Insights from the European electricity sector transition to 2035: technologies, co-benefits, and models

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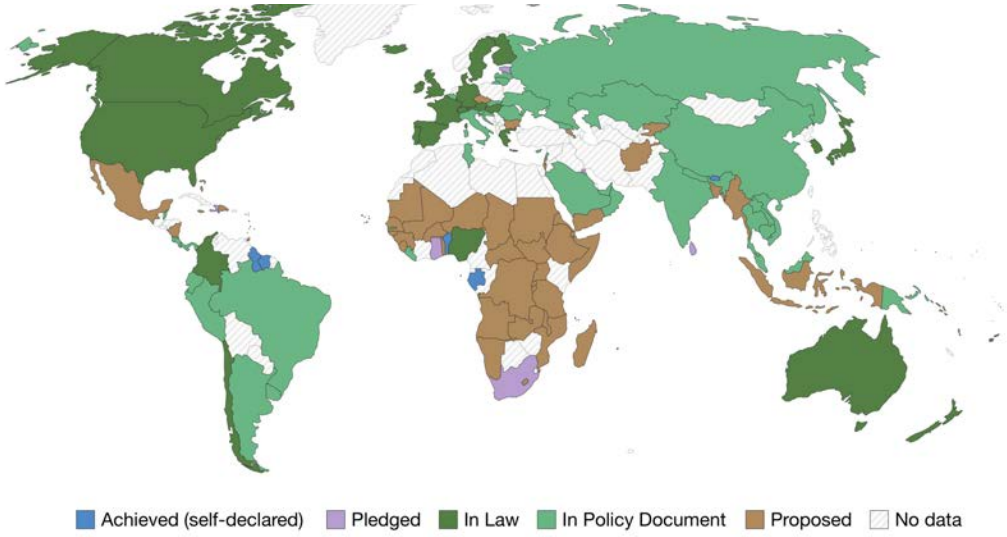
UNCTAD expert meeting

For today

- European electricity sector transition to 2035 and the parallels to other countries
- Certain, optional, and declining technologies
- Co-benefits for policies across sectors
- The need for spatially-explicit energy models

Long-term carbon neutrality

Net-zero carbon emission targets



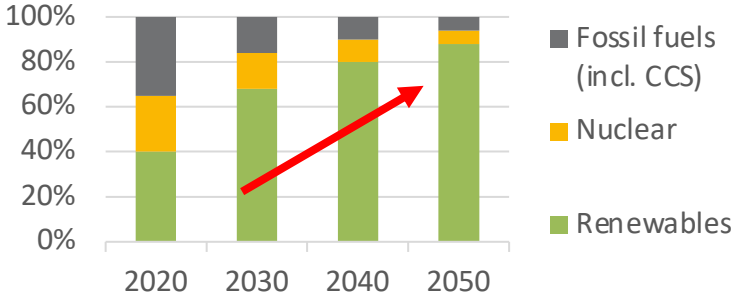
Source: Net Zero Tracker. Energy and Climate Intelligence Unit, Data-Driven EnviroLab, NewClimate Institute, Oxford Net Zero. OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY

European Green Deal

Climate-neutral

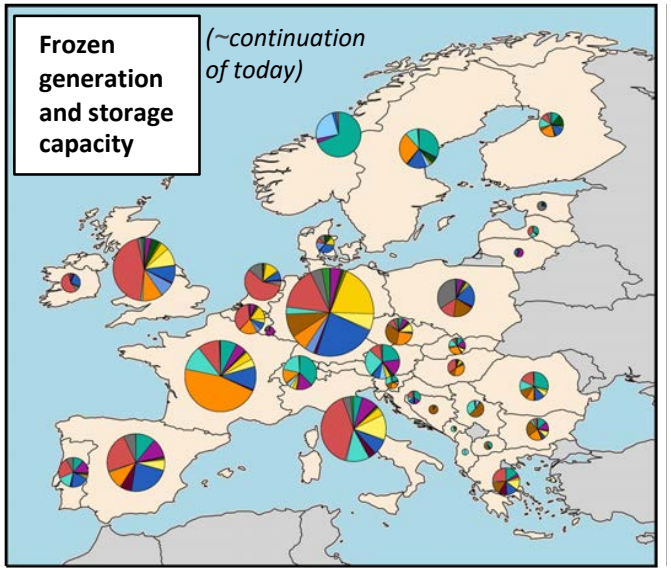
Equitable transition

Projected electricity generation (%)



Source: “Mix scenario”, European Commission (2020).

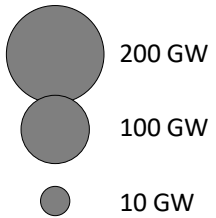
Technologies for 70% emissions reduction in electricity sector by 2035 (1)



Technologies

- Wind (onshore)
- Wind (offshore)
- Solar (roof)
- Solar (open)
- Biogas
- Woody biomass
- Waste
- Hydro dams
- Hydro run-of-river
- Small hydropower
- Geothermal
- Nuclear
- Gas
- Oil
- Hard coal
- Lignite
- Pumped hydro
- Battery
- Hydrogen

Generation capacities



Source: Sasse & Trutnevyte (2023) Nature Communications

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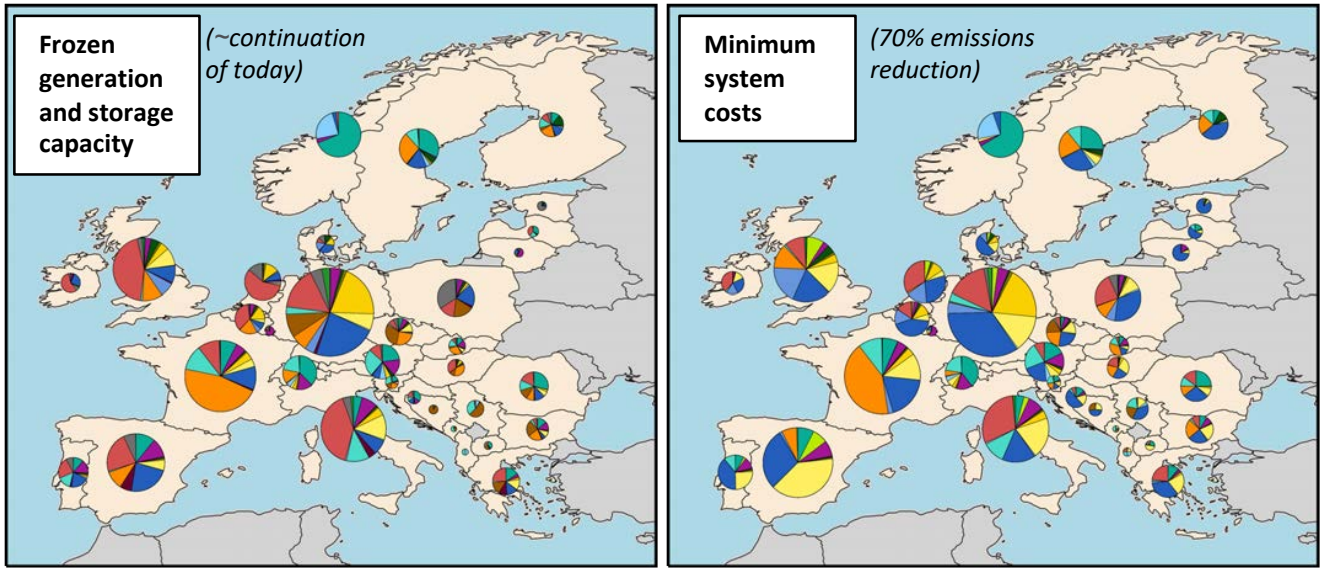

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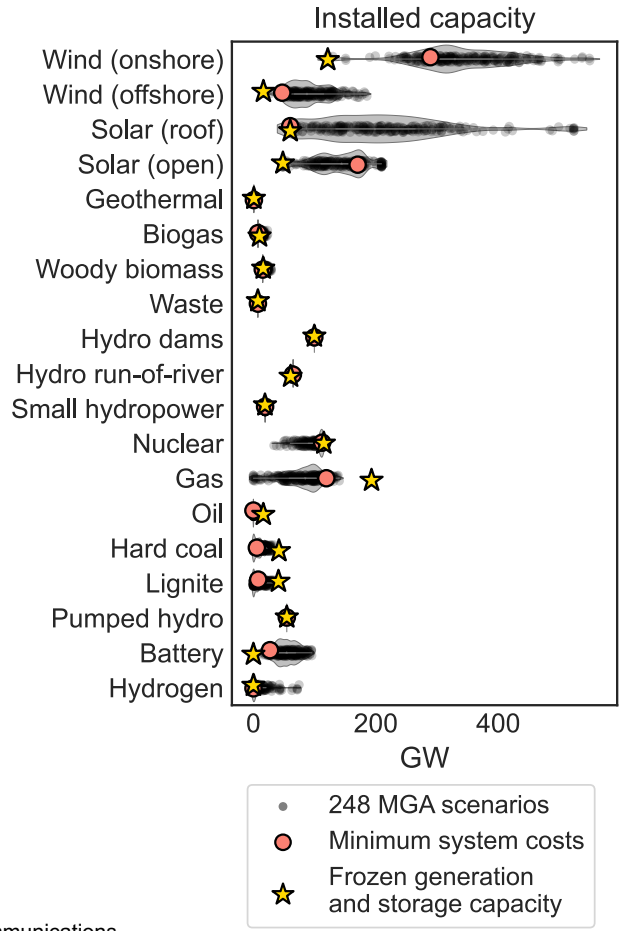
Technologies for 70% emissions reduction in electricity sector by 2035 (2)



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*MGA – Modeling to Generate Scenarios

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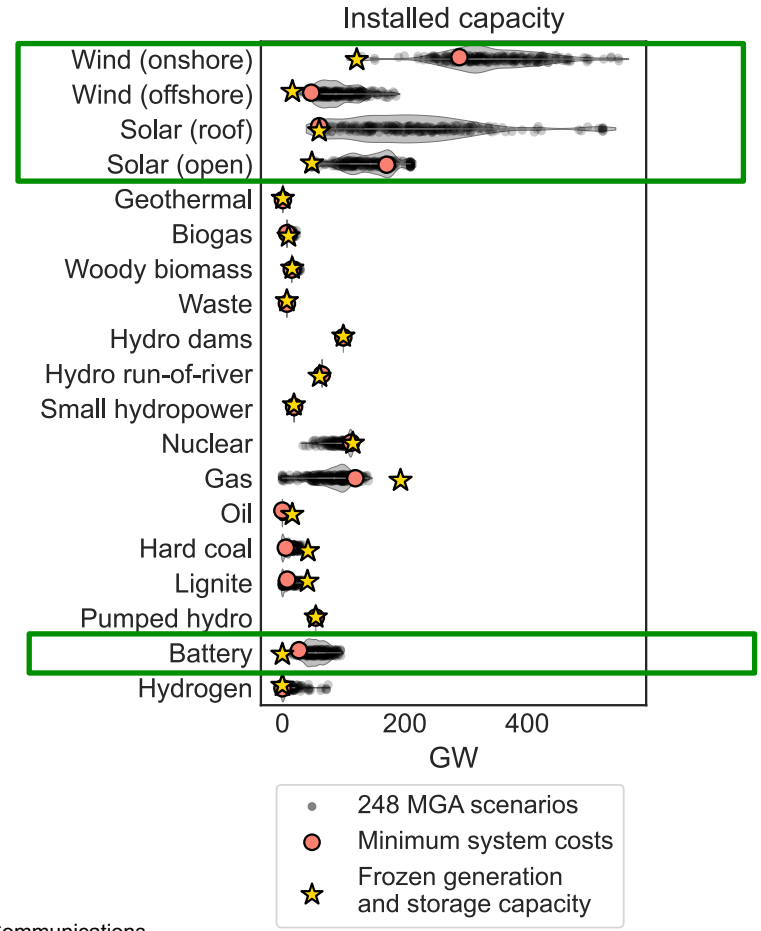

Certain technologies

Cost competitiveness, growing markets, decreasing risk, modular and hence easier projects etc.

Source: Sasse & Trutnevyte (2023) Nature Communications

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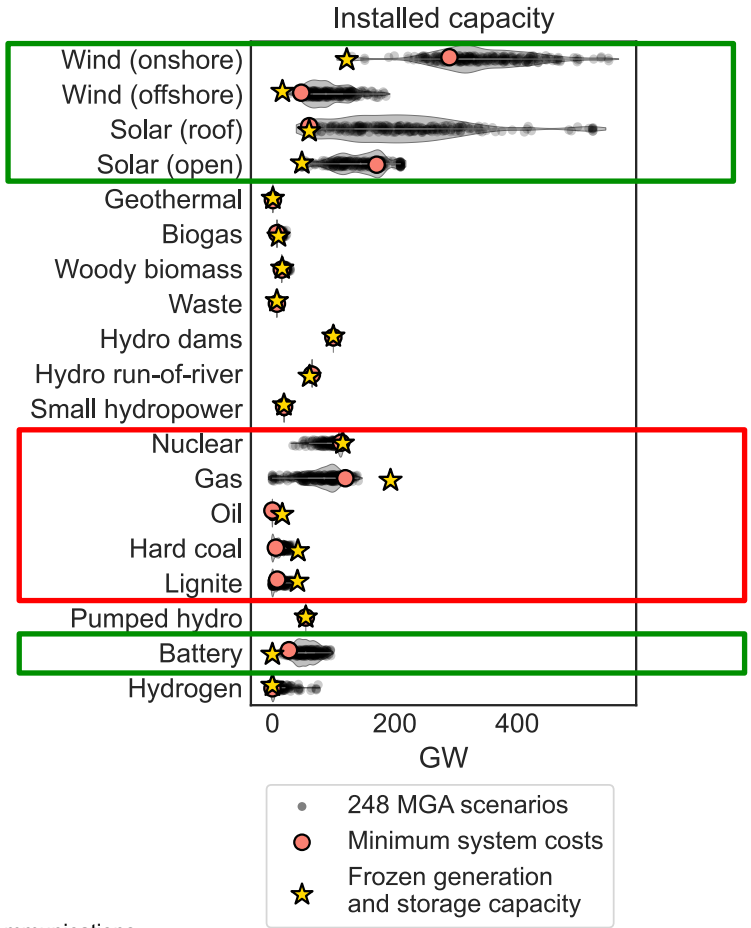

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Cost competitiveness, growing markets, decreasing risk, modular and hence easier projects etc.

Declining technologies

Declining markets and supply chains, ever increasing transition risk, high complexity of nuclear projects etc.

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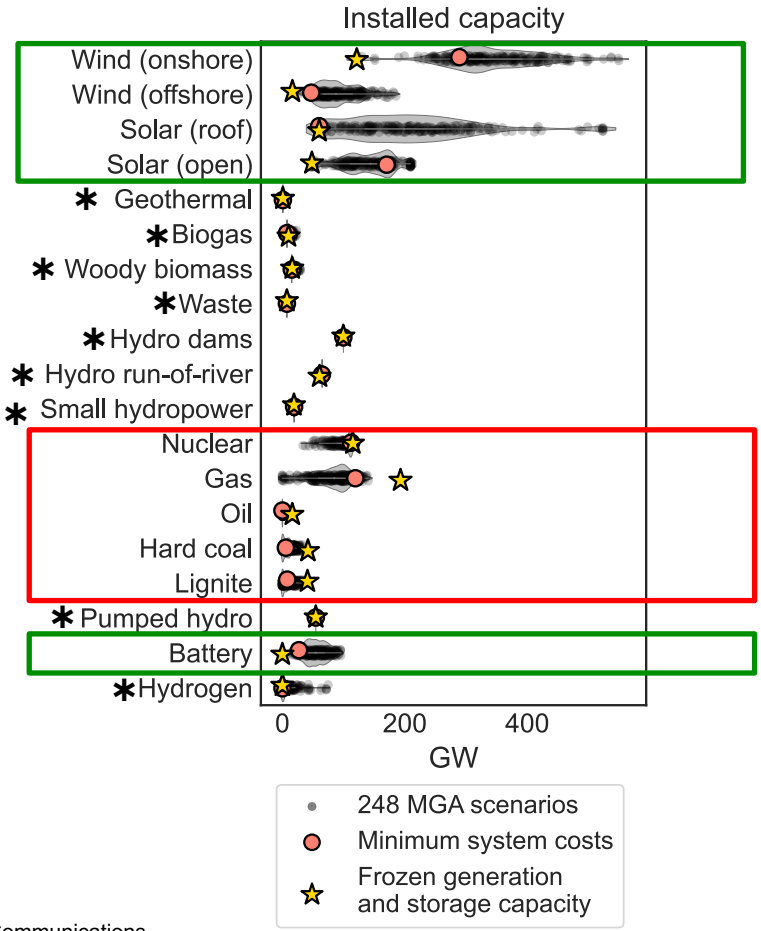

Certain technologies

Cost competitiveness, growing markets, decreasing risk, modular and hence easier projects etc.

✱Optional technologies

Good low-carbon technologies with limited market potential (e.g. geothermal) or some risk/uncertainty (hydrogen)

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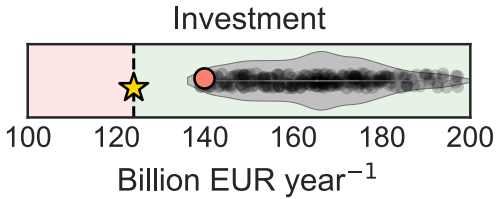
Co-benefits of carbon emissions reduction in Europe



Synergies with other policy goals

New investment and hence regional growth

248 MGA scenarios
Minimum system costs
Frozen generation and storage capacity

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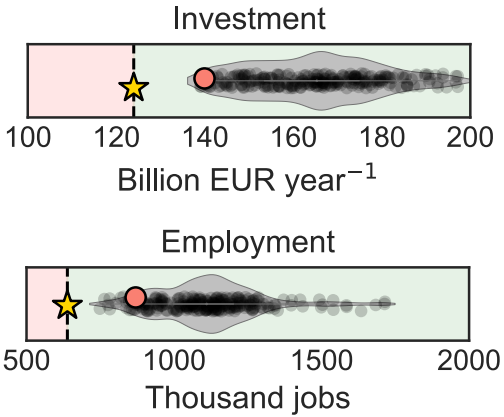

Synergies with other policy goals

New investment and hence regional growth

New direct employment locally,
but the workforce needs to be ready to avoid bottle necks

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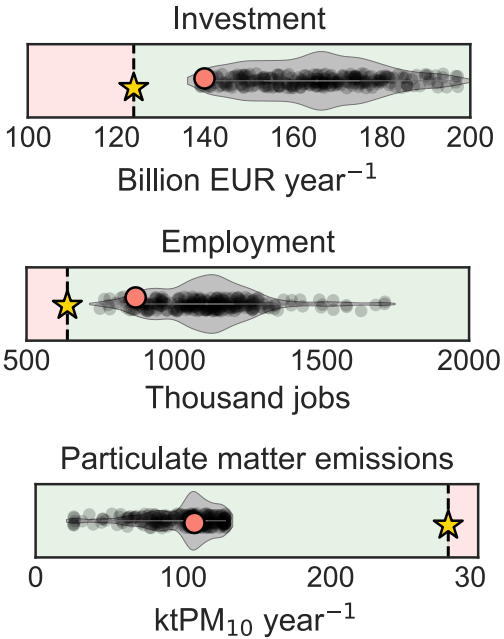

New investment and hence regional growth

New direct employment locally,
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Air pollution, improved health, reduced mortality, healthcare savings

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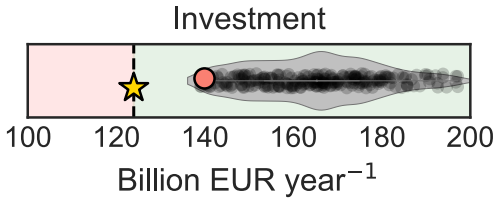

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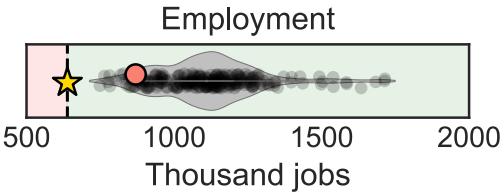

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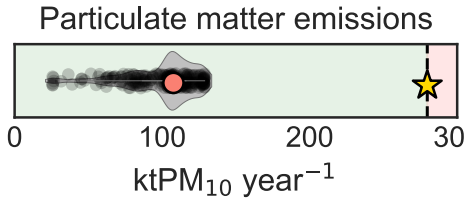
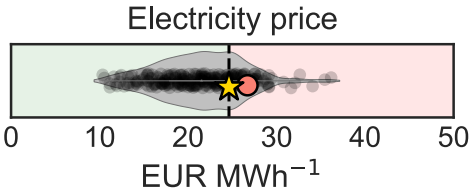
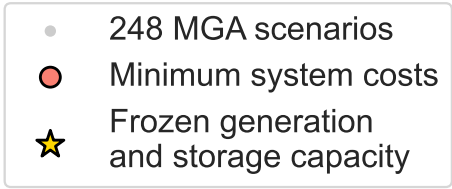


Air pollution, improved health, reduced mortality, healthcare savings



Lower electricity prices are more likely than not (depends on the scenario)



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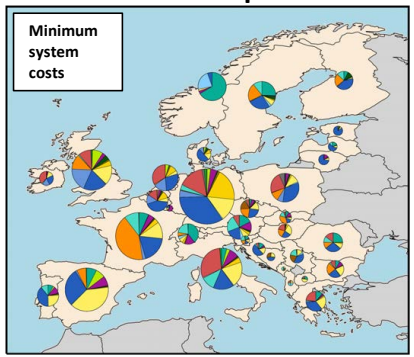
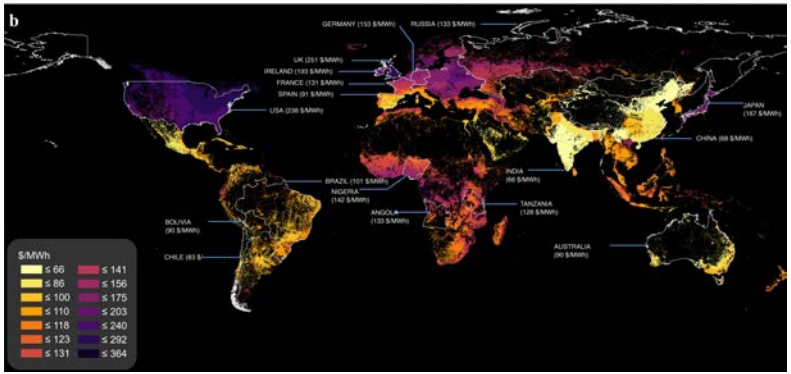
Building up capacity for spatially-explicit energy modeling

Europe



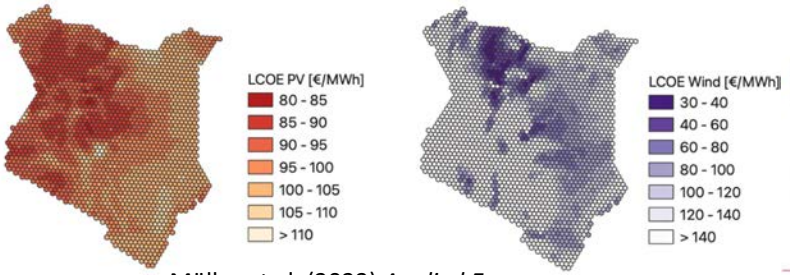
Sasse & Trutnevyte (2023) *Nature Communications*

World



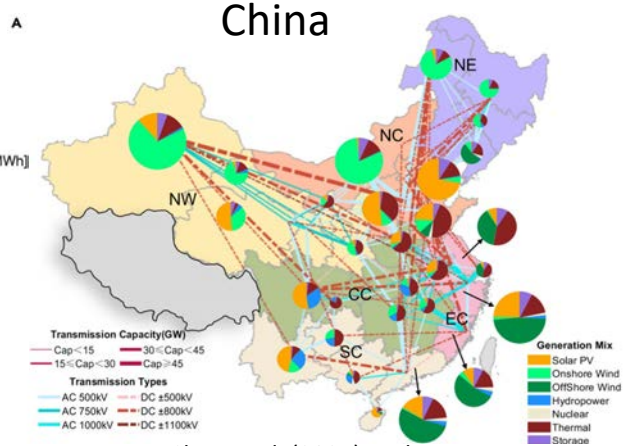
Joshi et al. (2021) *Nature Communications*

Kenya



Müller et al. (2023) *Applied Energy*

China



Chen et al. (2021) *Joule*

Benefits of such models:

- Long-term planning and short-term operation of generation and grids
- Help for siting projects
- Especially suitable for decentralized generation, like PV and wind

Prerequisites:

- Open data and code
- Open-source modeling tools
- Open documentation
- Training and building own modeling capacity

For today

- European electricity sector transition to 2035 and the parallels to other countries

Fundamental and rapid transformation of the electricity sector is a priority

- Certain, optional, and declining technologies

Solar PV and wind power are wise choices. Fossil fuels and nuclear power are declining technologies. Other low-carbon electricity technologies are also needed, but are unlikely to become key players (e.g. geothermal) or are still risky today (e.g. hydrogen)

- Co-benefits for policies across sectors

Climate mitigation offers co-benefits of attracting investment, creating jobs, reducing air pollution, improving health, and likely reducing electricity price

- The need for spatially-explicit energy models

It is time to set up open-access spatially-explicit models and build up own capacity to develop and use such model

Thank you very much for your attention!

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RES

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FACULTÉ DES SCIENCES