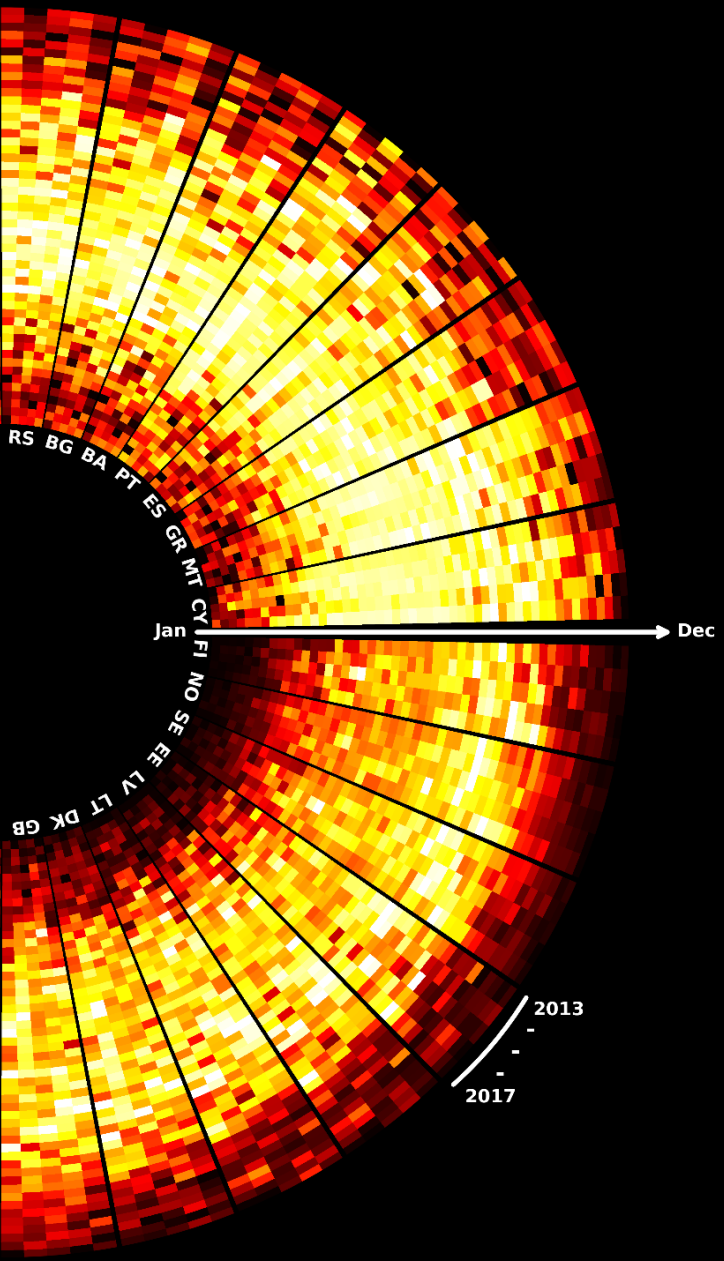


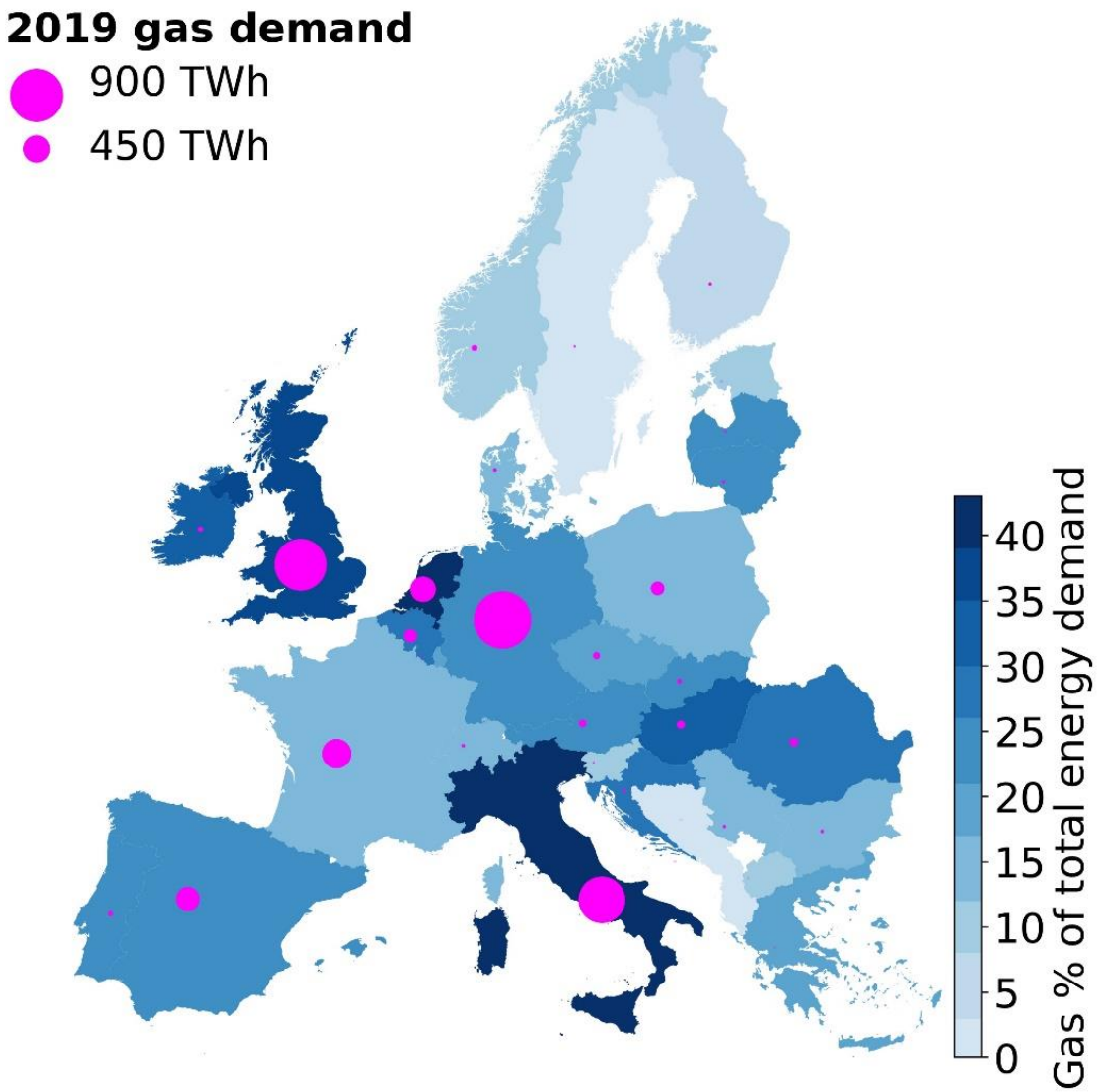
Which Handles do we need to Tweak to Speed up the Green Transition in Europe?

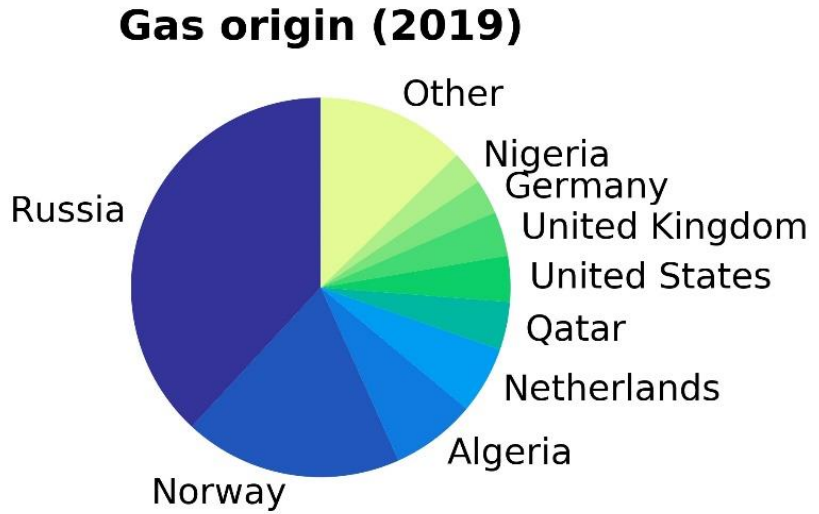
Marta Victoria

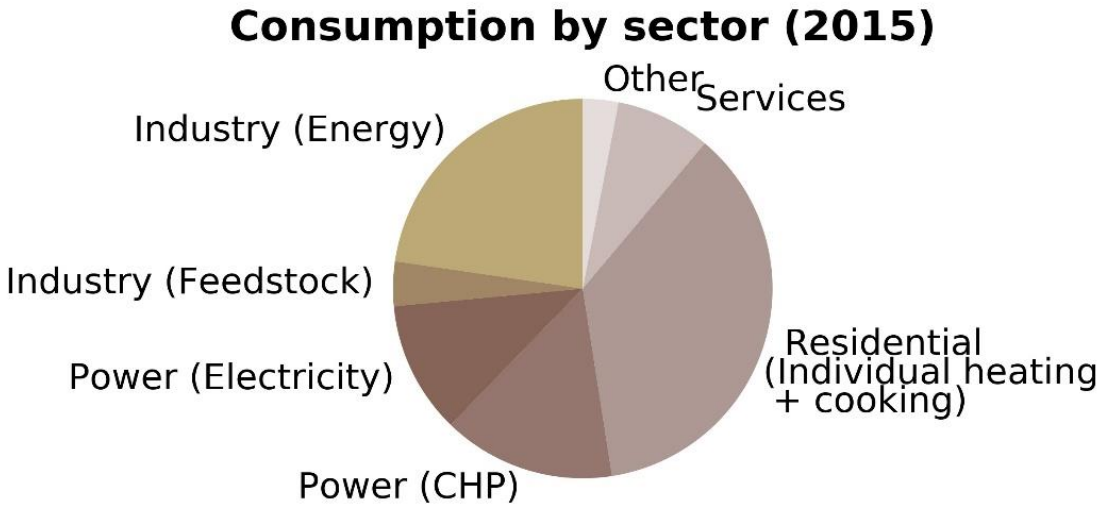
CORC
Novo Nordisk Foundation
CO_2 Research Center

AARHUS
UNIVERSITY

Where and how do we use gas in Europe?







Our research

CellPress

Joule

Report

Long-term implications of reduced gas imports on the decarbonization of the European energy system

Tim Tørnes Pedersen,[1,2,4,5,*] Ebbe Kyhl Gøtske,[1,2,4,*] Adam Dvorak,[1,*] Gorm Bruun Andresen,[1,2,*] and Marta Victoria[1,2,3,*]

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- 1.5°C path quickly relieves Europe's dependency on imported gas
- Massive ramp-up for wind and solar PV capacities required for 1.5°C
- Limiting gas requires ramping-up heat pumps faster
- Biogas potential fully utilized

Our research approach

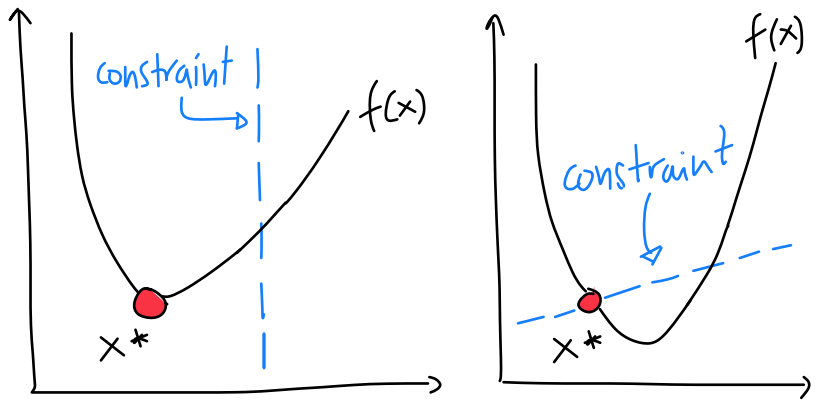
We look for cost-optimal system designs and define constraints to represent real physical limitations

$$\min \left(\sum_{n,s} \underset{costs}{generation} + \underset{costs}{storage} + \underset{costs}{transmission} + \sum_{n,s,t} \underset{costs}{variable} \right)$$

$$subject\ to:$$

$$\sum_{s} generation_{s,t,n} + balance_{t,n} = demand_{t,n} \quad \leftrightarrow \quad \lambda_{t,n} \qquad \forall t, n$$

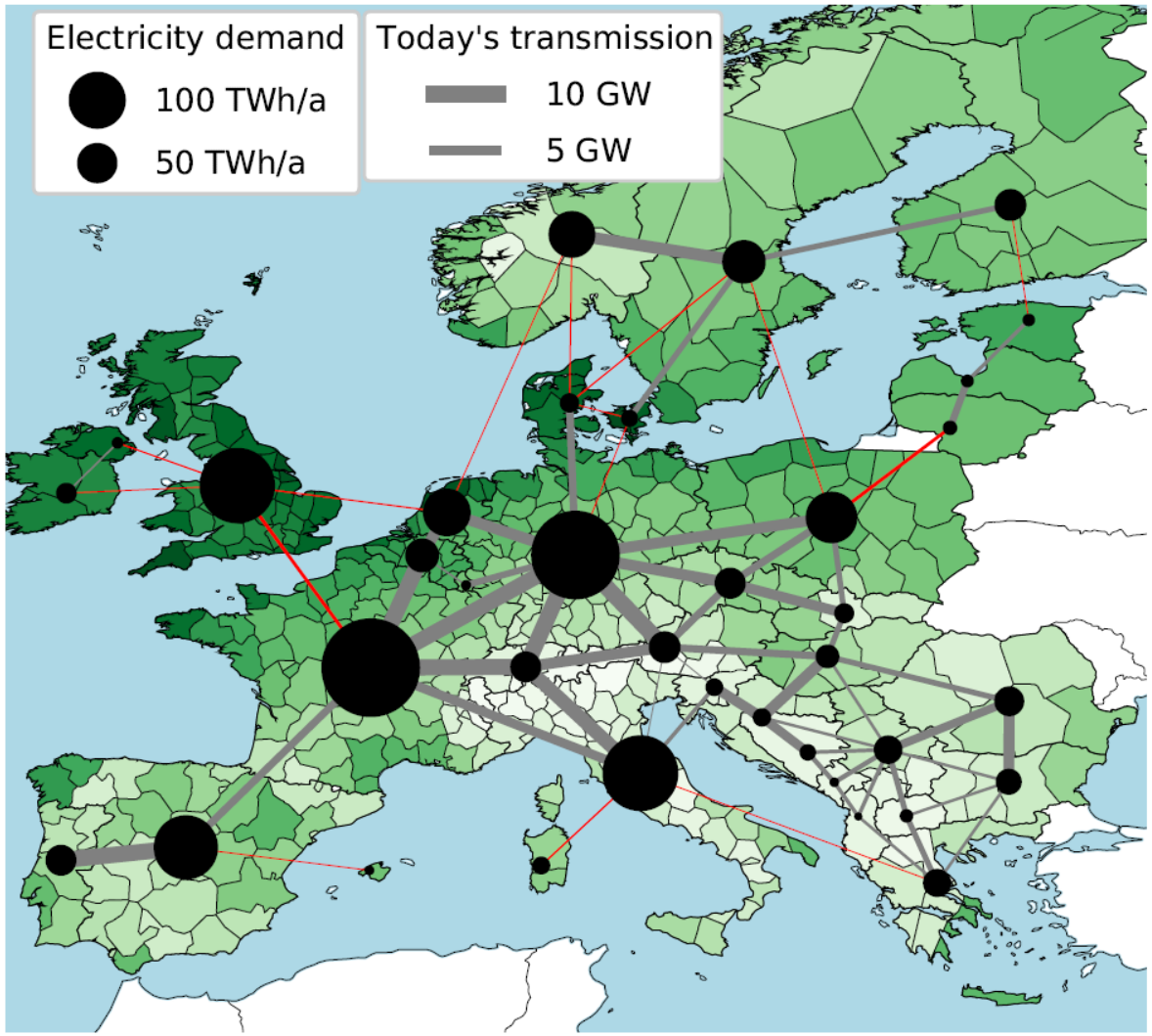
$$\sum_{s,t} CO_2\ emissions \leq CO_2\ limit \quad \leftrightarrow \quad \mu_{CO2}$$

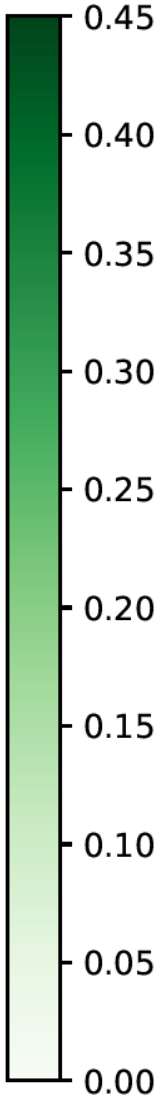


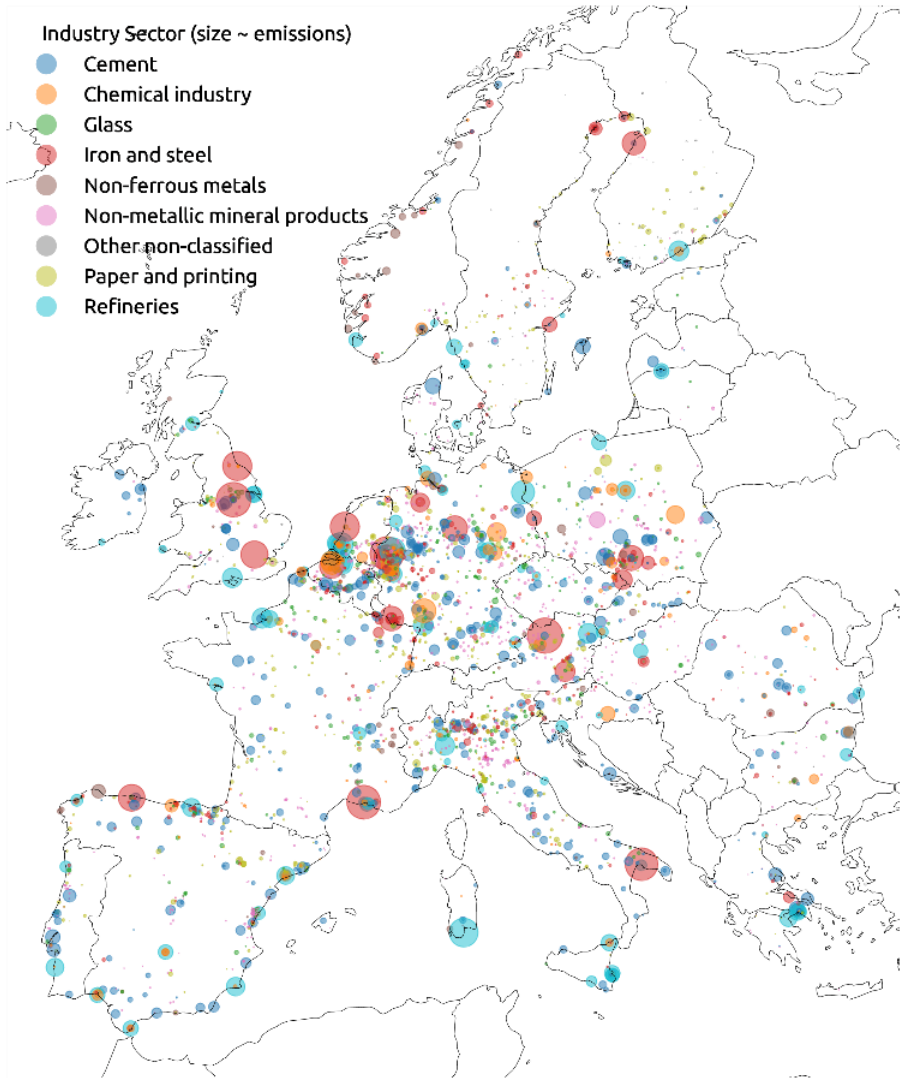
Cost and technology parameter assumptions for the DEA Technology Data catalogue

Open networked sector-coupled model of the European energy system

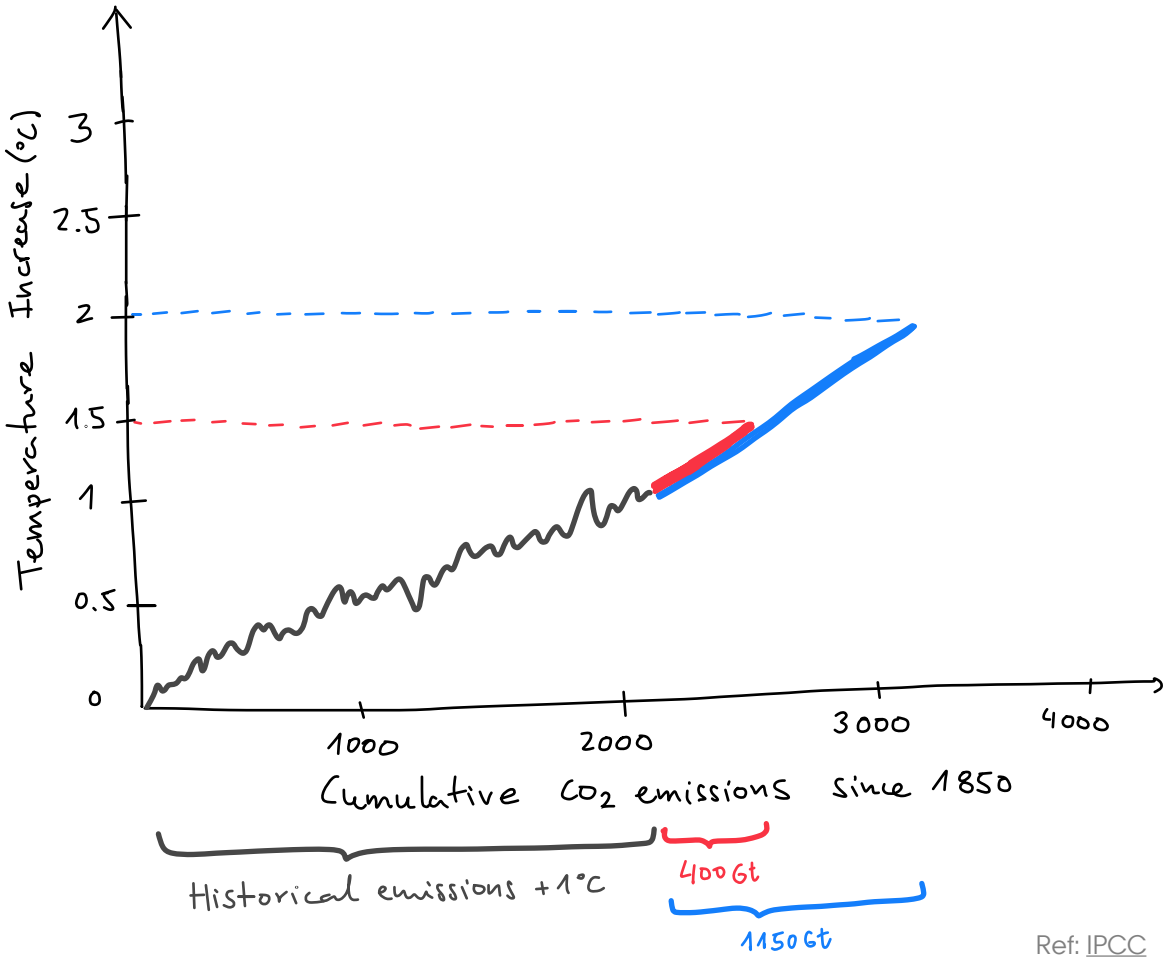
Sector-coupling: Electricity, Heating, Transport, Industry and feedstock, carbon cycle





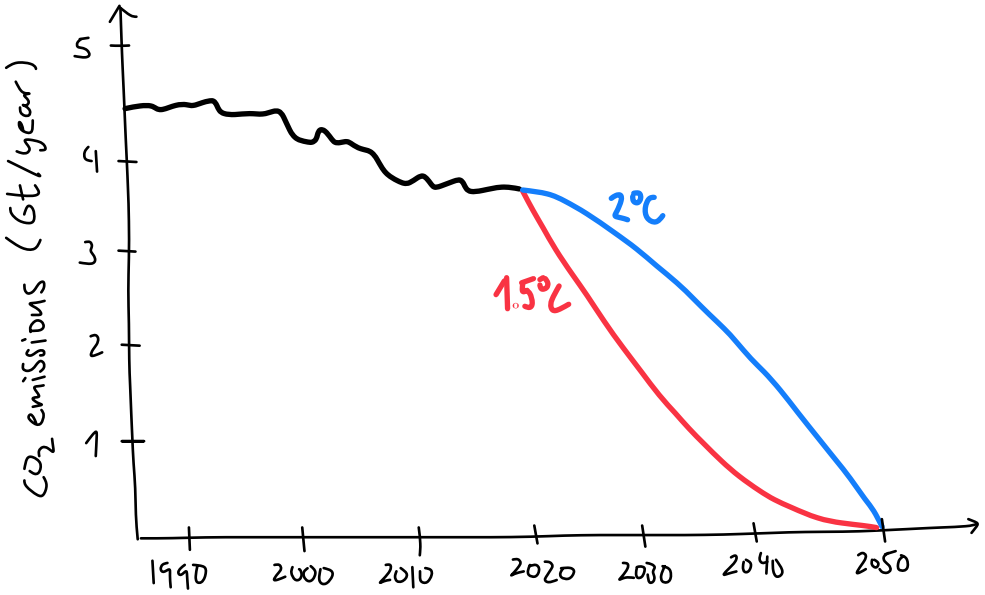


There is a linear relationship between cumulative CO_2 emissions and temperature increase.
We have a limited carbon budget.

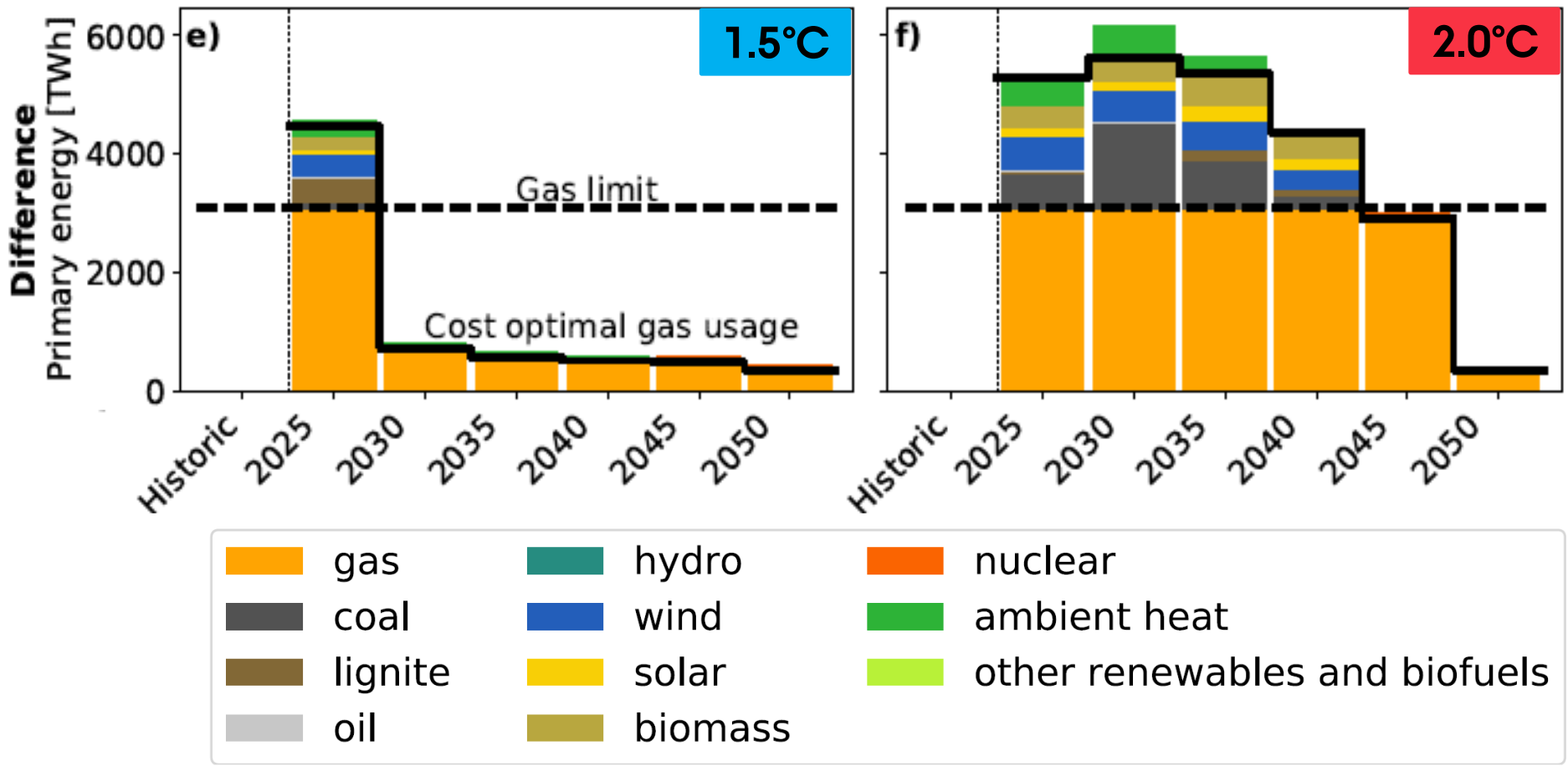


Ref: IPCC

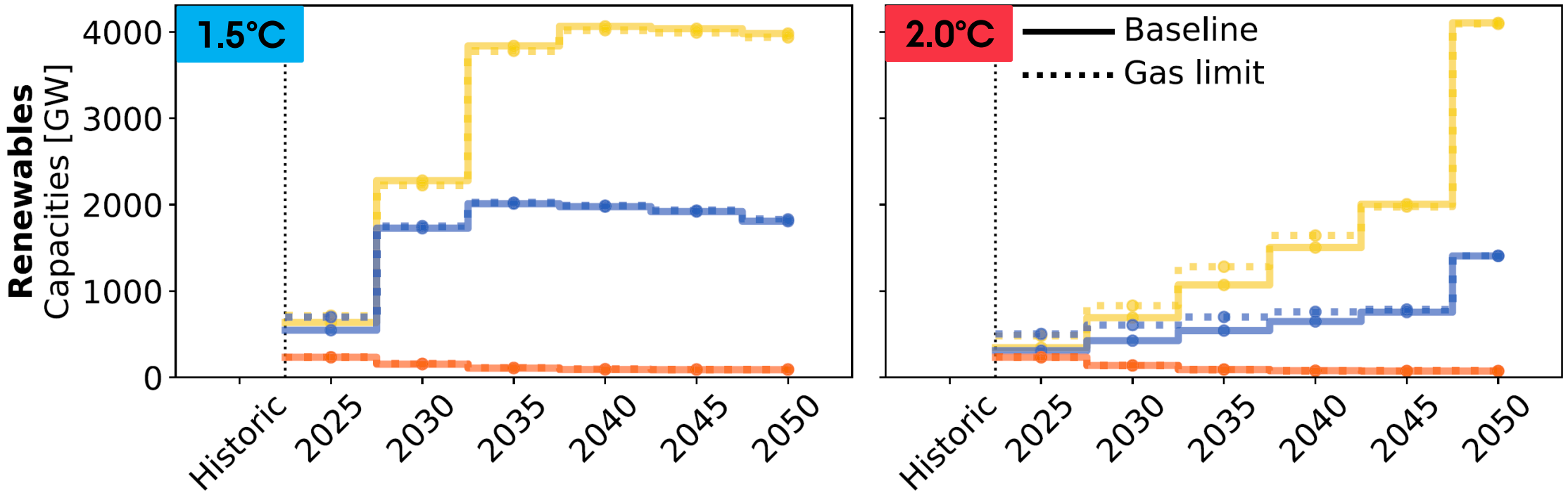
What are the consequences of using 1.5°C or 2°C budgets in Europe?
Impacts of limiting the use of gas (remove gas imported from Russia) ?



1.5°C path quickly relieves Europe's dependency on imported gas



Massive ramp-up for wind and solar PV capacities required for 1.5°C

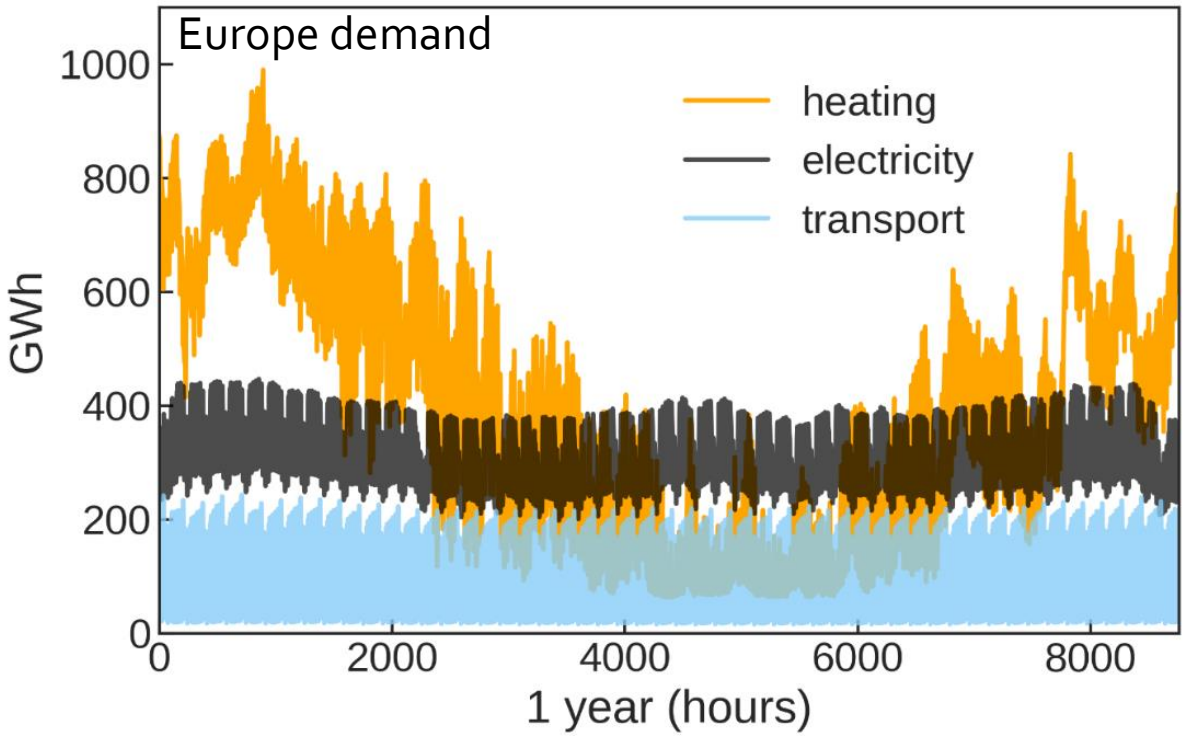


+ 500 GW/year wind and solar capacities

Limiting gas requires ramping-up heat pumps faster

Massive deployment of heat pumps needed

REPowerEU targets 10 million heat pumps by 2025 (our model shows 20 million)



Biogas potential fully utilized

- The potential assumed for biogas in Europe (320 TWh/y) is fully utilized (by 2030 in the 1.5°C scenario, by 2050 in the 2°C scenario)

- A similar amount (400 TWh/y) of synthetic gas is used (by 2050 in both scenarios)

1.5°C path quickly relieves Europe's dependency on imported gas

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Biogas potential fully utilized

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