Evaluating the Value of High Spatial Resolution in National Capacity Expansion Models using ReEDS

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Objective & Key Conclusion

- Power sector capacity expansion models (CEMs) have a broad range of spatial resolutions—e.g., NEMS (22 regions), IPM (64 regions), ReEDS (134 regions), PLEXOS (user defined).
- We use NREL’s Regional Energy Deployment System (ReEDS) model, a long-term national-scale electric sector CEM for the United States, to evaluate the value of high spatial resolution.
- We perform planning at three different spatial resolutions—1) REF: 134 balancing areas (native ReEDS resolution), 2) STATE: 13 NERC regions, 3) NERC: 13 NERC regions.
- We evaluate the impact of spatial resolution on renewable capacity deployment and location, associated transmission builds, and system costs.
- Spatial aggregation impacts the relative competitiveness of renewables, and higher levels of aggregation led to less solar PV deployment while wind deployment increased.

Impact of Spatial Resolution on Renewable Deployment & Planning Costs

ReEDS finds the regional mix of generation technologies that meet the electric sector requirements at least cost.

ReEDS output includes:
- Capacity and generation evolution of all generator types by region at high geospatial resolution
- Impact of policies on clean energy deployment
- Transmission expansion and inter-regional energy flows
- Emissions, fuel consumption and water consumption
- System costs and electricity prices

Impact on system planning cost & regional PV deployment

Effect of spatial aggregation of RE resource parameters:
- As in the case of PV resources, low cost high performance (high capacity factors and capacity value during peak periods) resources may be “missed” by the model as a result of averaging with other higher cost lower performance resources
- On the other hand, as in the case of wind resources, averaging the parameters of a remote “good” resource that needs transmission with a local “poor” resource that does not need transmission may improve the “poor” resource’s attractiveness

Impact on system planning cost (2015$)

Summary & Conclusions

- An overview of the ReEDS electricity system capacity expansion model that optimizes the generation portfolio along with transmission expansions from 2010 to 2050.
- ReEDS has high spatial resolution in terms of representing the U.S. electric sector using 134 BAs, with generation technology cost and performance data at the same or higher resolution (356 regions for wind and PV).
- The paper assessed the impact of two degrees of model aggregation by averaging the cost and performance of RE resources at 48 state and 13 NERC region levels.
- All three scenarios used the NREL’s Annual Technology Baseline (ATB) 2015 mid-case cost and performance assumptions.
- The ATB is a collection of current and future cost and performance projections for generating units for the U.S. electricity sector.

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