



Seventh International Transport Energy Modeling (iTEM) Workshop  
September 17-18, 2024  
United Nations Economic Commission for Europe  
Geneva, Switzerland



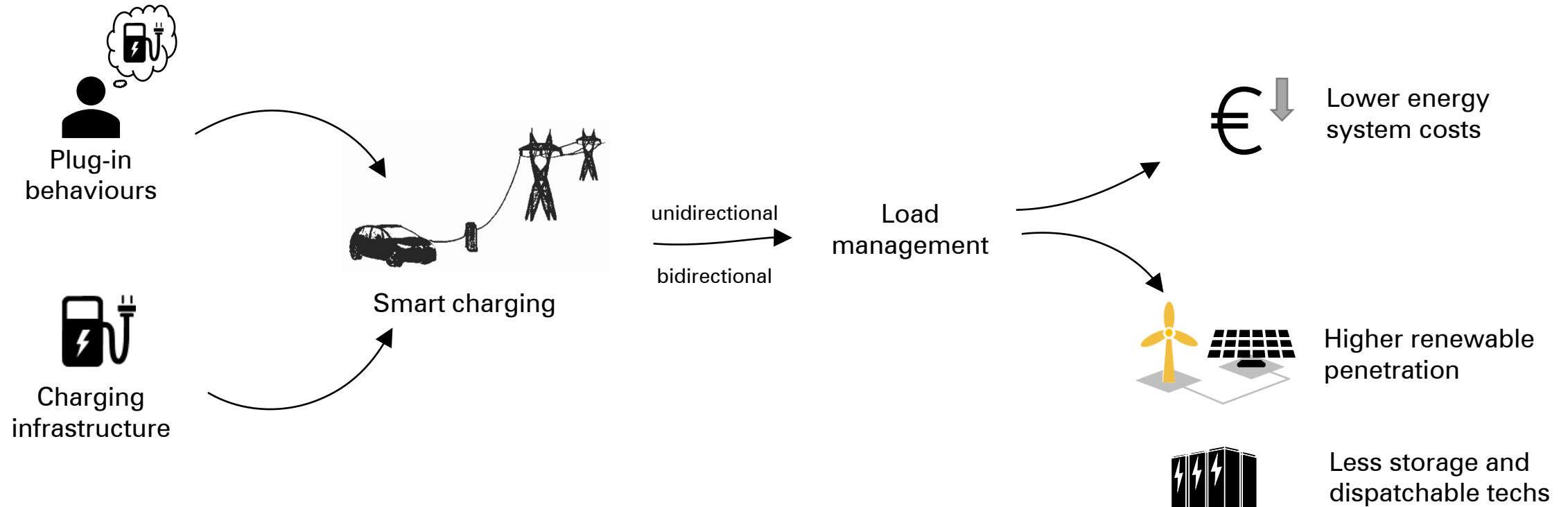
# Is V2G a game changer in defossilising future energy systems?



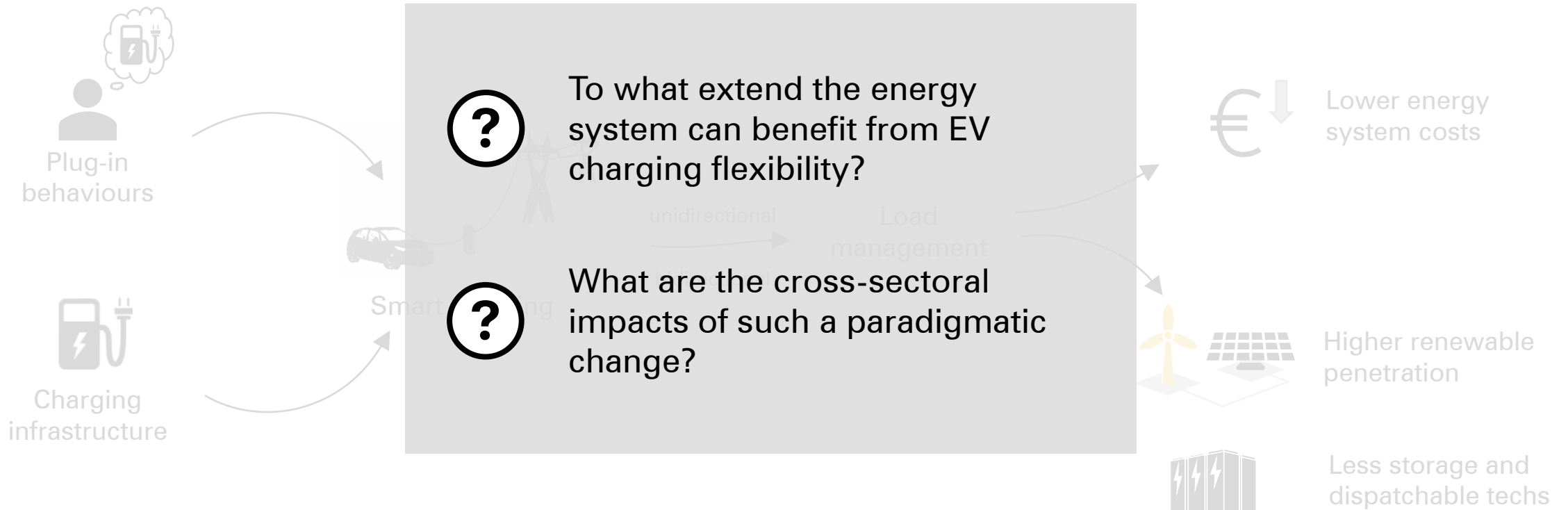
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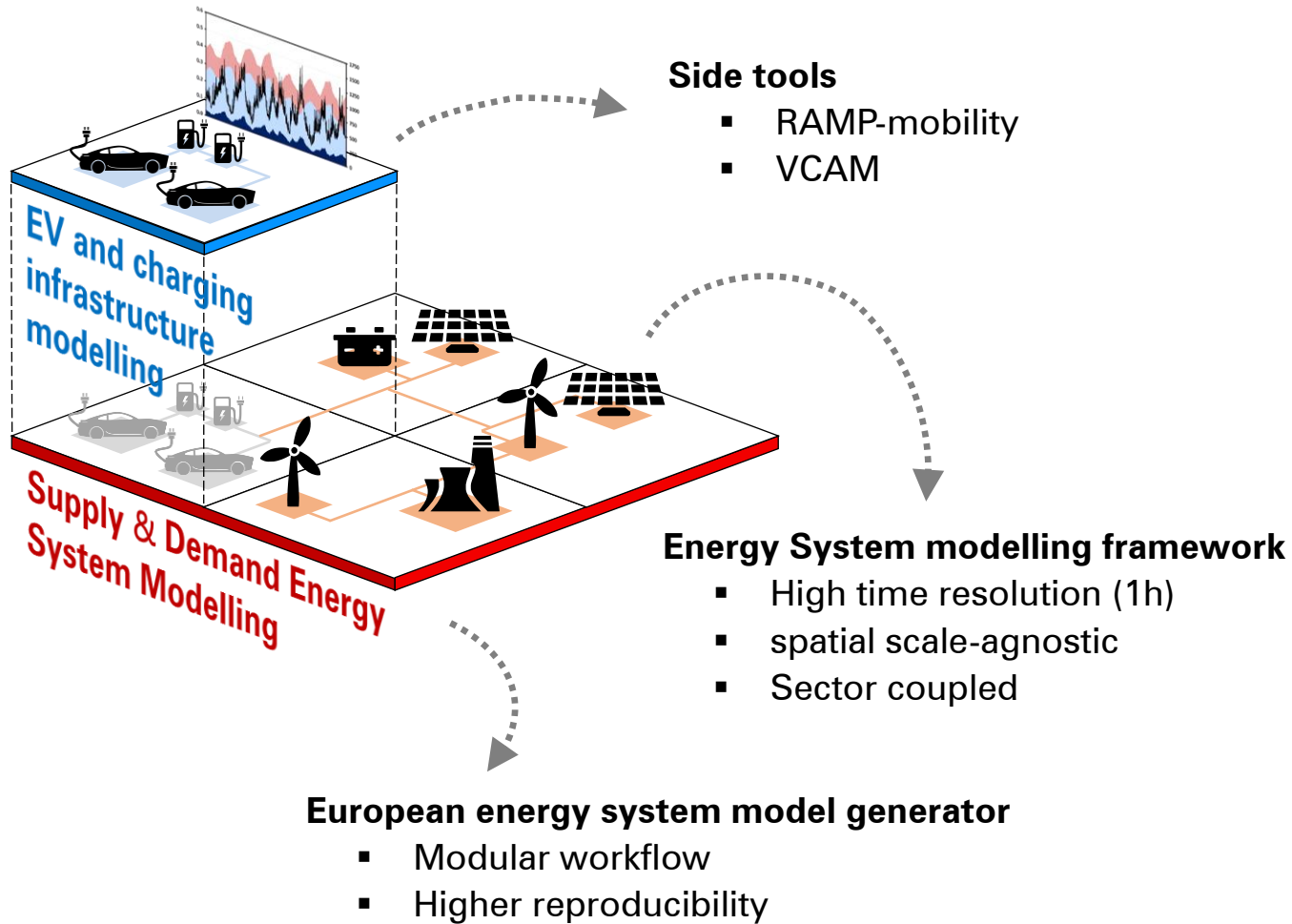
# From charging behaviours to energy system planning



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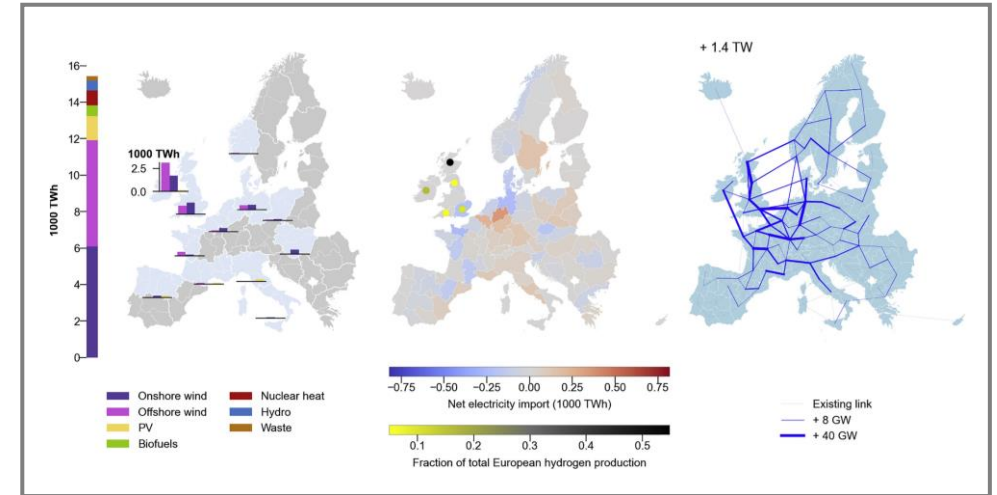
# Modelling Energy and Transport



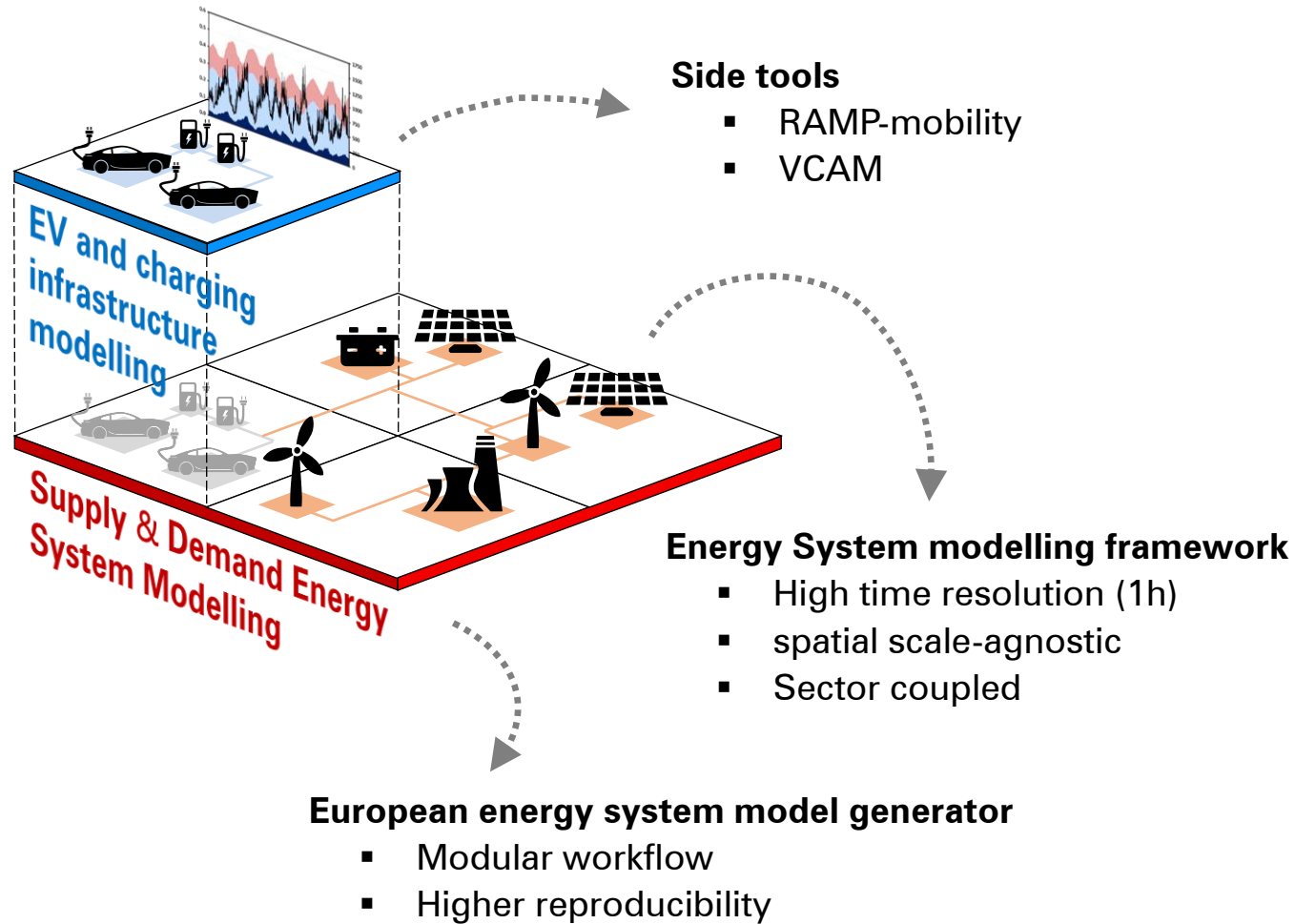
<https://github.com/calliope-project>

<https://github.com/RAMP-project>

Results example



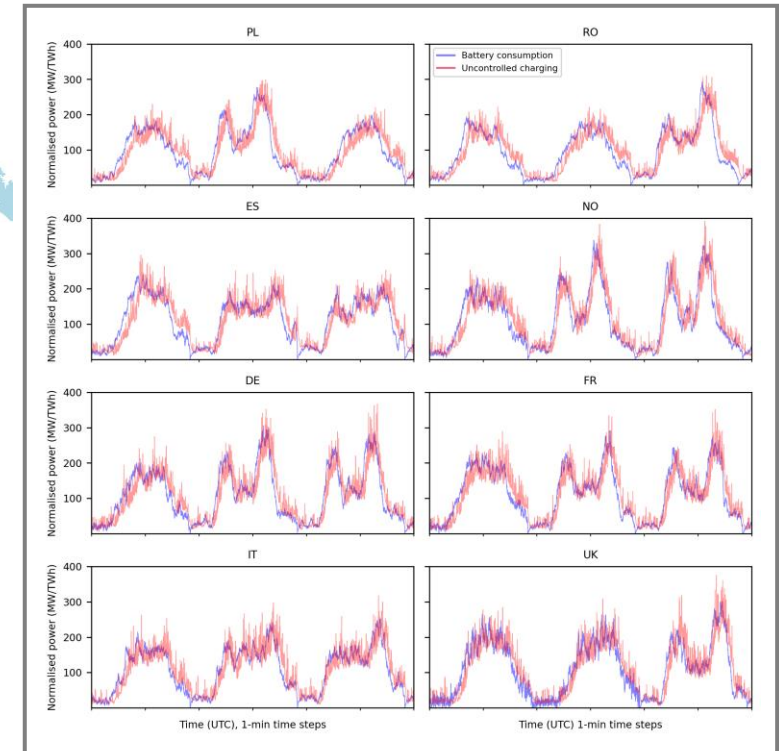
# Modelling Energy and Transport



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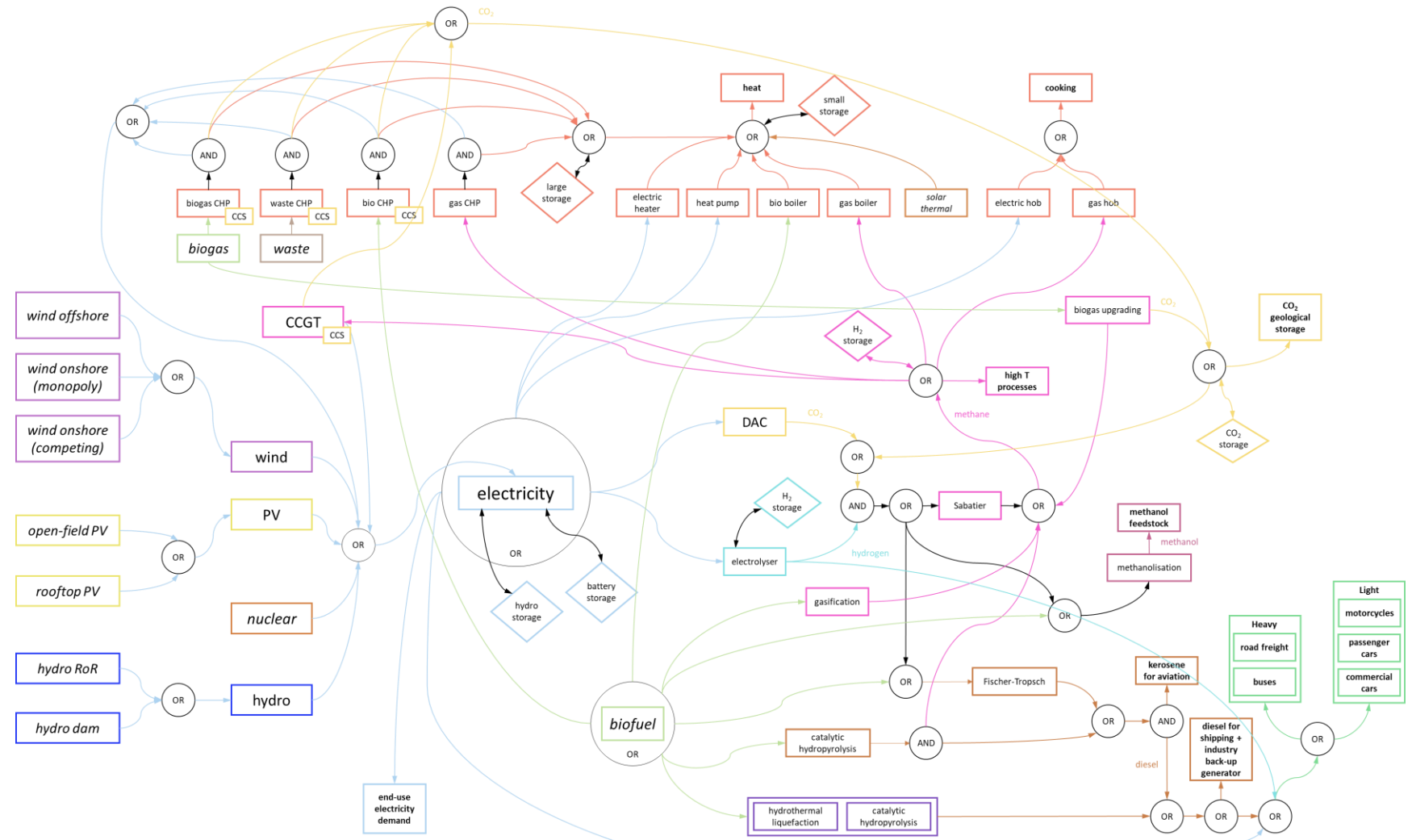
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Results example



# The European case study

- ⚠ Nodal resolution (35 countries)
- ⚠ 1-h temporal resolution
- ⚠ No distribution grid
- ⚠ Green field approach (2050)





# How is the EV charging scheduled?

## Model settings:

- 1h resolution model
- 1 node per country

## Scenarios:

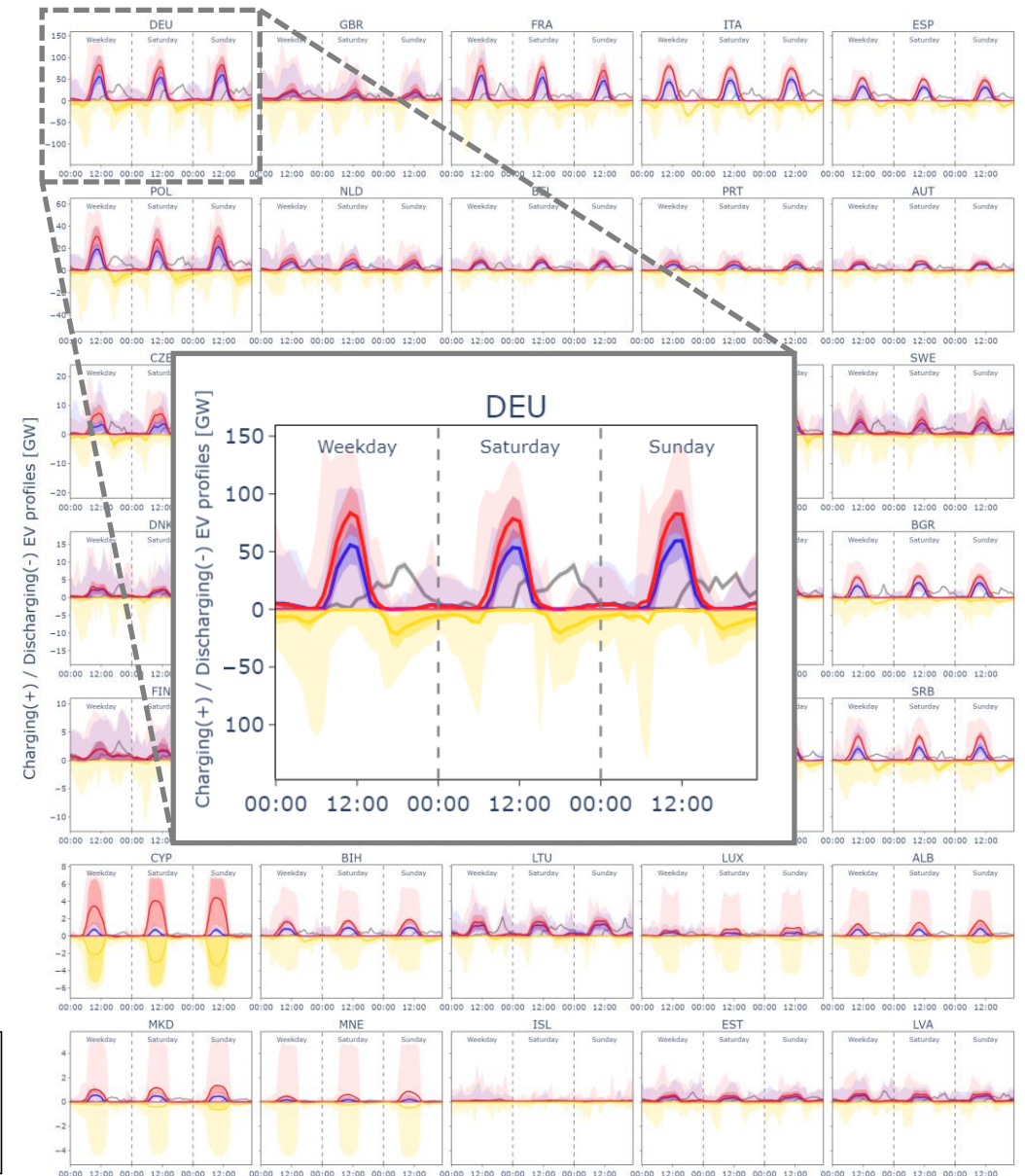
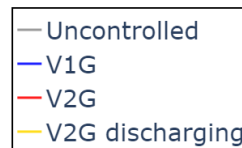
- EV flexibility:
  - ① fixed\_charge
  - ② uncontrolled
  - ③ V1G
  - ④ V2G
- Charging cost:
  - ① base
  - ② low
  - ③ high
  - ④ zero
- Grid expansion:
  - ① Dynamic
  - ② eHighways 2030



EV flexibility goes along with the Sun (aka PV panels).



By how much does the EV demand shift?



# To what extent is the EV charging load shifted?



When charging infrastructure costs are considered, V2G is not selected ( $cost_{V1G} < cost_{V2G}$ ).



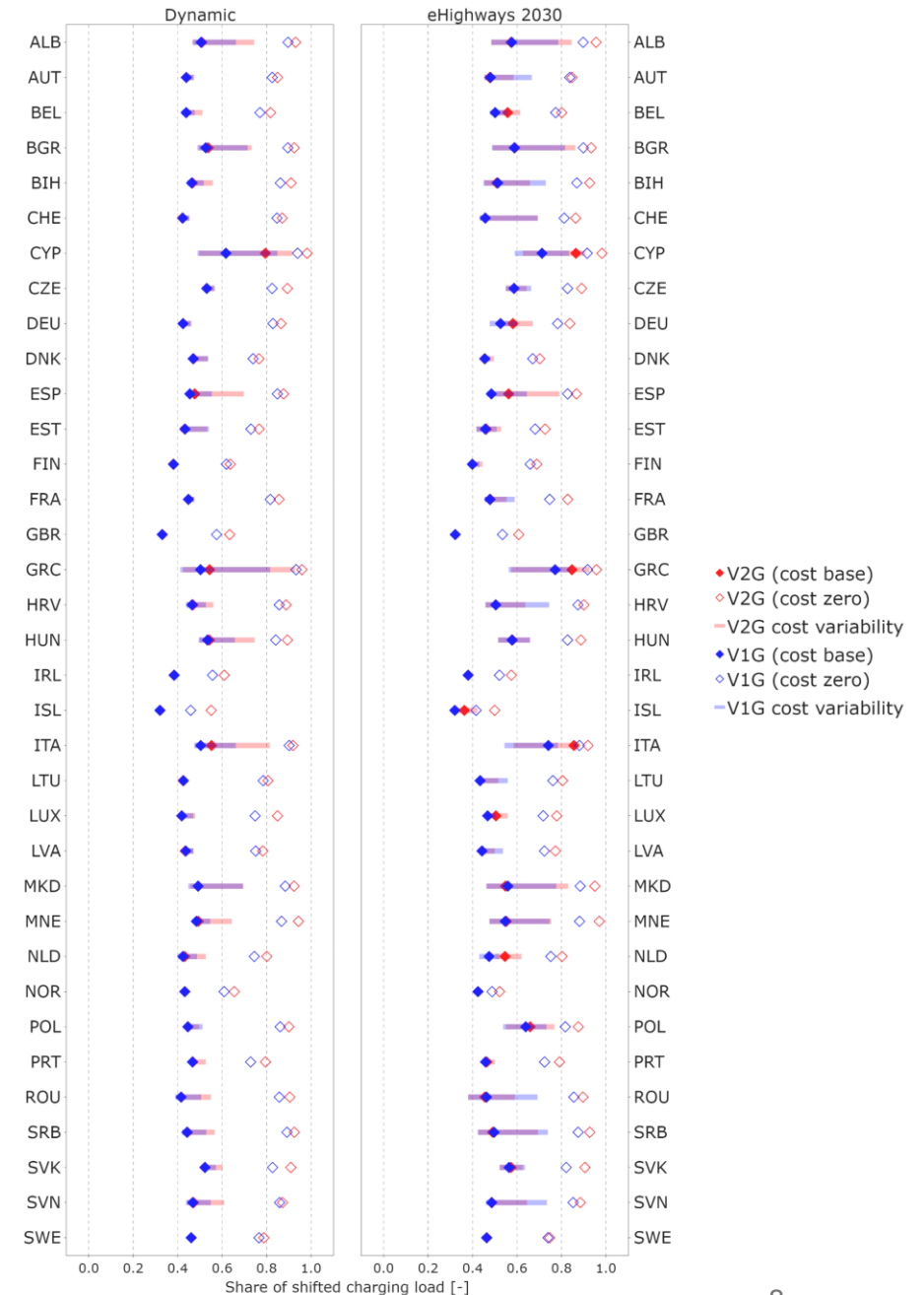
V1G is responsible for a >40% shift of the charging demand.



V2G brings about more substantial benefits in some countries compared to others.



What is the impact on electricity supply?





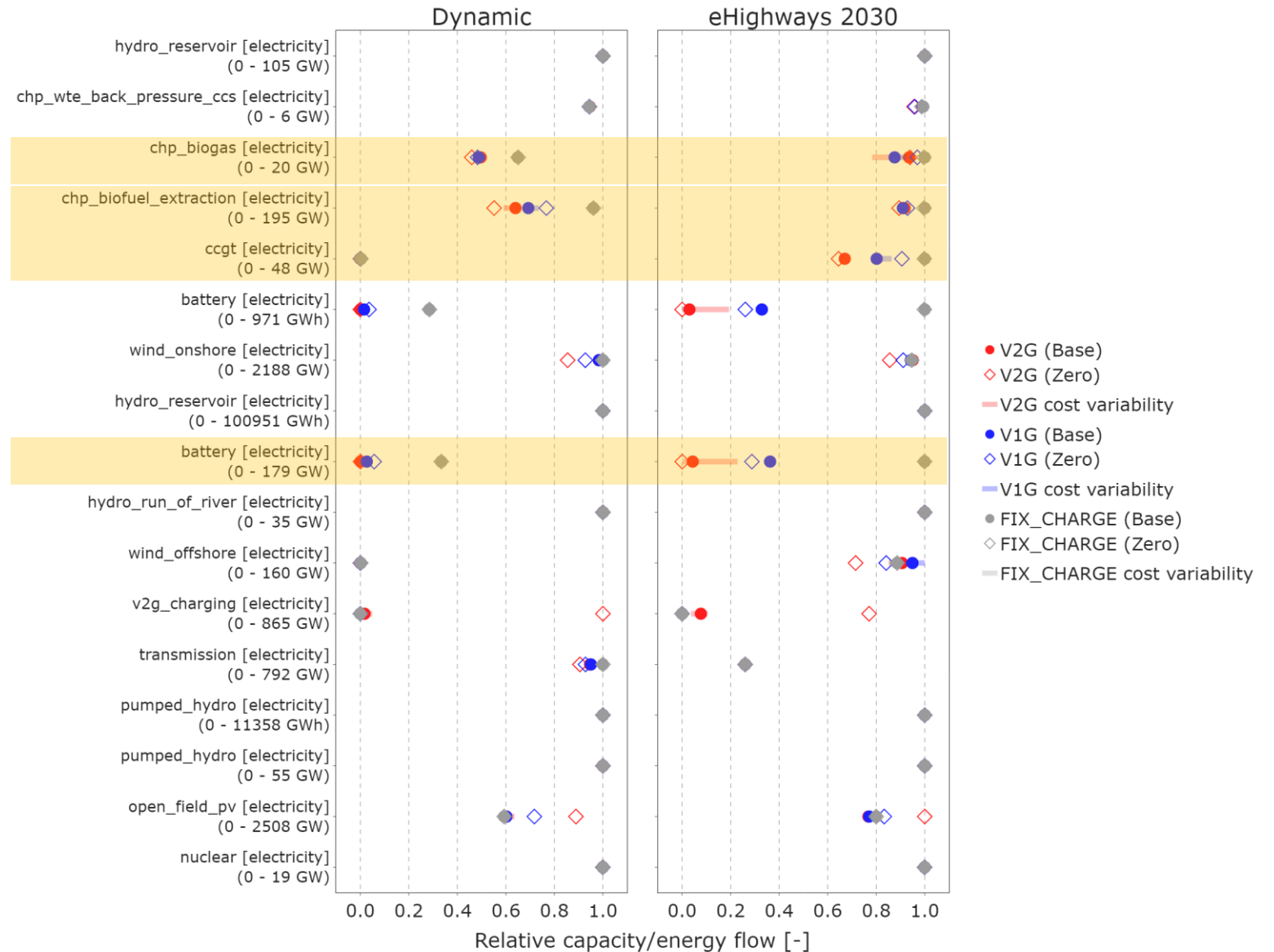
# What happens to the power sector?



When grid expansion is limited, V2G starts playing a crucial role for the power sector



What is the impact on the other sectors?



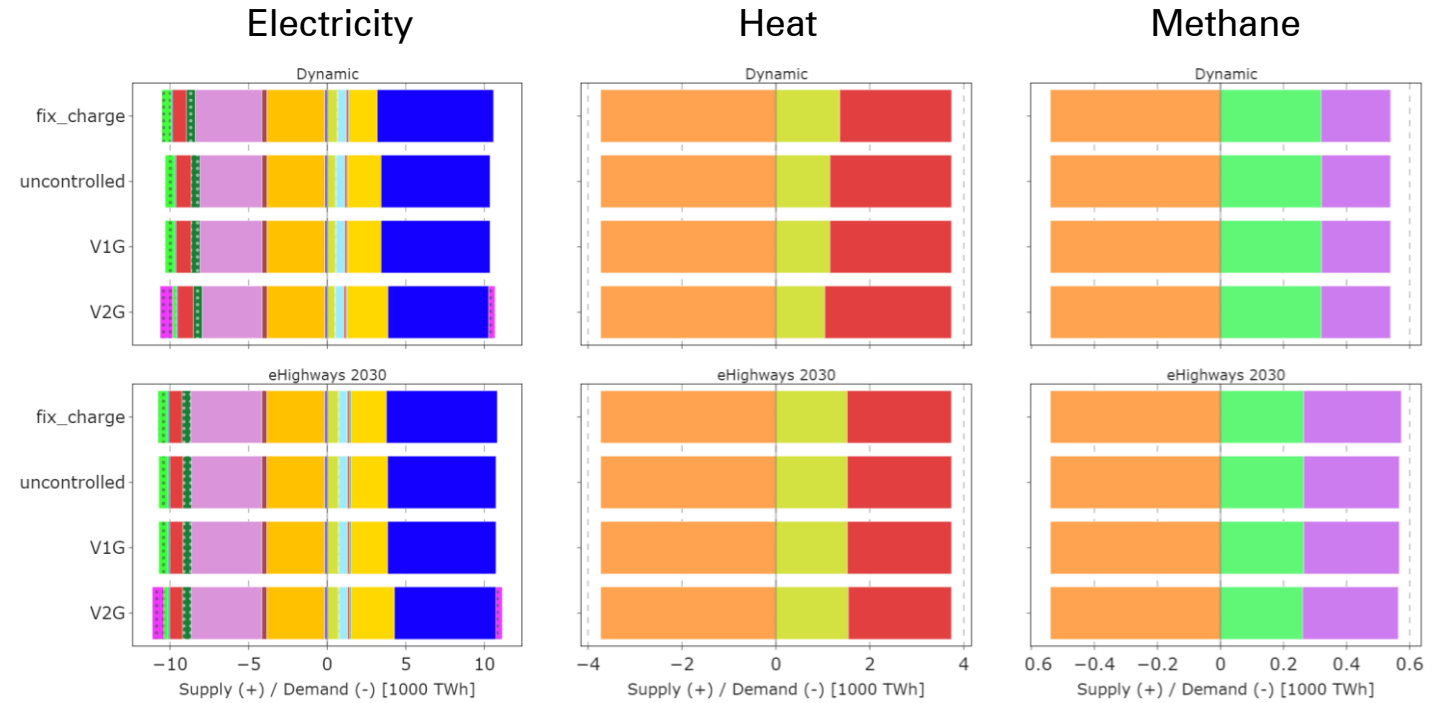
# What happens to the other sectors?



**Electricity sector: V2G boosts PV penetration. Less dispatchable power units such as CHPs.**



**Heat sector: HP penetration increases due to a reduction of CHP heat and power production.**



- | Demand         | Supply         |
|----------------|----------------|
| ■ dac          | ■ chp          |
| ■ demand elec  | ■ chp wte ccs  |
| ■ electric hob | ■ hydro        |
| ■ electrolysis | ■ nuclear      |
| ■ ev charging  | ■ pumped hydro |
| ■ heat pump    | ■ pv           |
| ■ pumped hydro | ■ wind         |
| ■ v1g charging | ■ v2g charging |
| ■ v2g charging |                |

- | Demand        |
|---------------|
| ■ demand heat |
- | Supply      |
|-------------|
| ■ chp       |
| ■ heat pump |

- | Demand           |
|------------------|
| ■ demand methane |
- | Supply                |
|-----------------------|
| ■ biogas upgrading    |
| ■ hydrogen to methane |

# What happens to the other sectors?



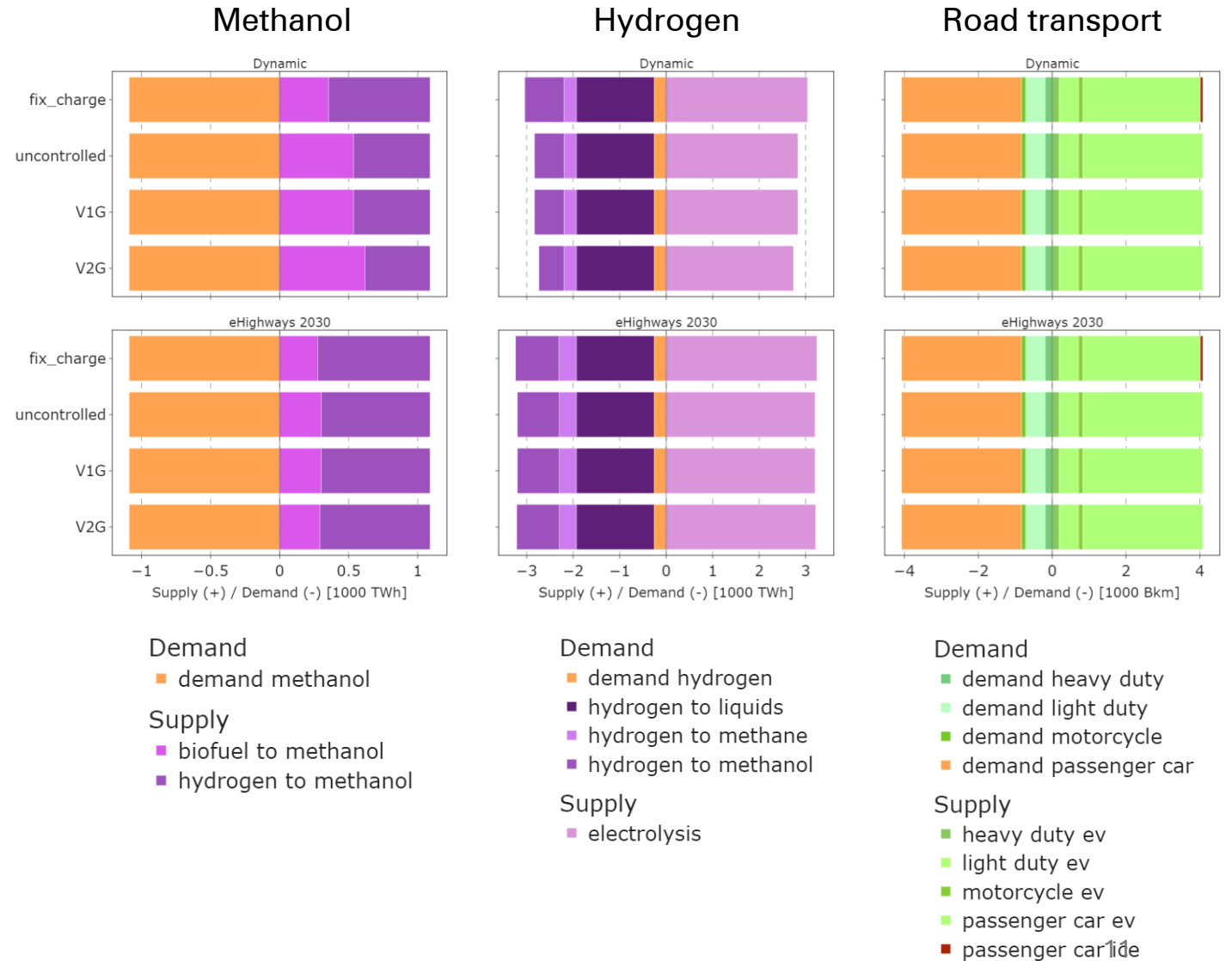
The biofuel (saved from CHPs) is used for producing methanol.



From an energy perspective, electric vehicles are more cost-optimal than all the other options (hydrogen, syn-diesel).



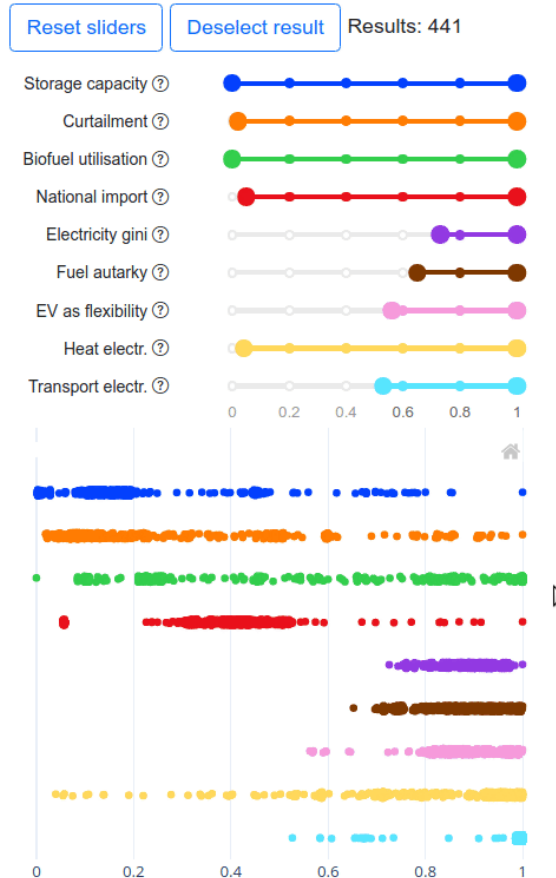
Bio-based methanol is cheaper than H<sub>2</sub>-based one. Will a lower cost drive more consumption in other applications?



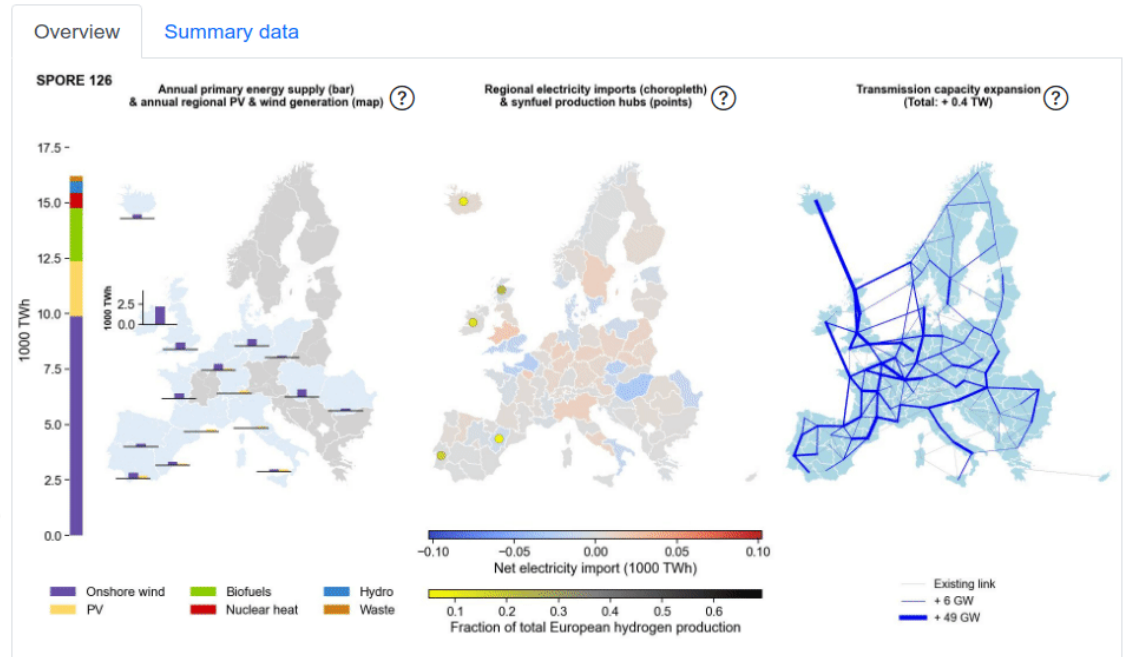
# Energy and Transport: Crossed destinies

*Pickering et al. (2022). Diversity of options to eliminate fossil fuels and reach carbon neutrality across the entire European energy system*

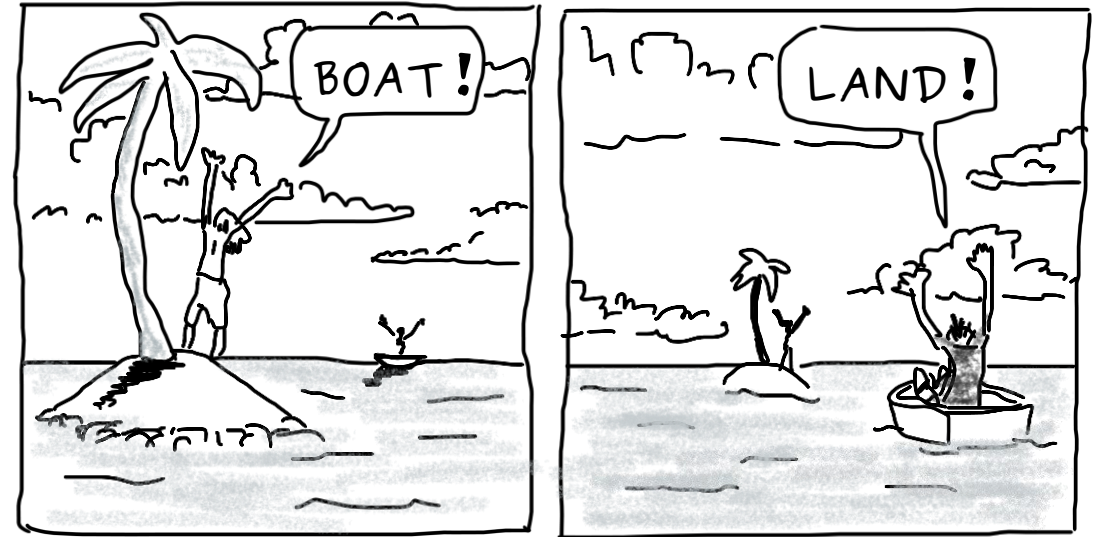
Explore results yourself:  
<https://explore.callio.pe/>



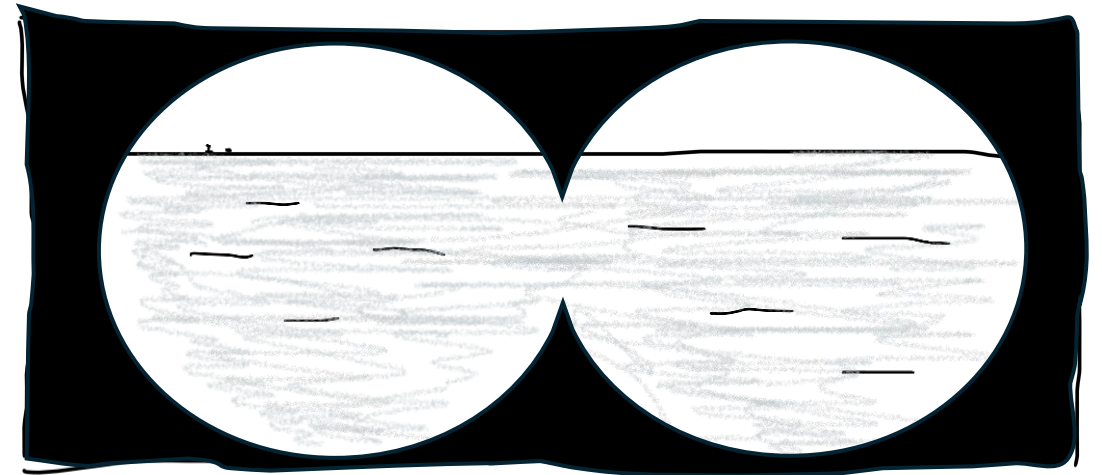
▶ Click here to show help



Perspectives  
matter...



...but a system  
view is crucial





# Q&A



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