Meeting Soaring Demand More Quickly… While Mitigating Increases in Rates and Emissions

A US-Wide Perspective

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US Demand for Power is Growing

Electricity demand is surging from:

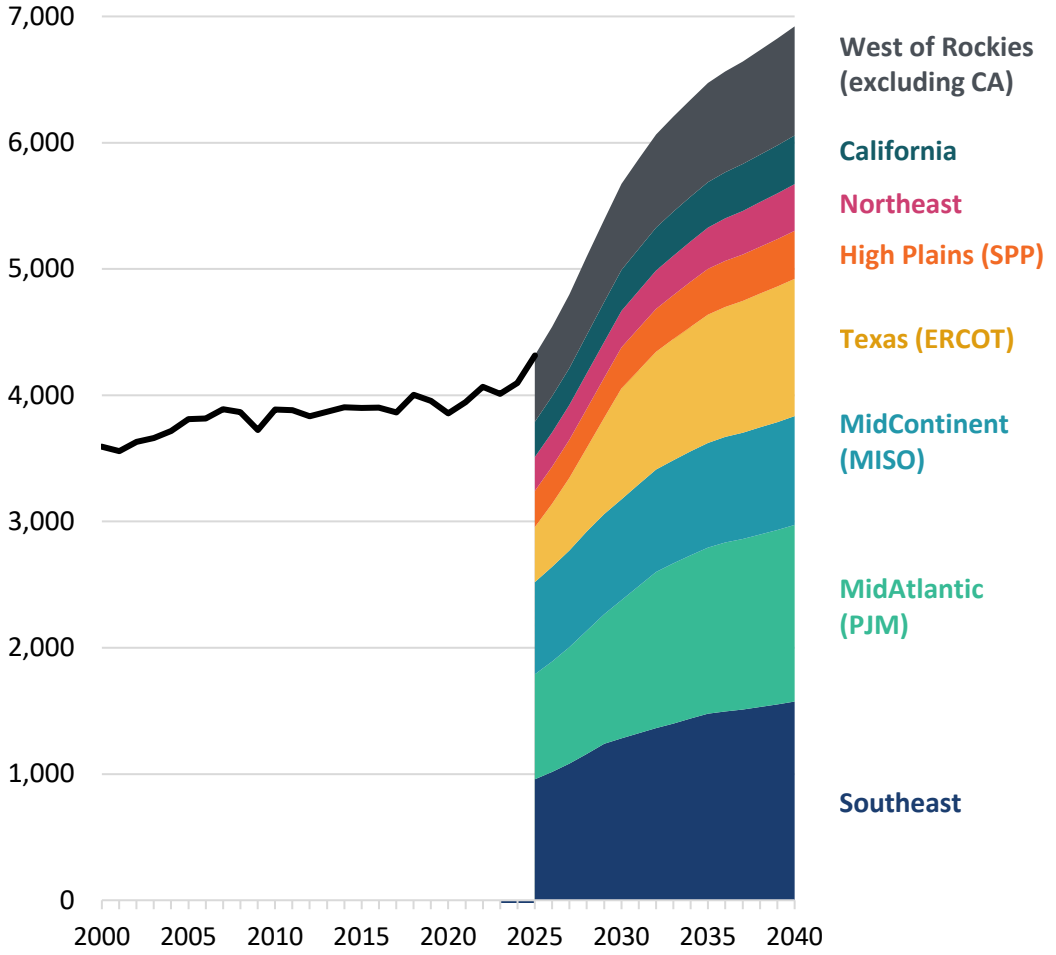
- Data centers for AI
- Manufacturing reshoring
- Electrification of vehicles, buildings, and industry

Peak demand (MW) growth rates are 5× that of the past decade; energy demand (MWh) is growing even faster with new high-load-factor loads

This growth will require much more transmission and generation capacity and energy, challenging:

- Resource adequacy
- Costs and rates, and
- Emissions

Forecast of Annual Electric Energy Consumption (TWh/yr)



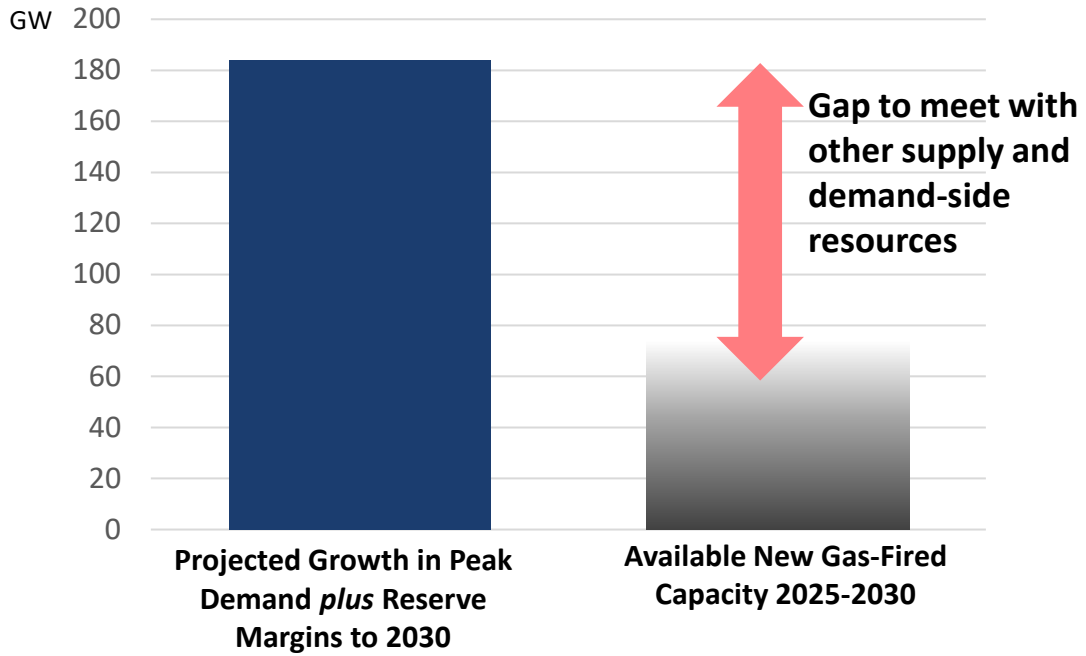
Sources: Brattle compilation of 2024 and 2025 RTO and utility load forecasts.

Resource Adequacy Challenge: Gas-Fired Alone Will Not Meet the Need

Next 5 years will need new capacity for 160 GW peak growth *plus* reserve margin and replacing retirements

- Retention is important where needed and cost effective
- All new supply resources have lead times for development, equipment, construction, and interconnection
- New gas-fired generation will be limited by supply chains:
  - <80 GW in interconnection queues[1] and not all will be built[2]
  - Supply chains may limit development to closer to 50 GW by 2030
  - Lead times for turbines mean 50 months to build a CC, 44 for CT[3]
- Many more resources will be needed to meet the gap:
  - BESS, wind and solar
    - >2 TW ICAP in queues is vast, even if resource adequacy value is derated
    - 2025 has 18 GW BESS, 33 GW utility-scale PV, 8 GW wind planned[4]
    - Loss of tax credits will reduce builds dramatically
  - Demand side: DR/VPPs, energy efficiency… more cost effective now
  - Uprates and restarts (though these are limited)
- Tx interconnection must be further expedited, and behind-the meter resource additions

New Gas-Fired Plants Insufficient to Meet Projected Demand



Notes: Available new gas-fired capacity does not include uprates to existing plants; projected peak demand growth calculated from compilation of RTO and utility load forecasts; does not account for the need to replace planned retirements.

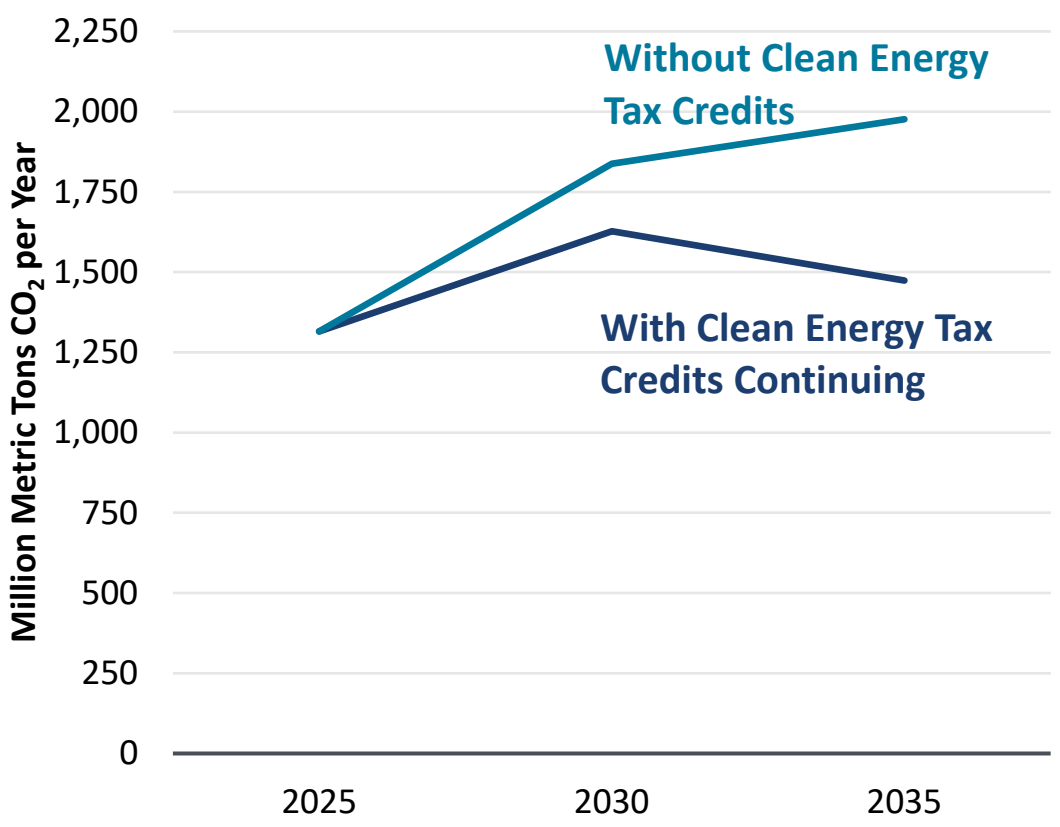
Sources: 1. LBNL, "Queued Up: 2024 Edition," April 2024
2. Rough estimate based on statements from turbine manufacturers
3. Brattle 2025 CONE Study for PJM Quadrennial Review
4. EIA: Solar, battery storage to lead new U.S. generating capacity additions in 2025

Cost and Rates Challenges: Rates Will Increase but Can Be Managed

	Challenges	Solutions
G	• **Generation** scarcity is driving the installed cost of new CCs to $1800-2100/kW; BESS costs more per UCAP kW • Rate impacts will be greatest in restructured states more exposed to marginal costs of capacity or capacity price caps • Natural gas forwards higher ($4 vs. <$3 over past 2 yrs) • Rate impact from loss of tax credits greatest in Plains	• Maximize EE and VPPs/DR (incl. on-site generation) • Retain resources where needed • Beware building/procuring for uncertain high forecasts • Difficult questions for capacity market price caps • Retain the tax credits
T	• **Transmission** capital expenditure is increasing – From $20-25 billion annually over the last decade to $30 billion in 2024; EEI projecting $40 billion annually over the next few years – Driven by new load and generation, and equipment scarcity prices	• Get more out of existing grid, with SIS, RASs • Expand capacity at low cost with GETs • Co-locate new generation & innovate with energy parks • Ensure new loads pay their share + any stranded costs • For new transmission, leverage multi-value planning
D	• **Distribution** has been the fastest growing capital spending, to replace aging infrastructure, harden against fires/storms, and accommodate DERs	• Improve distribution system planning through granular load forecasting, scenario analysis, and proactive buildout • Orchestrate DERs to reduce investment needs

Emissions Challenge: Load Growth Exceeding Clean Supply Growth

- Challenge: The projected load growth rate over the next 10 years is 220 TWh per year (see slide 3), compared to an average of 55 TWh new wind/solar additions over past 10 years, with a maximum of 96 TWh per year[1]
- Our simulations of the US power sector projects sharp increases in emissions without tax credits continuing
- Even the case without tax credits is optimistic, with:
  - States with clean energy goals meeting them, including meeting offshore wind goals
  - Wind development at 11 GW/yr and solar at 24 GW/yr, comparable to recent growth rates *with* tax credits
- Bending the curve will be challenging if all this load materializes. Key points:
  - Energy efficiency
  - Installing as much wind and solar as we can
  - Long-term: nuclear, geothermal, and CCS?



Sources: Brattle gridSIM analysis.

Sources: 1. EIA: May 2025 Monthly Energy Review

Takeaways

The industry has been striving for “cleaner, cheaper, and more reliable;” now load growth is **challenging resource adequacy, rates, and emissions more than ever before**

- This is pressuring every element of the industry: supply chains, resource development, transmission interconnection and planning, distribution CapEx and management, and rate structures
- This raises questions about market/regulatory models, open access, and affordability
- There will be more need for innovation and outside-of-the-box approaches and demonstrating acceptable tradeoffs relative to alternatives

Promising innovations include:

- New business models for accommodating new loads, including BTM, BTM-to-grid, macrogrids
- Adoption of best practices for transmission interconnection
- Adoption of proactive, multi-value transmission planning and widespread use of GETs
- Proactive distribution system planning to serve new loads more cost-effectively and with fewer delays
- Customer programs and grid architecture to allow DERs to provide grid services

Longer-term directions:

- Further mobilize all resource types including renewables
- Return to developing offshore wind and lower the cost
- Develop advanced nuclear, geothermal, and other new non-emitting dispatchable technologies

Presenter Bio

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Dr. Newell leads Brattle's electricity practice in analyzing critical economic questions around the industry's energy transition.

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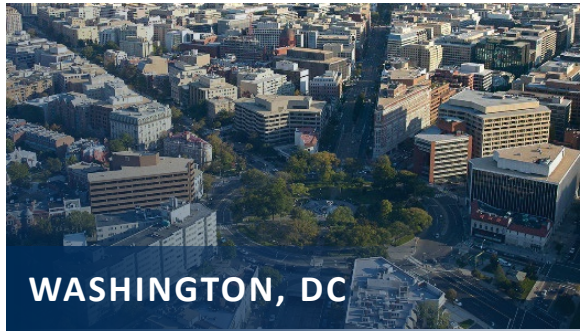

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