WHAT IS THE OPTIMAL ELECTRICITY SHARE FOR VERY INEXPENSIVE SOLAR PV?

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Research Question

- What factors affect the amount of Solar PV in highly renewable Energy Systems?

Hypotheses:

- Average solar availability (capacity factor)
- Cost of solar
- Cost of related resources (battery, wind)
- Latitude of region
- Including sectors besides electricity (ex: transport, industry, agriculture)
- Heating or cooling demand
- Correlation between electricity, heating, or cooling time series
- Transmission between nodes

Methods

- Project future costs of solar, wind, and battery assuming learning rates and installation
- Investigate the effect of cost and other factors with single node model for four regions with different qualities of solar (Denmark, Spain, California, Colorado), including solar, wind, and gas generators, with zero carbon allowance
- Then, use PyPSA-Eur-Sec, an open, networked sector-coupled energy system model for European countries to investigate the effects from added complexity (e.g. transmission)

Conclusions

- For a single node model, we find:
  - Solar is already dominant in places like California
  - Even least-optimistic assumptions of solar prices increase solar share dramatically
- For a sector-coupled model, we find:
  - Without transmission, solar is correlated with latitude
  - Adding transmission destroys correlation
  - Sectors restores correlation

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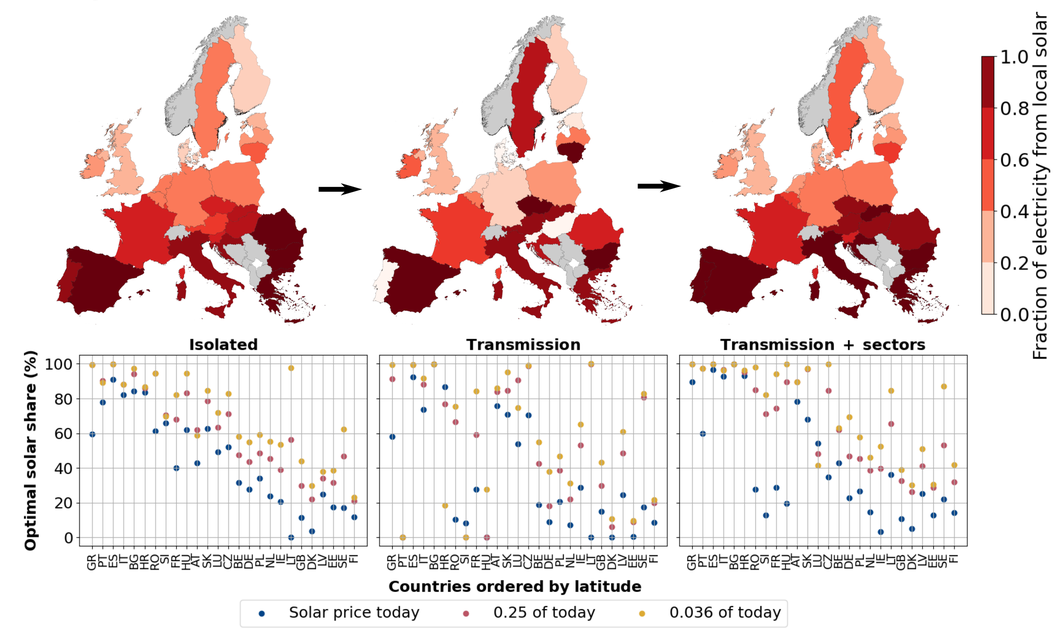
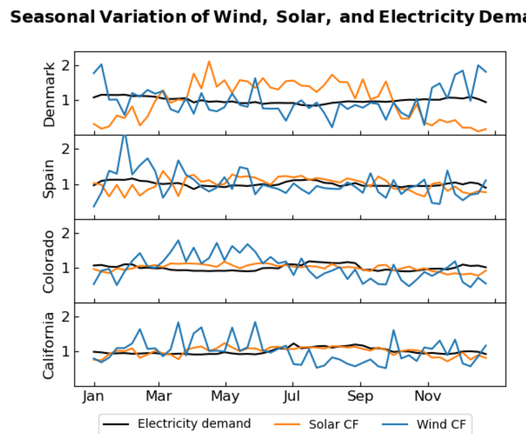
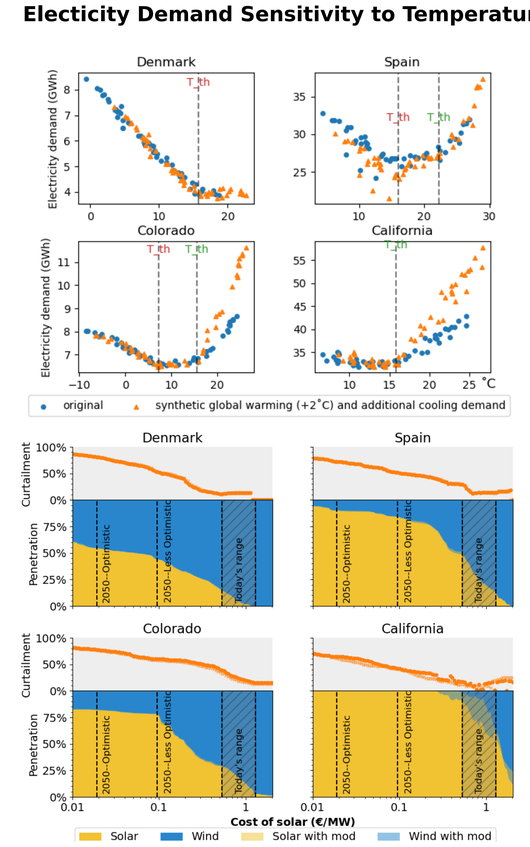
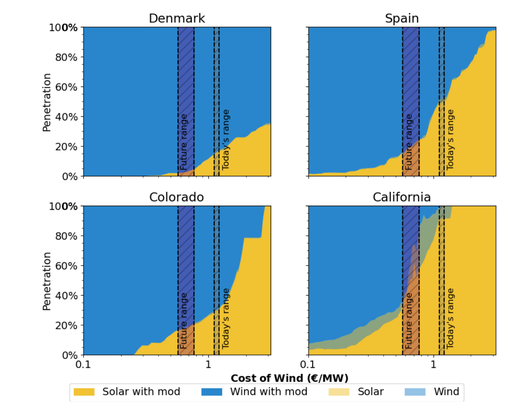
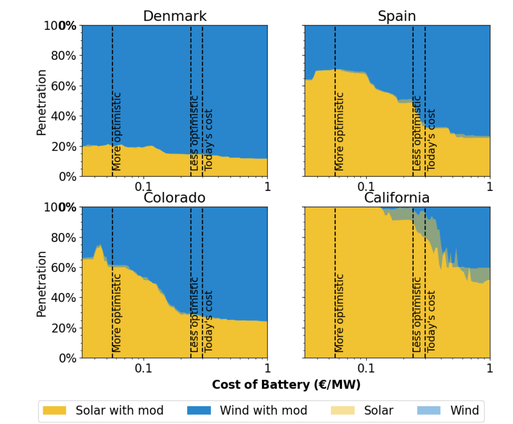
Optimal solar penetration depends on the system's global **connectivity** and **complexity**











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