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Ostschweizer Fachhochschule

PORT OF SWITZERLAND

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SUCO
SUSTAINABILITY CONSULTING

# Integrated Energy Solutions for Sustainable Port Development

**Elimar Frank,** Thomas Franz, Felix Rost, Andrew Bollinger, Laura Jakobeit, Michael Schüller, Martina Heer

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# Integrated Energy Systems (IES)

Achieve low GHG emissions, high energy efficiency and economic benefits of a system

e.g. area with multiple users / demands → sector coupling

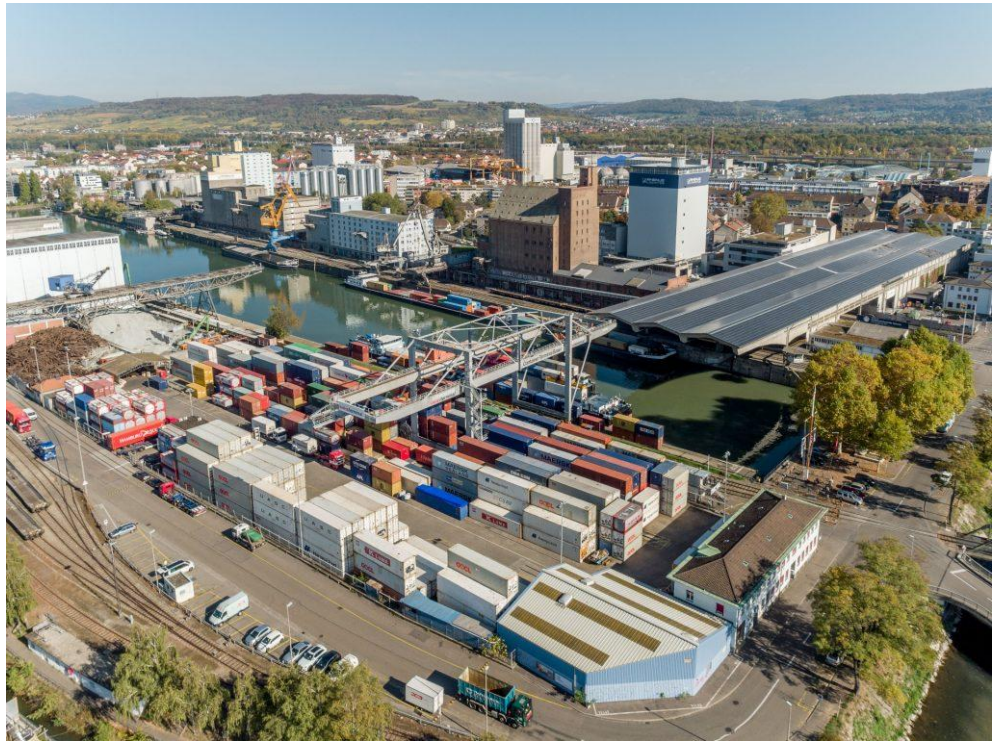
by
combining the physical and virtual integration of

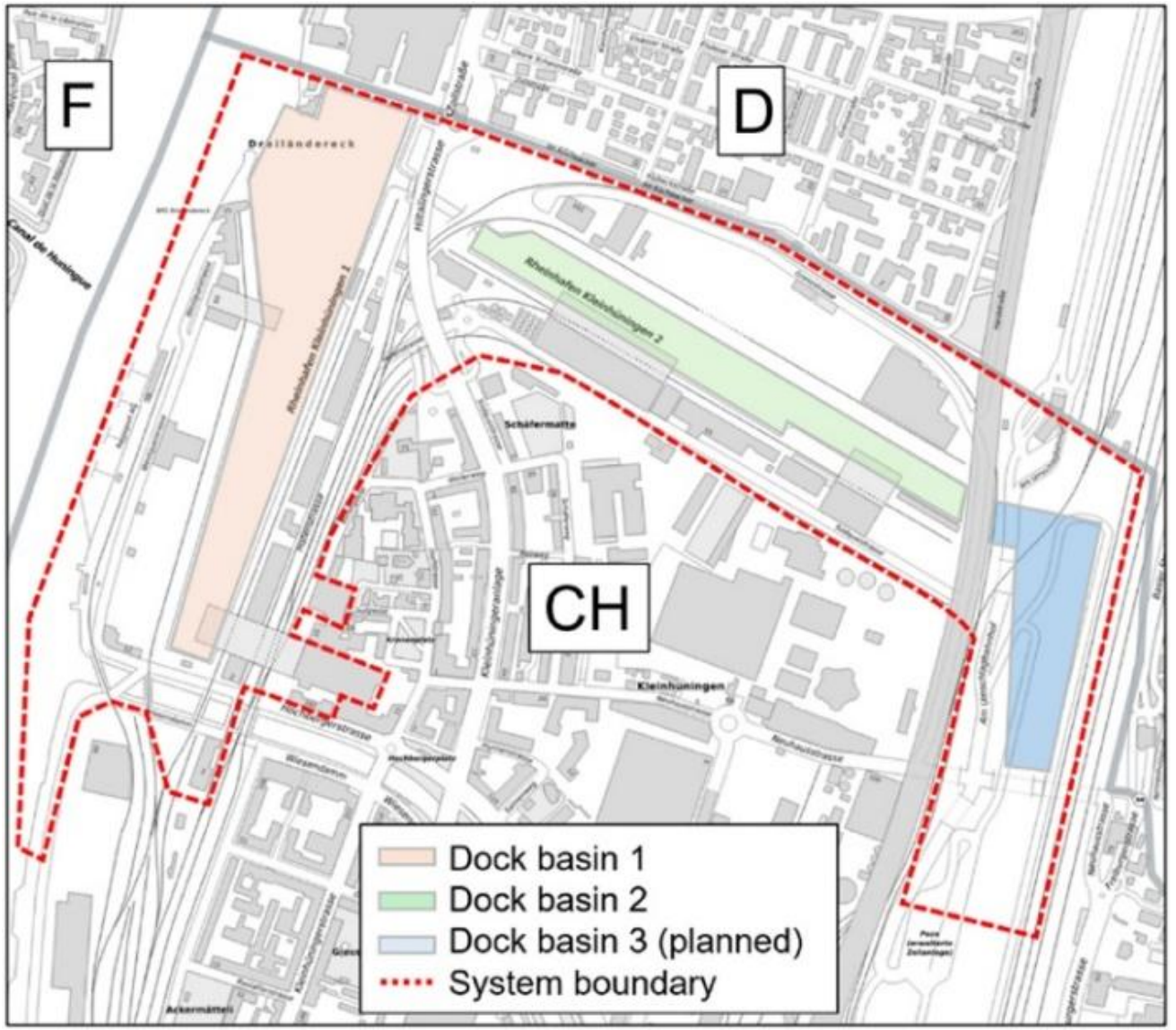
(complex) modelling of energy/power and costs with high time-resolution

energy sources, energy transformation, storages, distribution technologies and energy demand management.

reduce losses, increase (local) renewable energy exploitation, optimise costs

# Port in Basel-Kleinhüningen





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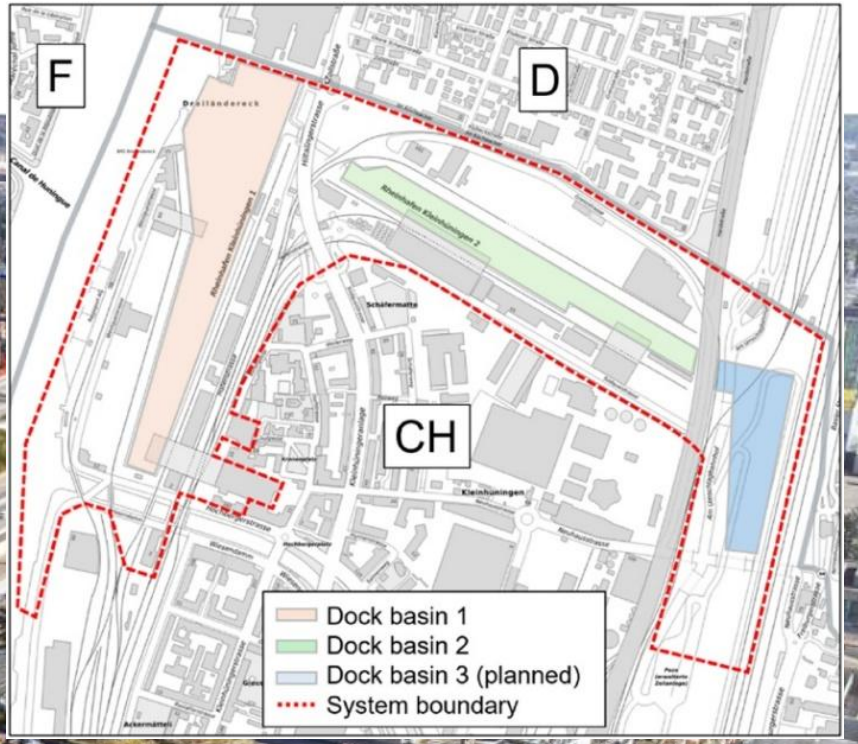
# Introduction

## Gateway Basel Nord

**Nationales Containerterminal**
**für Schiene, Rhein und Strasse**







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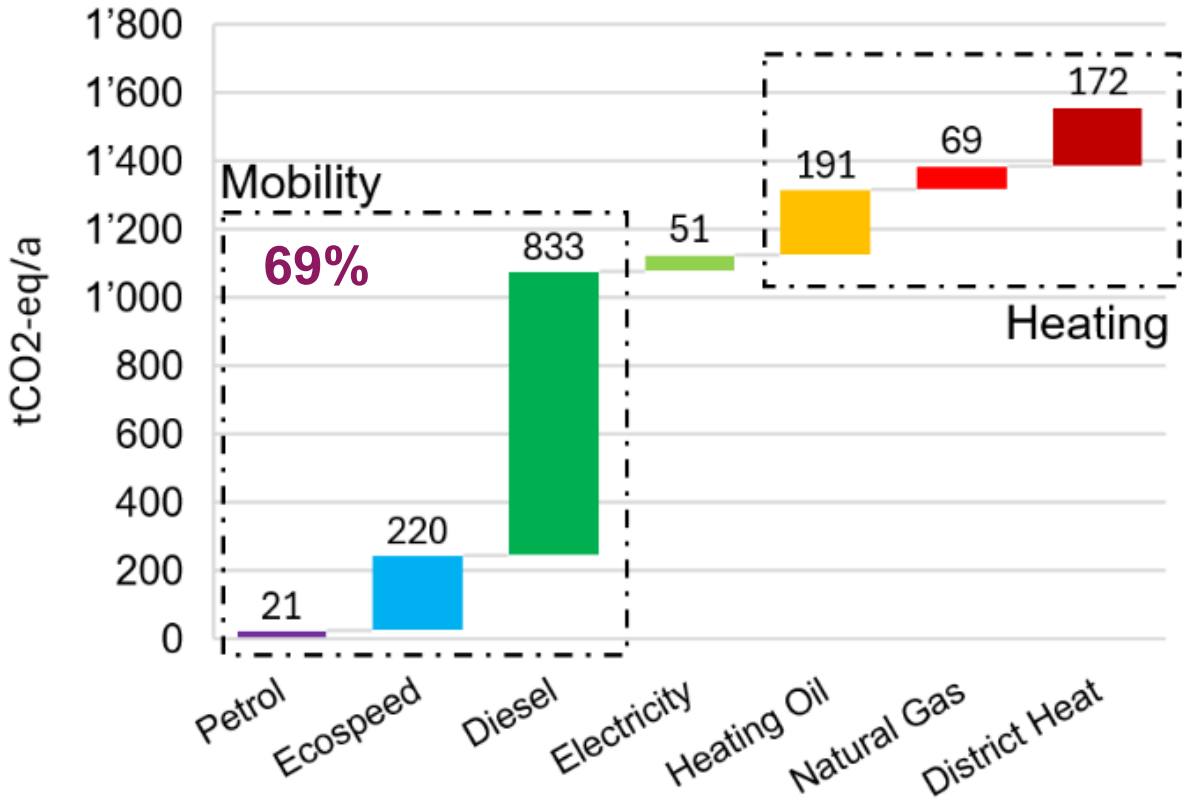
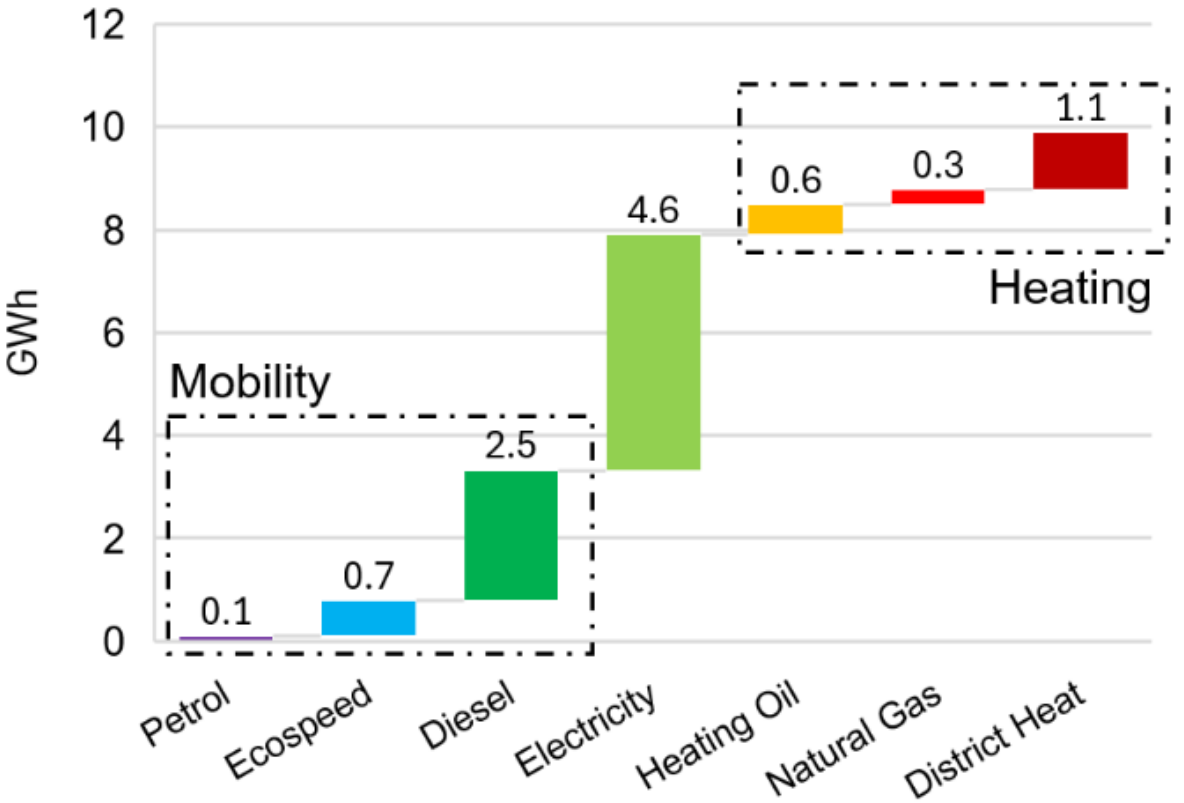
# 2025: GHG Emissions (left) and Energy Demand (right)



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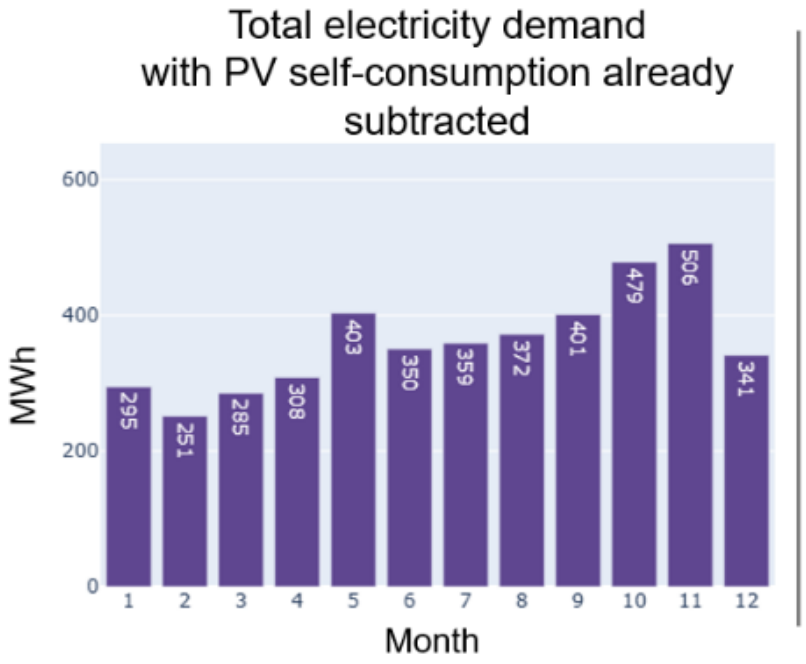
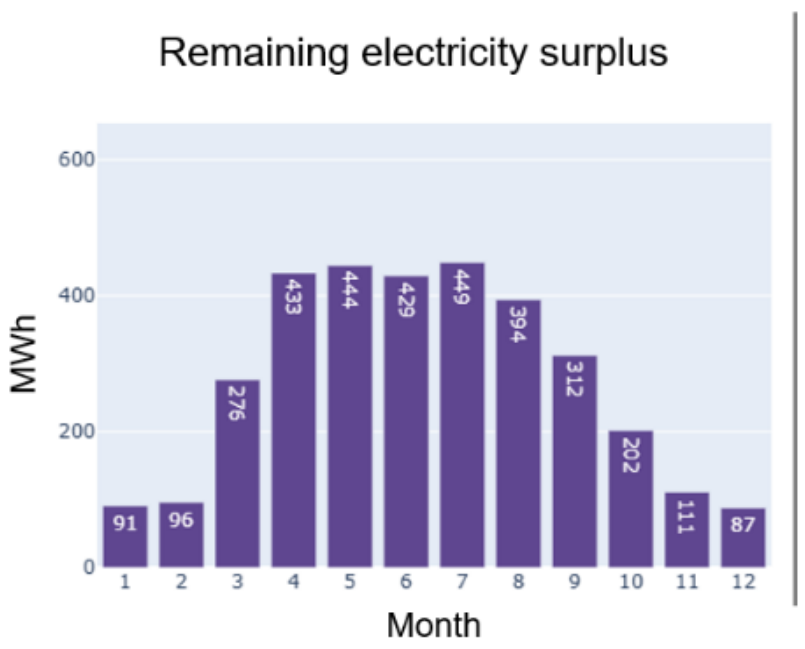
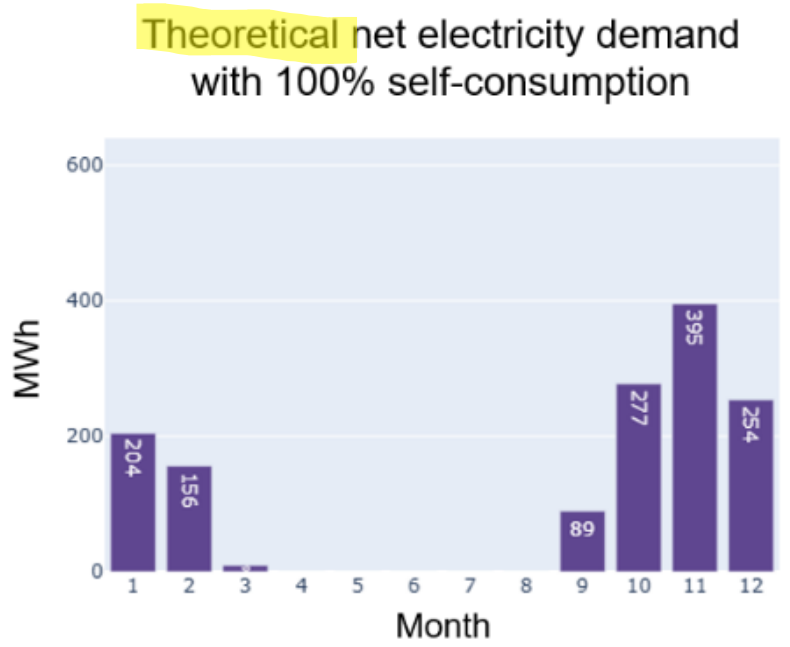
# 2025: 3.8 GWh from PV in Port Area



# Hubs for Modelling of Current and Future Situation

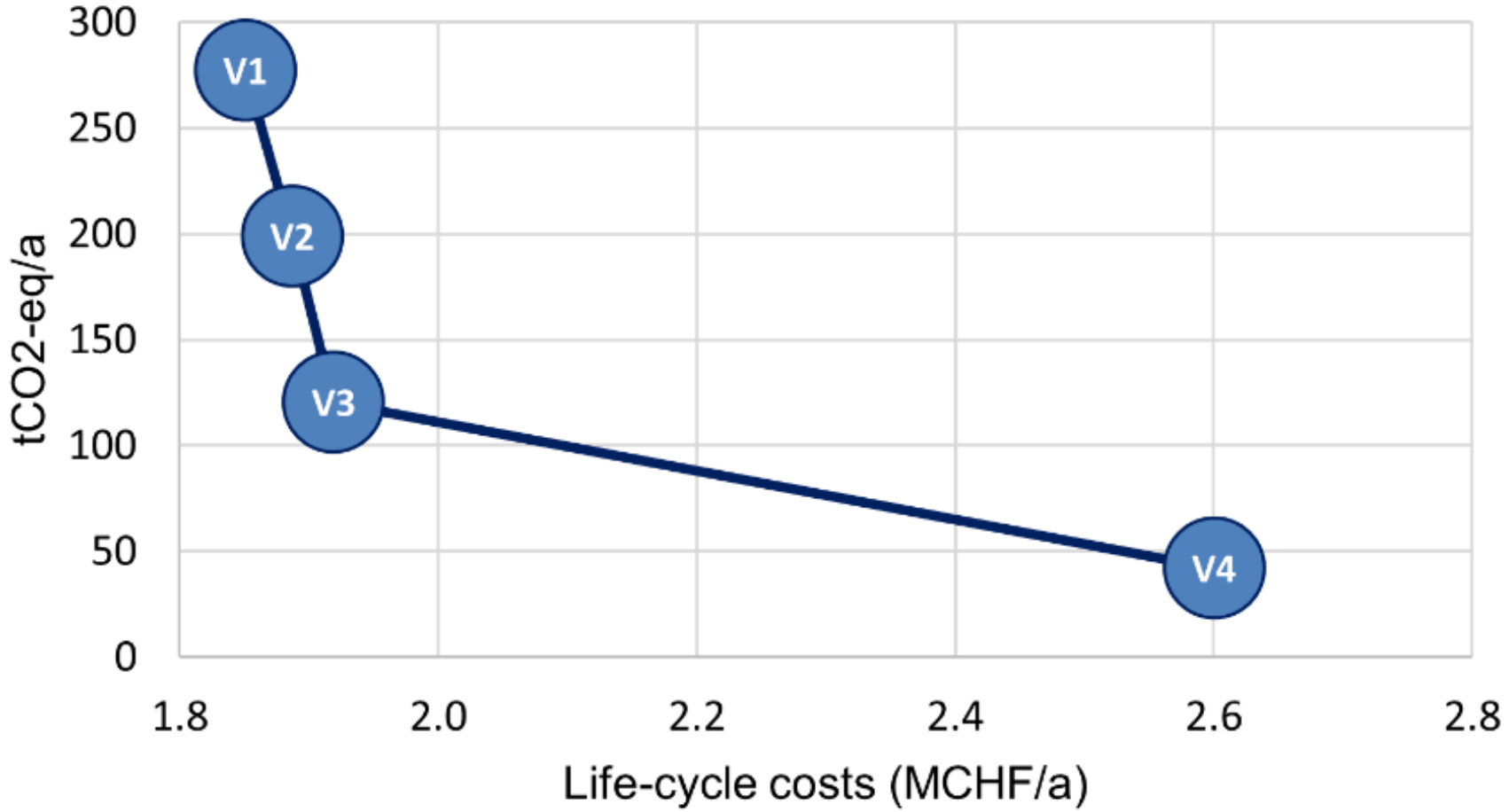
# Selected Key Model Parameters

| Investment Costs | | |
|---|---|---|
| Solar PV | 1’337 | CHF/$kW_{peak}$ |
| Battery | 250 | CHF/kWh |
| Ground-source heat pump (fixed cost) | 24’074 | CHF |
| Ground-source heat pump (variable cost) | 2’801 | CHF/kW |
| E-mobility charger | 400 | CHF/kW |
| Electrical connection (medium voltage) | 270 | CHF/m |
| Electrical connection (low voltage) | 200 | CHF/m |
| **Energy costs** | | |
| Electricity (energy price) | 0.29 | CHF/kWh |
| Electricity (capacity price) | 11.9 | CHF/kW/month |
| Diesel (Ecospeed) | 0.10 | CHF/kWh |
| HVO | 0.241 | CHF/kWh |
| District heating (energy price) | 0.128 | CHF/kWh |
| District heating (capacity price) | 21.6 | CHF/kW/a |
| Remuneration for electricity grid feed-in | 0.110 | CHF/kWh |

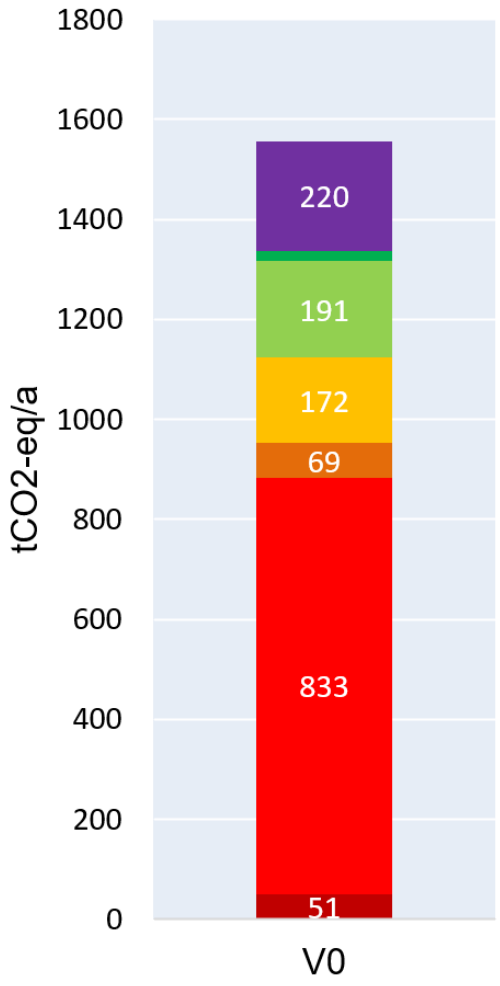
# Selected Key Model Parameters

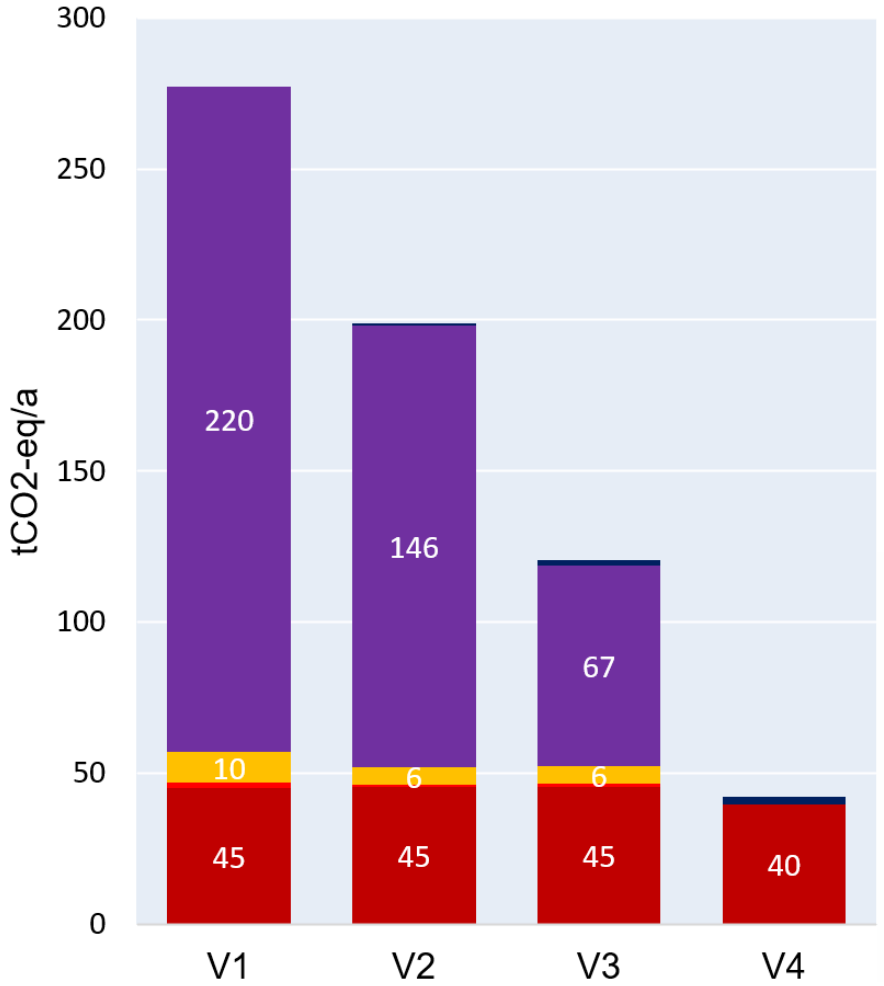
| $CO_2$ intensity of energy carriers | | |
|---|---|---|
| Grid electricity | 0.012 | kg-$CO_2$/kWh |
| Diesel (Ecospeed) | 0.324 | kg-$CO_2$/kWh |
| HVO | 0.004 | kg-$CO_2$/kWh |
| District heat (2035) | 0.086 | kg-$CO_2$/kWh |

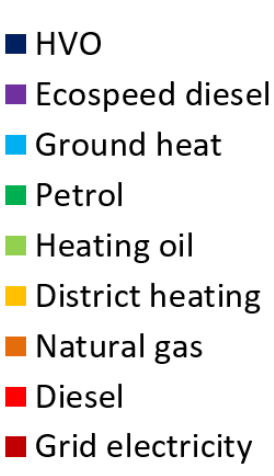
# Optimal Scenarios along Pareto Front

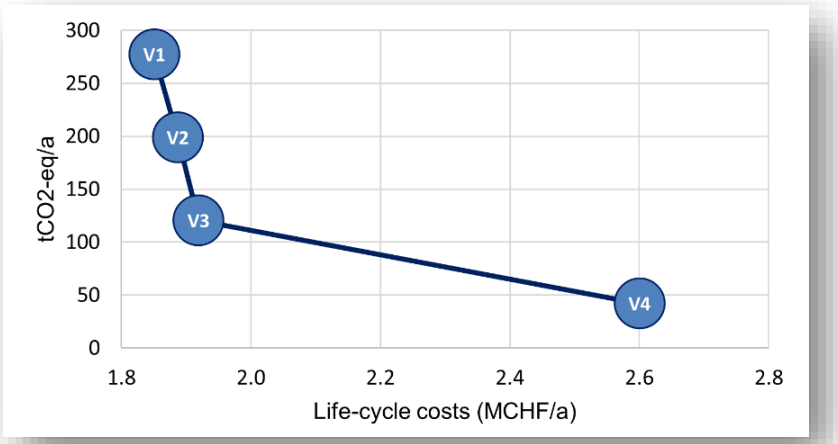


# GHG Emissions of Optimal Scenarios



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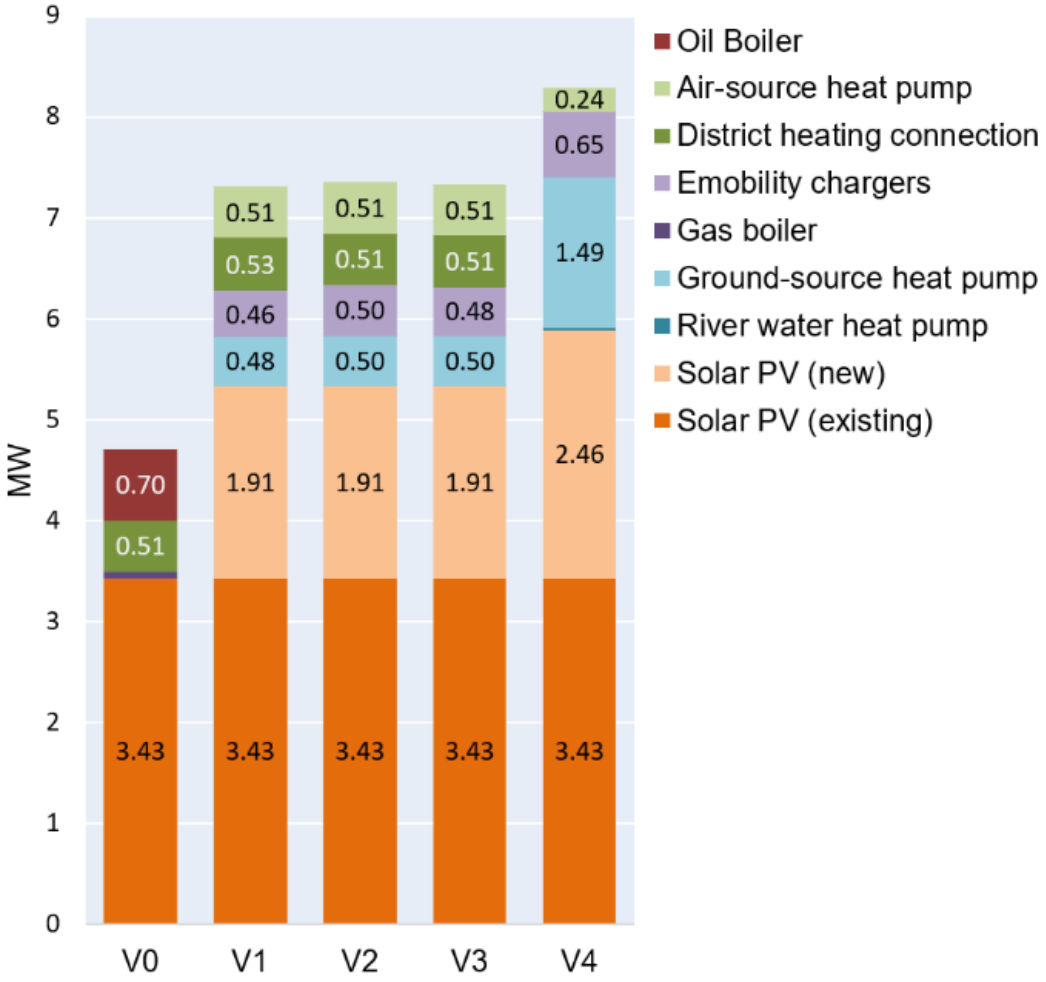
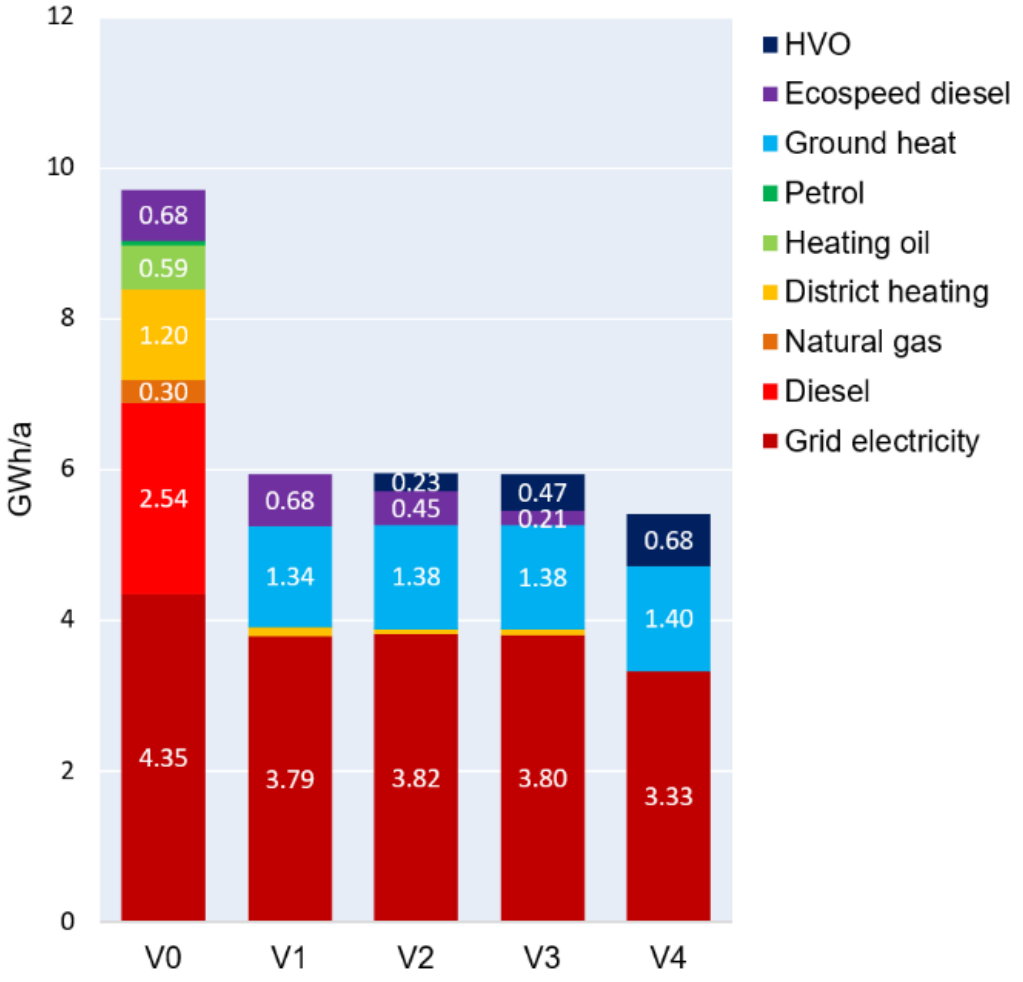
# Optimised Installed Capacities and Energy Use



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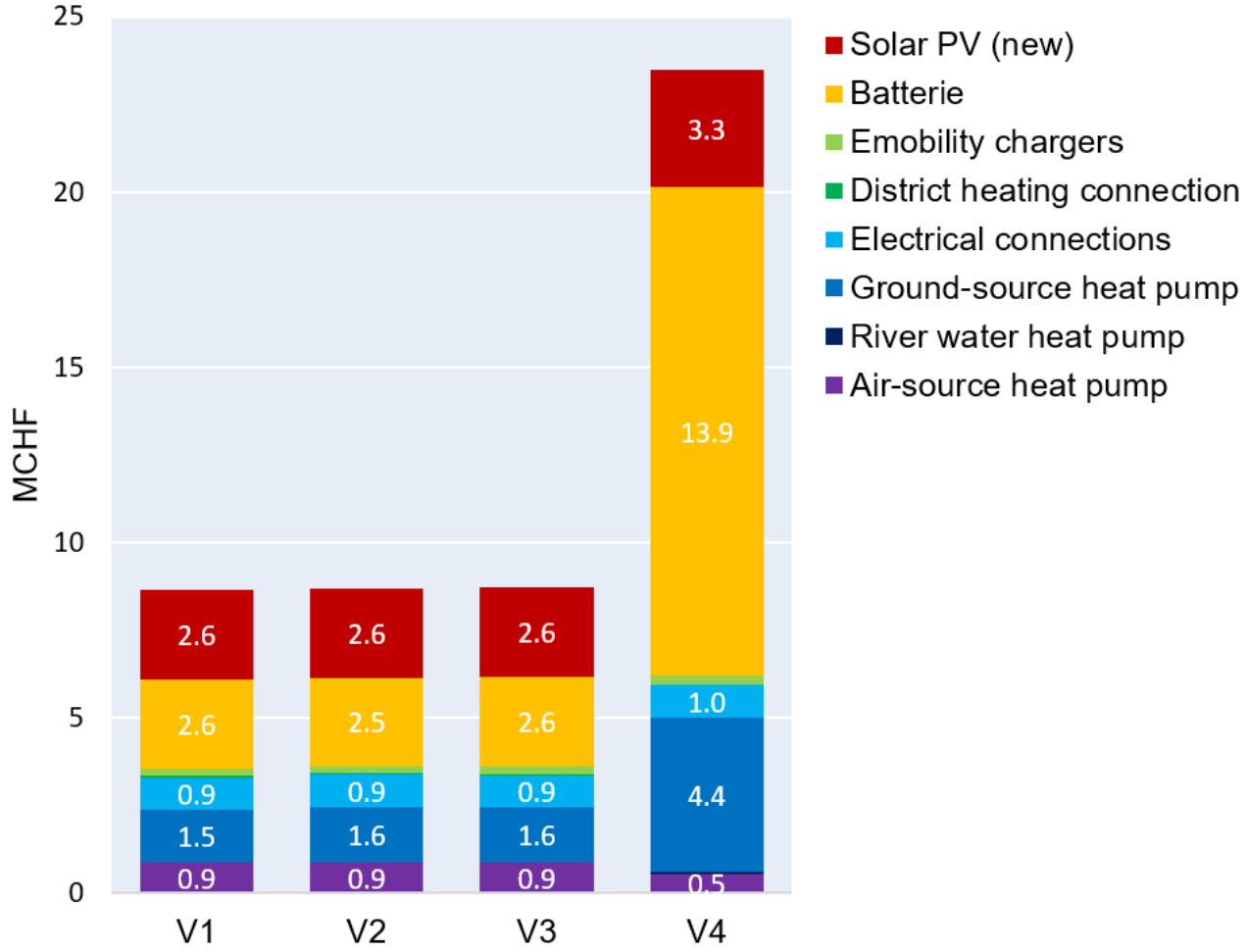
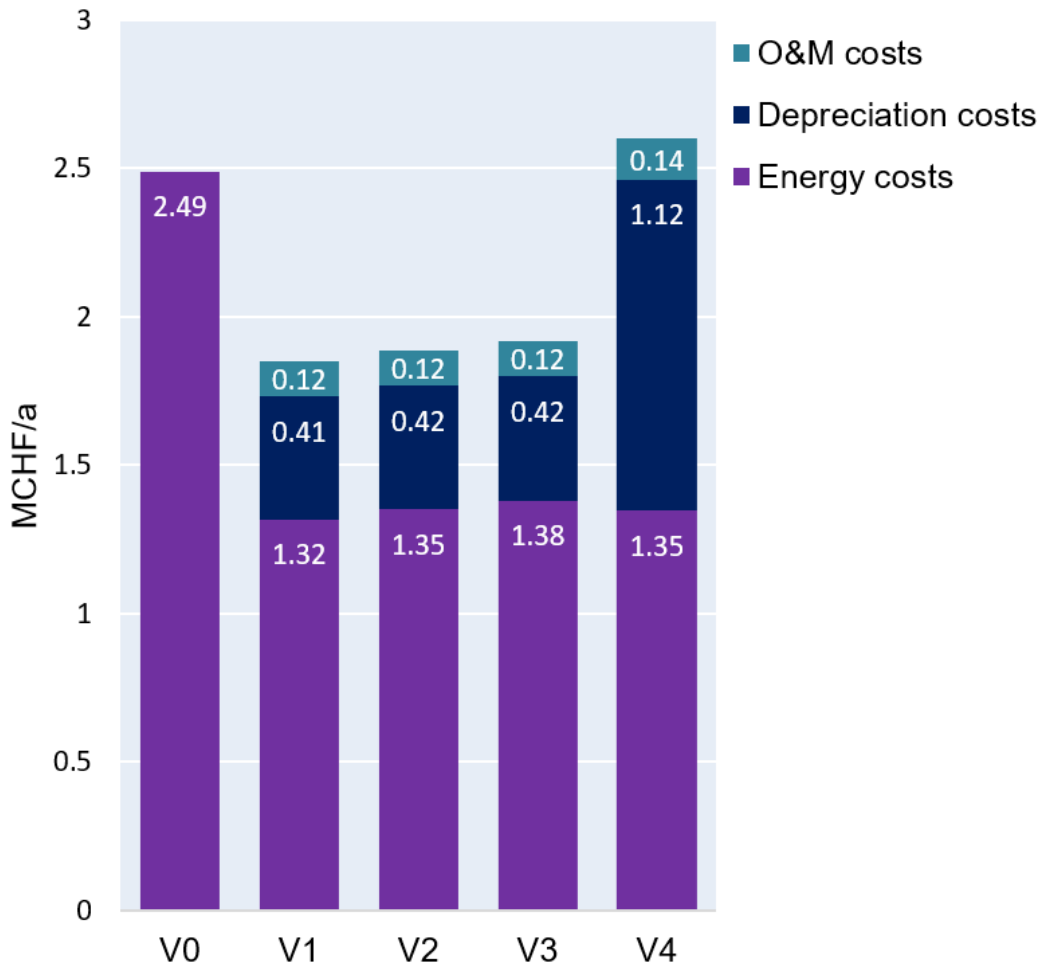
# Technology Investment Costs and Total Annual Costs



# Conclusions and Outlook

IES were used to demonstrate pathways for transforming a complex, multi-stakeholder industrial port area towards climate neutrality…

… while maintaining economic viability…

… and considering energy resilience of the perimeter.

Improvements of modelling, e.g. inclusion of heat storage

High upfront investments are needed, but life cycle costs are lower than «continue as before»

Concept for investments and operation under development

**Please read our Conference Paper for more information.**

# Thank You!

elimar.frank@ost.ch

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# System Transformation (IES)