Modeling the future U.S. electric power system

For

The National Academies Committee on the Future of Electric Power

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By

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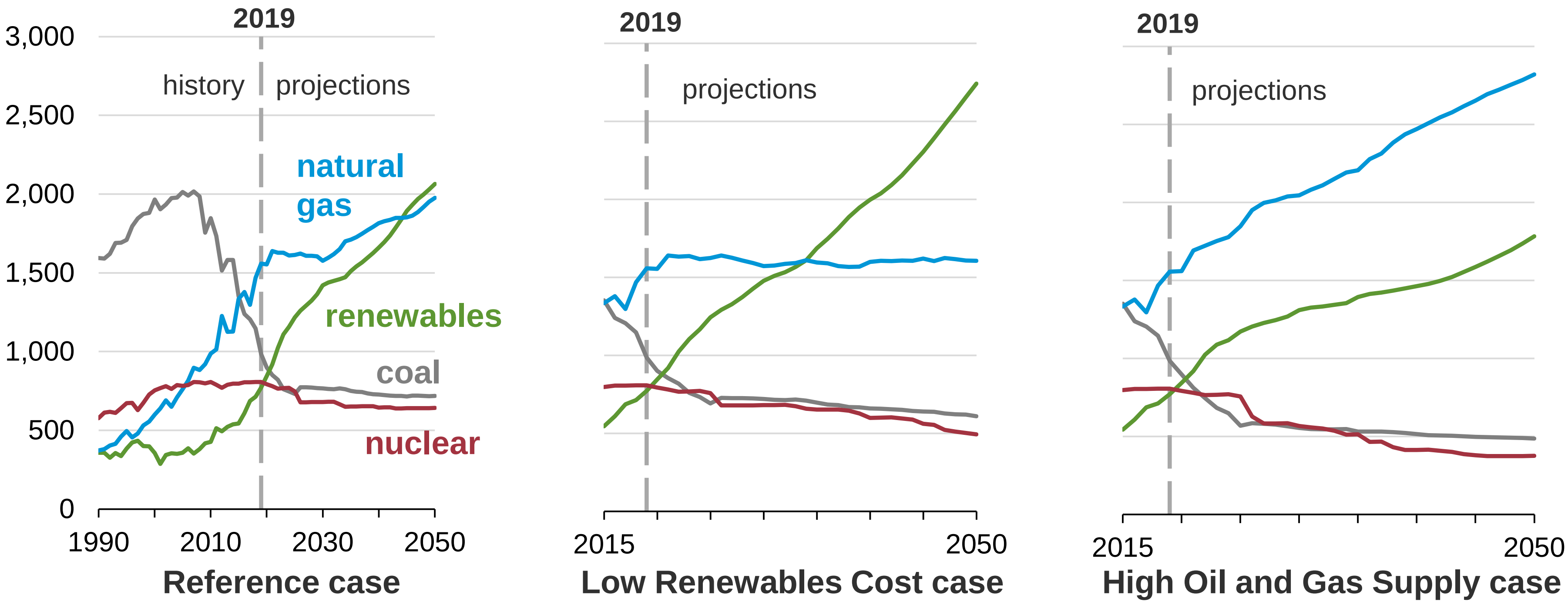
“Are these the shadows of the things that Will be, or are they shadows of the things that May be only?” – C. Dickens

The future power system will be different from today’s

AEO2020 electricity generation from selected fuels

billion kilowatthours

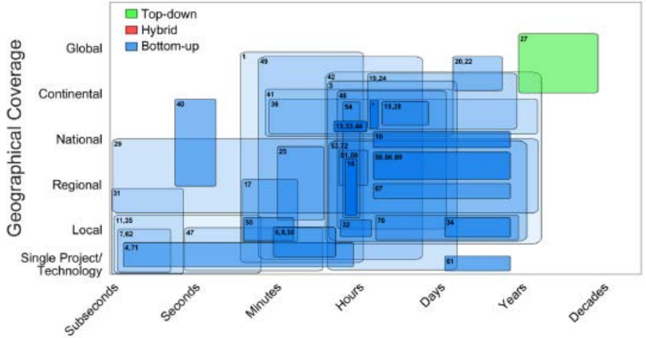


"All models are wrong, but some are useful" – G. Box

Which model should we use to model it?

- Models don't *replicate* decisions in the real world, they *simulate* their effects

- Tradeoffs, breadth vs. detail in:
  - Space/Regionality
  - Time/Horizon
  - Sector
  - Fuel/Technology



- Horses for courses – there is no "one best way" model

- Check policy prescriptions for robustness
  - Stability of policy impact outcome across variations of inputs, different model structures
  - Stability across models with different scope/granularity of sector/space/time

Figure from Ringkjøb (2018)

OK, well then, how can we use models to help us get there?

1. Models can identify the art of the (im)possible
   - System configurations that are plausible/implausible
   - Potential outcomes of system perturbations (e.g., changes to laws and/or regulations)
   - But, beware of “zero” assumptions (e.g., what is the cost of NIMBY?)

2. Models can distinguish between cost and value
   - The shadow price on a constraint in an optimization model is a proxy for value
   - So, spinning reserves have no intrinsic value…but frequency control can be valuable
   - One person’s cost of integration is another’s arbitrage opportunity

tl;dr version: Design markets to compensate for value, not reimburse for cost