (2025): <https://maritime-executive.com/article/hormuz-shutdown-drives-up-bunker-prices-with-broad-effects-on-shipping>
²OPIS (Dow Jones) (8 April 2026): <https://www.opis.com/resources/energy-market-news-from-opis/marine-fuel-prices-in-rotterdam-port-jump-as-much-as-86-on-middle-east-conflict/>
³A.P. Møller-Maersk (2022): <https://investor.maersk.com/news-releases/news-release-details/annual-report-2022>

References

Kandhiralla et al., 2025; Katumwesigye et al., 2025; Kobos et al., 2020; Korberg et al., 2021; Mackenbach et al., 2021; Moon et al., 2025; Perčić et al., 2020; Perčić et al., 2022; Weron, 2014

Full reference list

