

Modeling Intermittent Resources



EPRI

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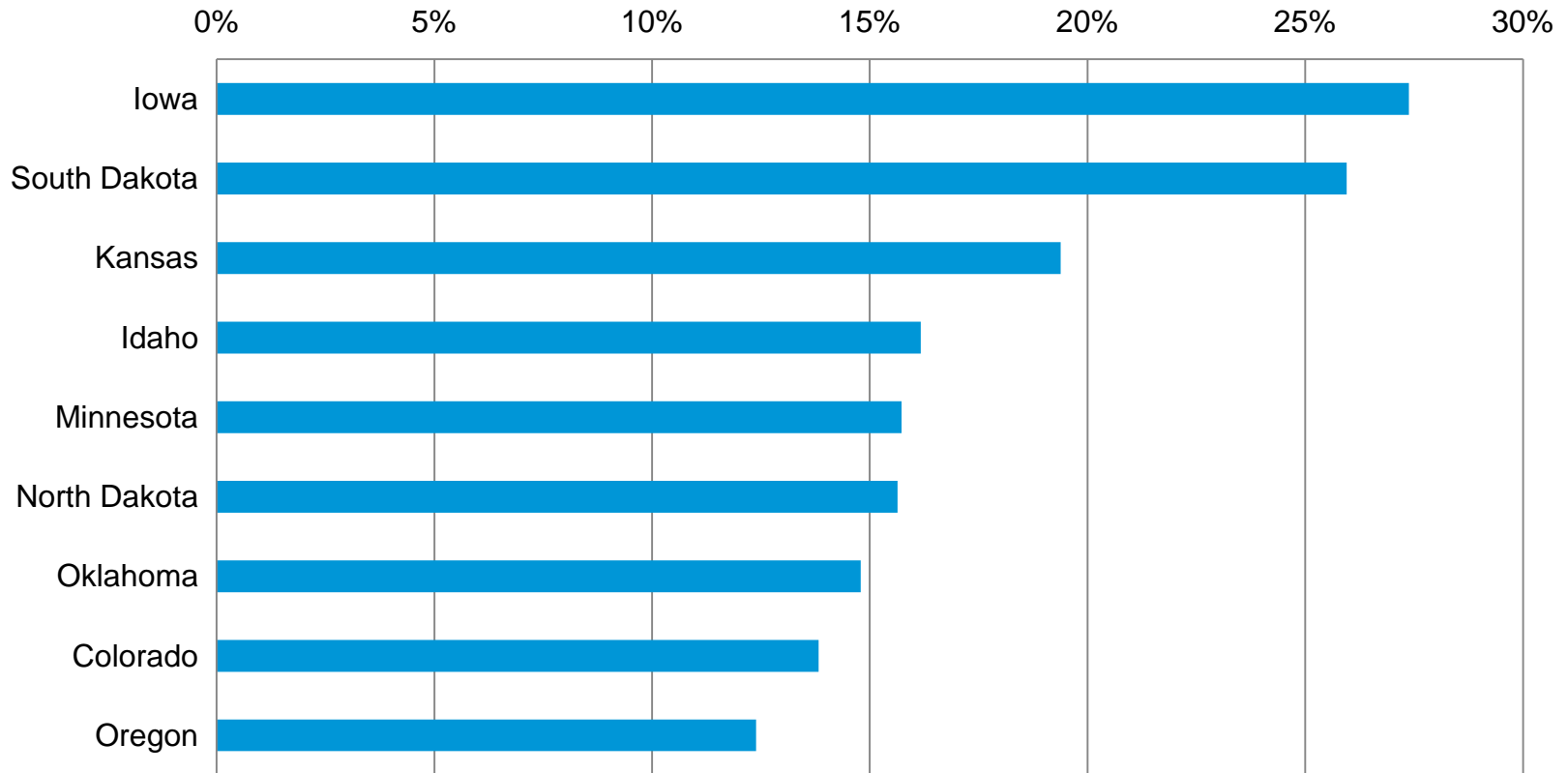
May 14, 2014/ Washington, DC

Overview

- Current state-of-the-market
- Projections
- What are the issues, and how does EIA handle them?

Wind penetration is over 20% in some states

Wind Generation as a Percentage of Total Net Generation in 2013

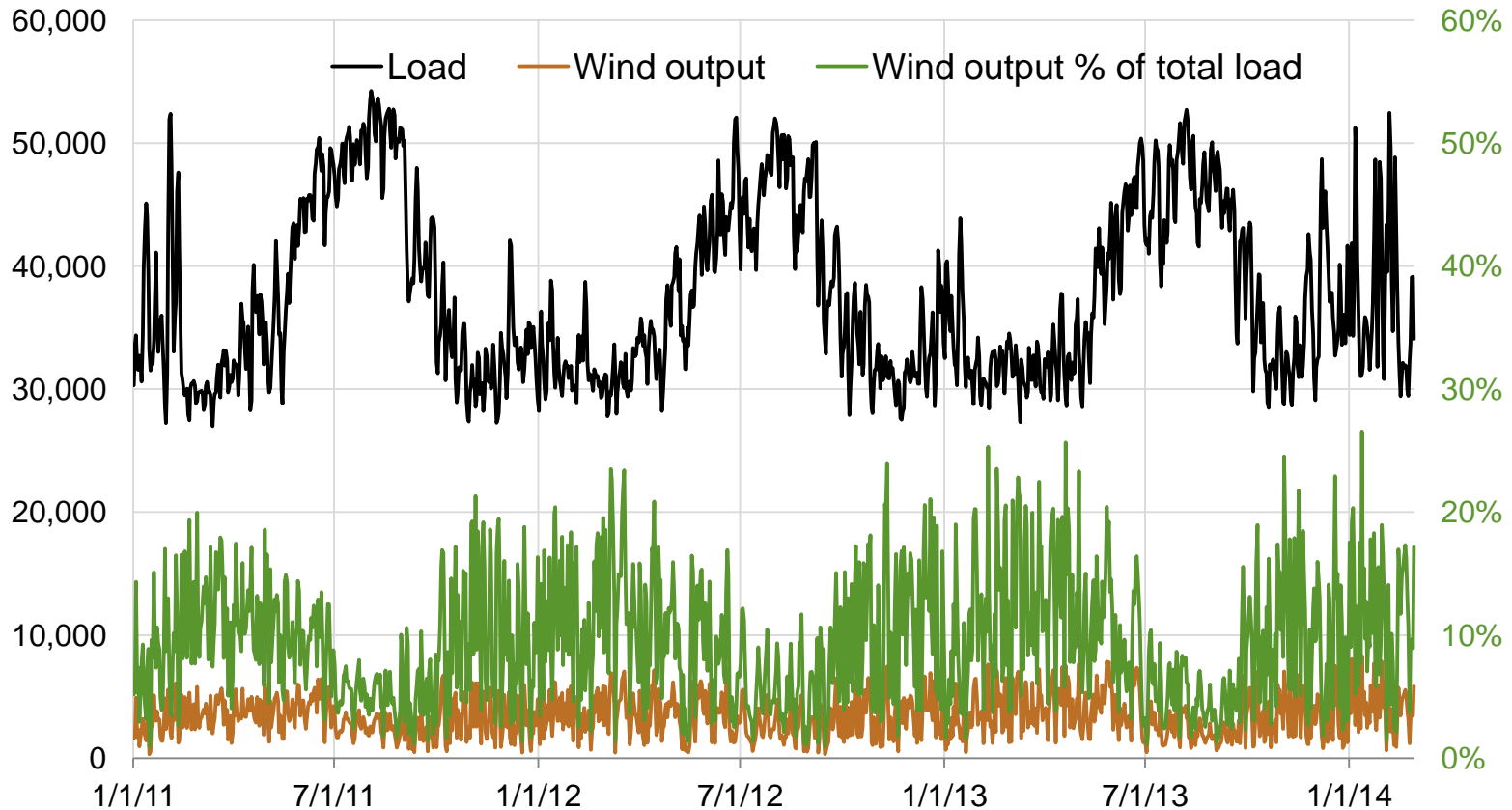


Source: EIA

Wind penetration has made significant inroads in several RTOs

ERCOT Daily System Load Versus Wind Output

megawatts

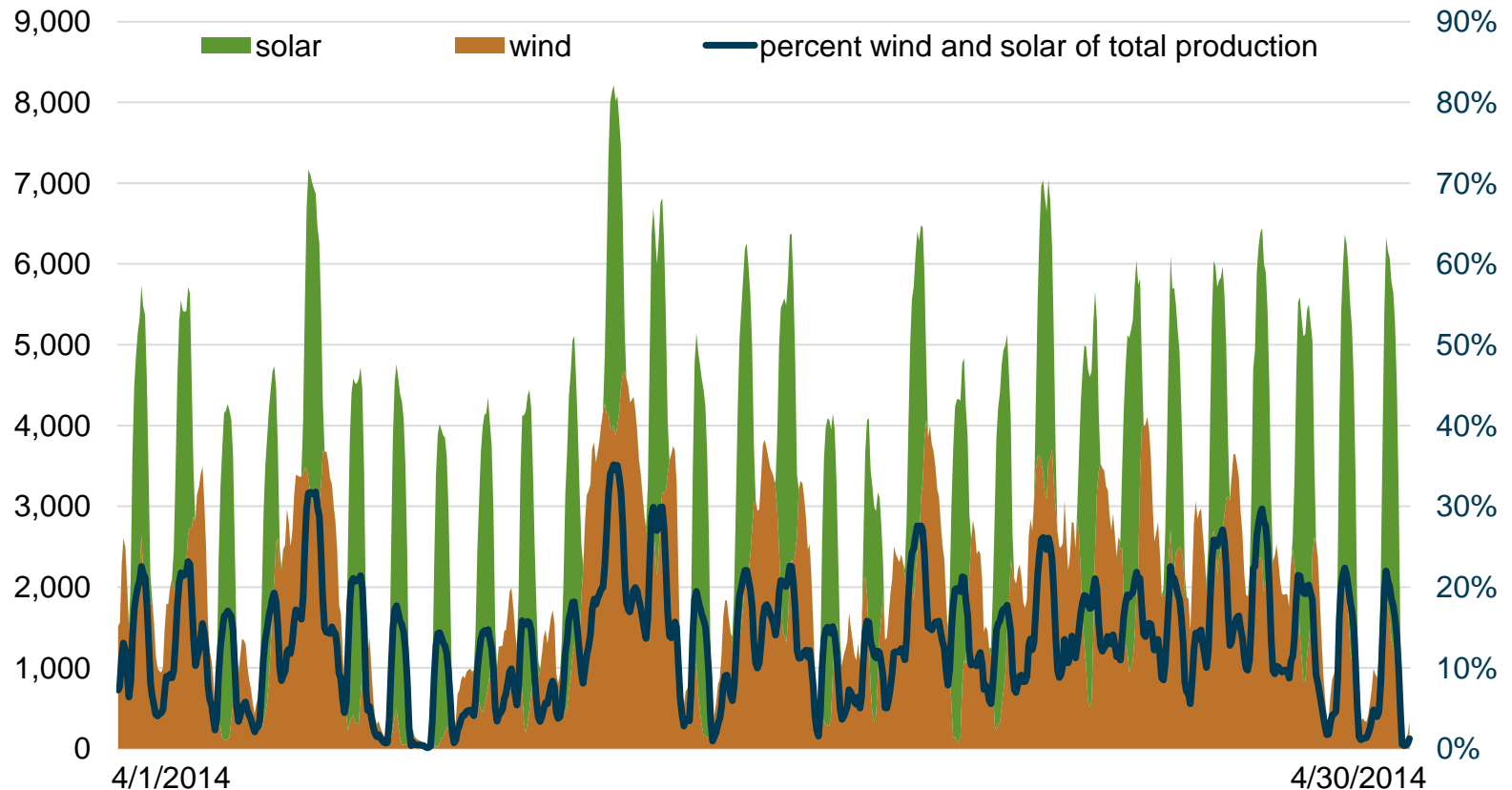


Source: ERCOT

In some regions, solar is starting to see significant growth as well

CAISO Hourly Average Solar and Wind Production in April, 2014

megawatts



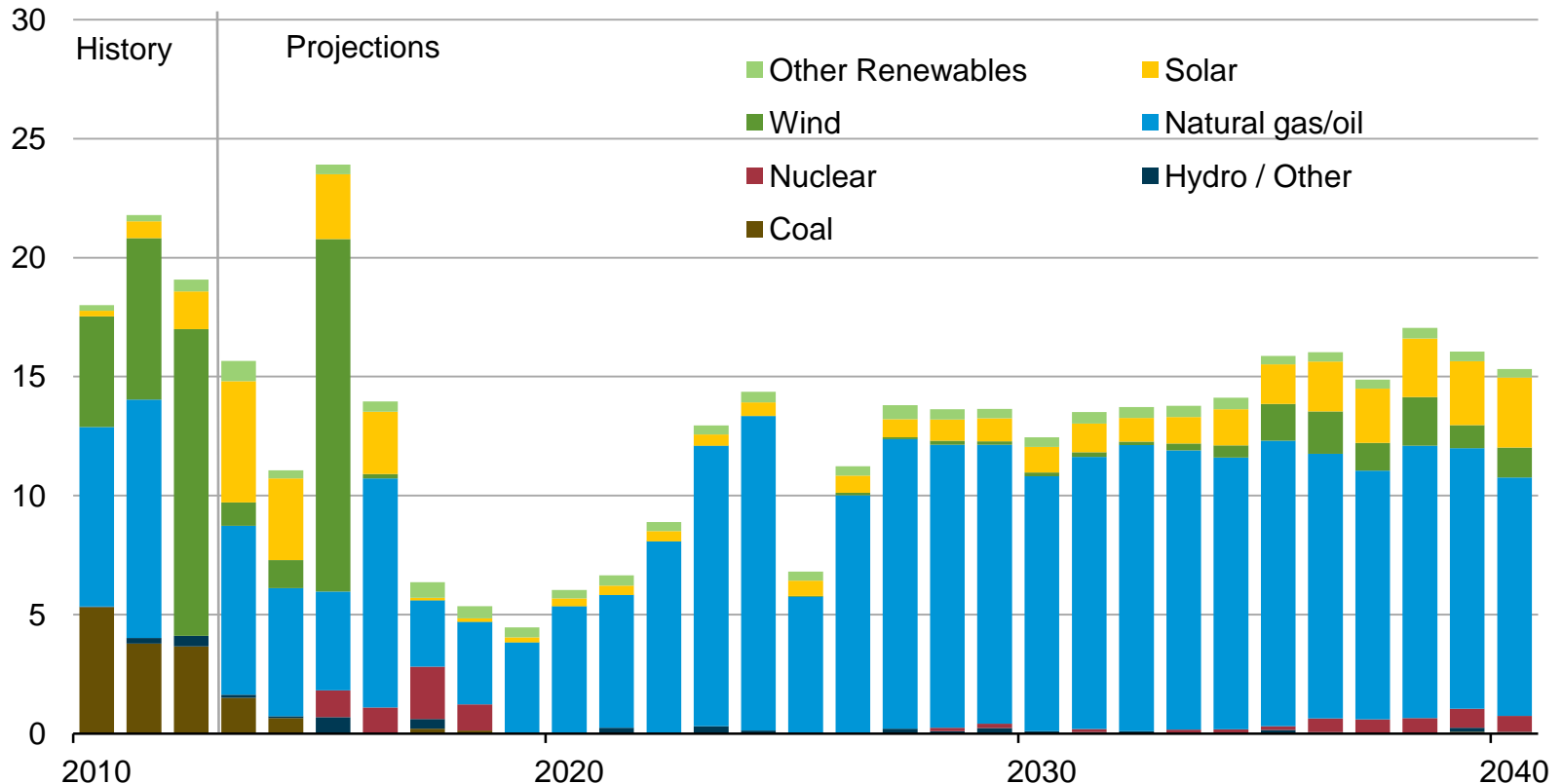
Source: CAISO Renewables Watch

Issues that we've seen so far

- The lights are still on
- Surplus wind can cause curtailments (wind operators don't like this) and/or negative power prices (nuclear/coal operators don't like this)
 - Are negative power prices just an artifact of the PTC which will disappear as plants “age-out” of PTC eligibility?
- Inopportune timing of ramping can exacerbate concerns over having adequate ramping capability
- Reshaping net load

EIA doesn't see a lot of demand for new capacity additions of any type over the next 5-10 years

U.S. electricity generation capacity additions gigawatts

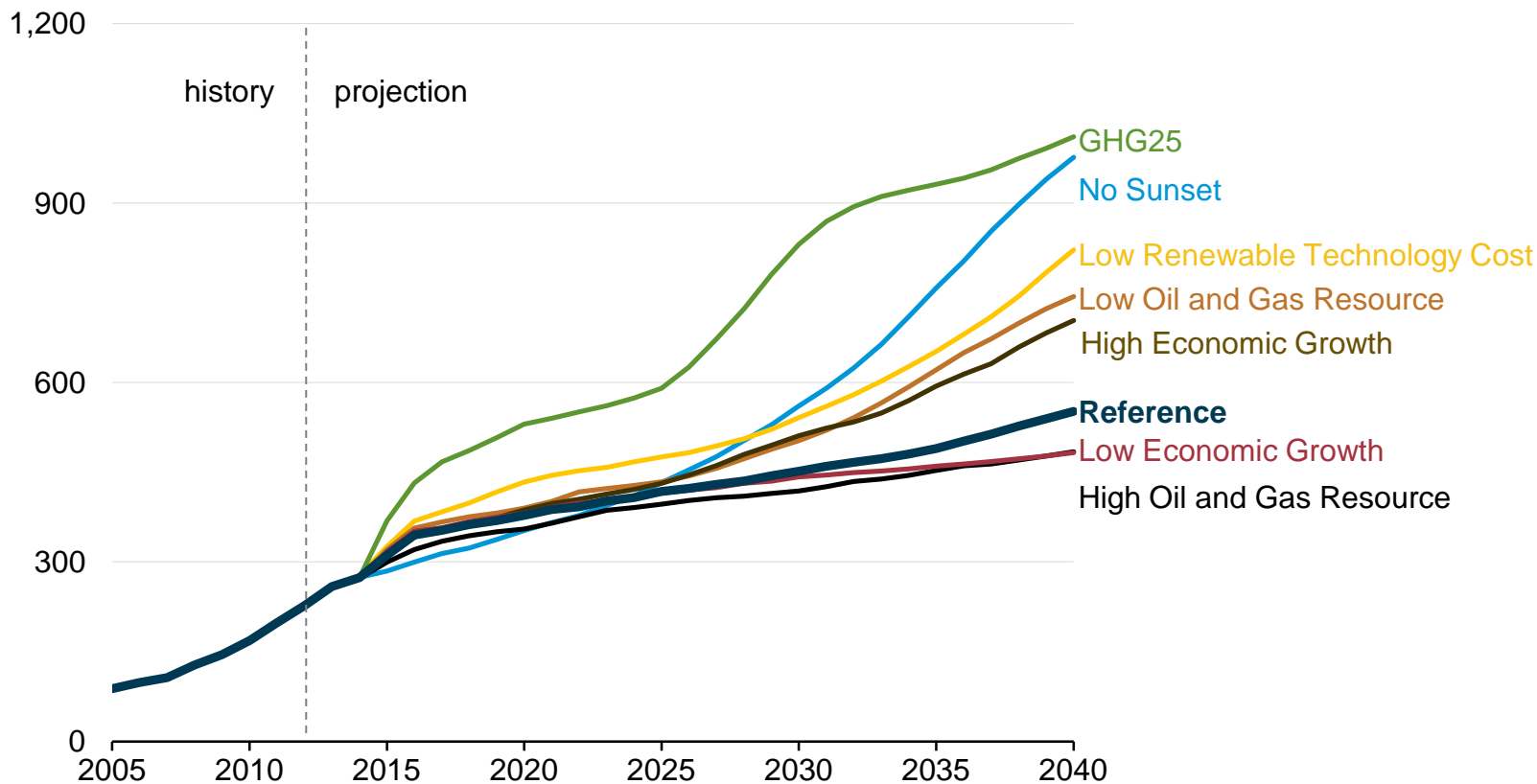


Source: EIA, National Energy Modeling System run ref2014.d102414a

However, policy or other market factors could create substantial markets for wind/solar over a 10-20 year timeframe

U.S. Nonhydroelectric Renewable Electricity Generation in Eight Cases (2005-40) of the Annual Energy Outlook 2014

billion kilowatthours

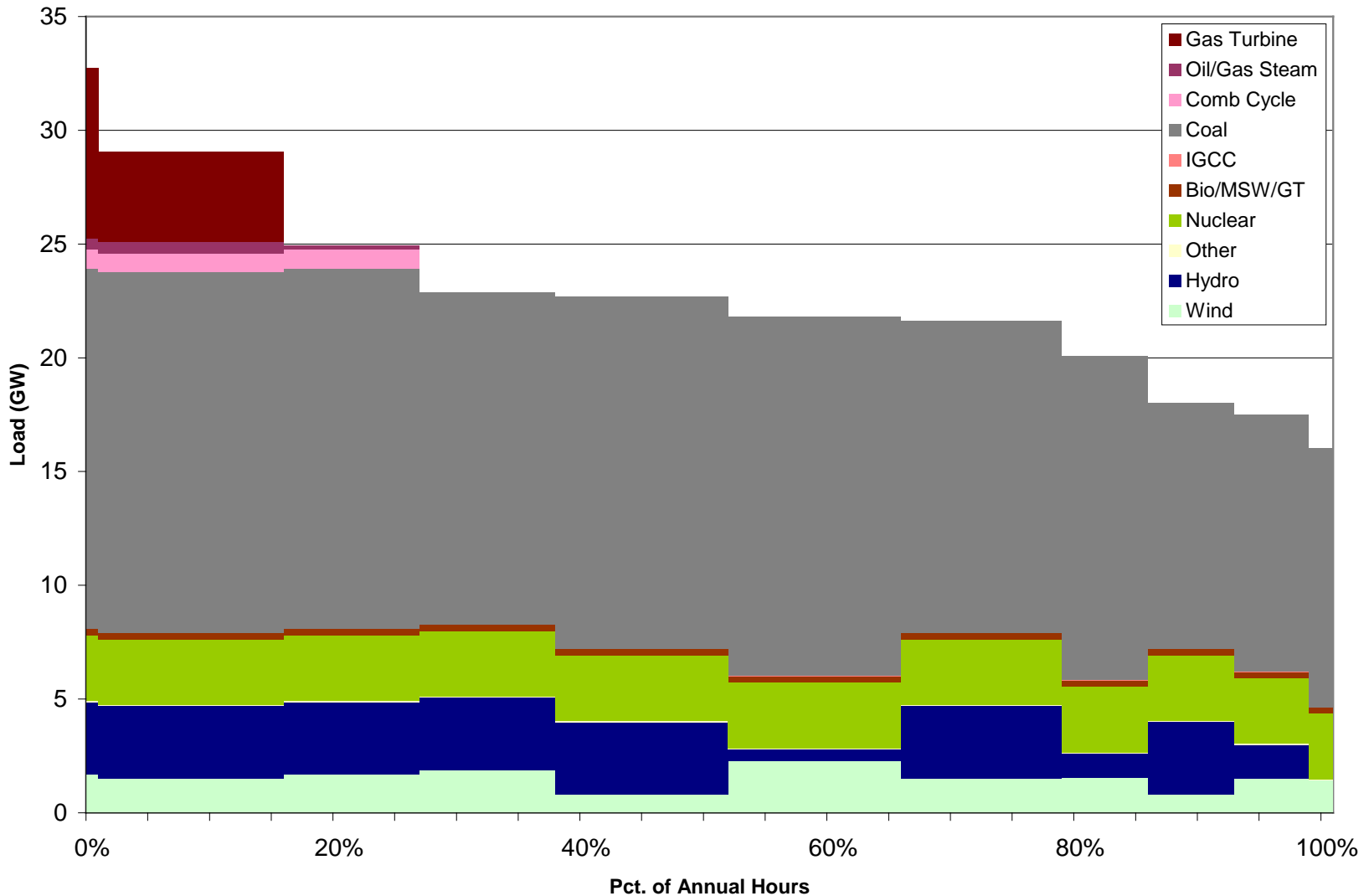


Source: EIA, National Energy Modeling System

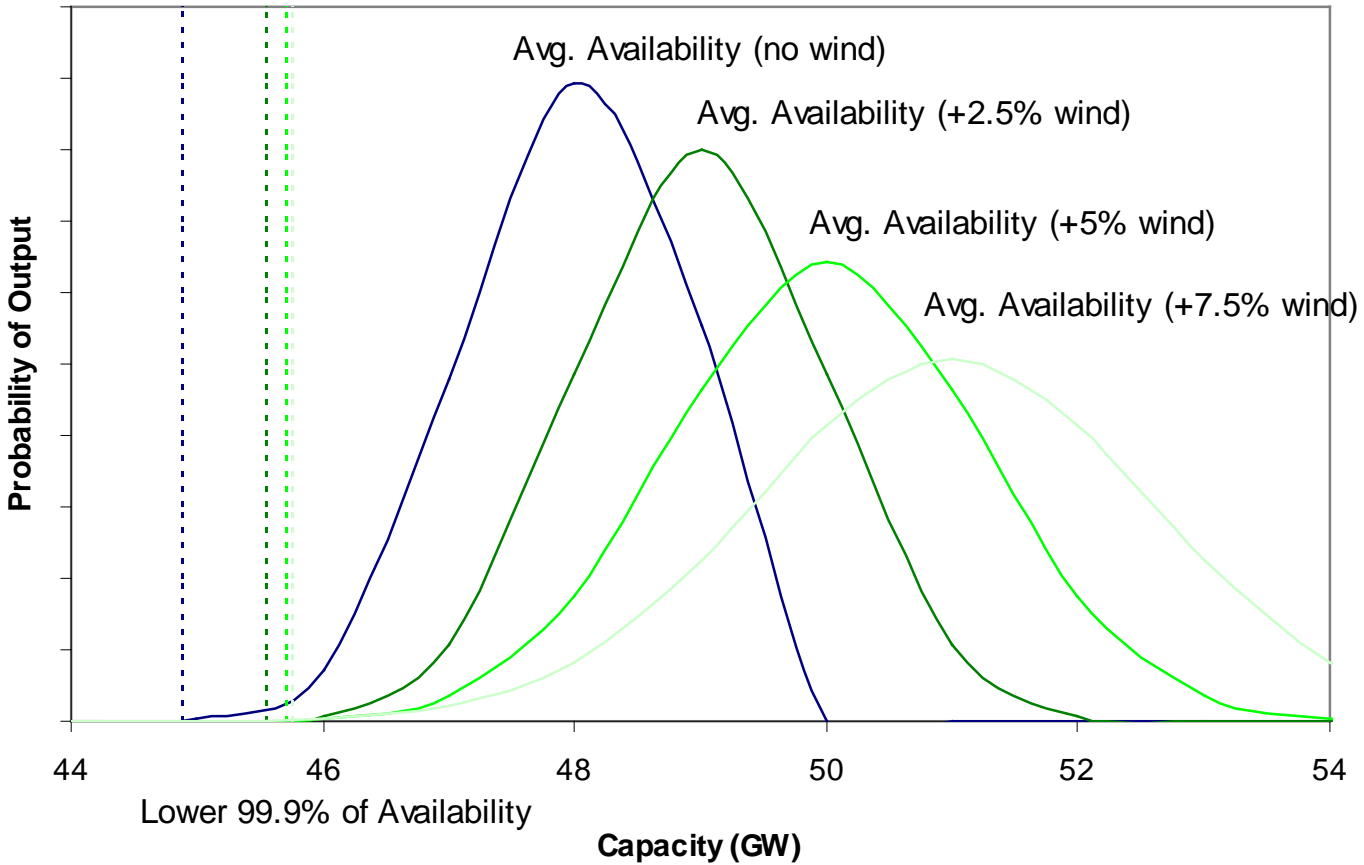
Issues associated with intermittent generation vary by timescale

- Allocating appropriate TOD/seasonal value to the generation
- Ensuring adequate reserve margin (i.e. capacity credit)
- Surplus generation (curtailments, negative prices)
- Ensuring adequate operating reserves (ramping, spinning reserve, non-spinning reserve)
- Transient impacts (voltage regulation)

EIA considers the value of wind and solar generation over a 3-season, 3-TOD load duration curve



EIA assigns capacity credit based on effective load carrying capacity (approx)



EIA estimates surplus generation, and assumes wind will be curtailed to accommodate

- In the near-term, this assumption does not comport with industry reports of “negative pricing”
 - Negative prices tend to force steam generators to curtail, not wind
 - While wind is cheaper to curtail, it has an opportunity cost in terms of tax and RPS credits
- Over the longer-term, 10-year PTC claim period will expire, eliminating most of the incentive for negative pricing from wind.

EIA has recently incorporated spinning reserves into NEMS

- Spinning reserve requirements set depending on the mix of generating technologies used to meet peak demand by region.
- This approach allows better representation of capacity requirements and costs in regions or cases with high penetration of intermittent loads.
- We are currently examining whether it makes sense to include non-spinning reserves as well

EIA does not represent “transient” impacts

- Load following/ramping impacts are captured by spinning and potentially non-spinning representations
- Newer wind technologies (DFIG, AC-DC-AC systems) have largely mitigated problems with local voltage issues
- Temporal resolution of the model makes representation of many operational issues difficult to directly address
- Impacts on fossil unit efficiency cannot currently be modeled
- EIA also does not allow regional penetration over 40% because of uncertainties over impacts at and beyond this level

What's next?

- Focus on interactions of distributed renewables (especially PV) with distribution, transmission, and generation
 - Improve resolution of TOD/Seasonal output data sent between demand and electricity models
 - Re-examine the limits to PV penetration on distribution systems and how we model market impacts
- Explore adding energy storage
 - Can help accommodate higher penetrations of intermittents
 - Addition of storage could provide confidence that we can ameliorate intermittency impacts even at very high penetration levels
 - What kind of storage to model? (short-term, daily, seasonal; technology)
 - Is storage either “necessary” or “sufficient” to allow higher penetrations?

For more information

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