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Pathways to Net-Zero

The Role of 24/7 Carbon-Free Electricity

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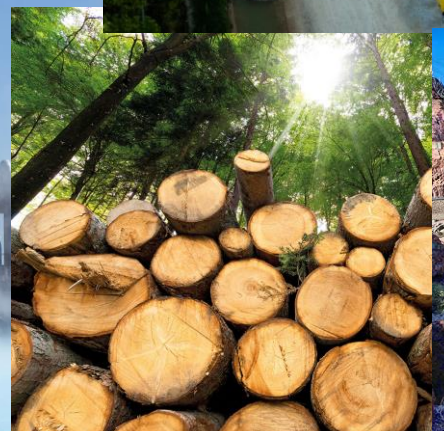
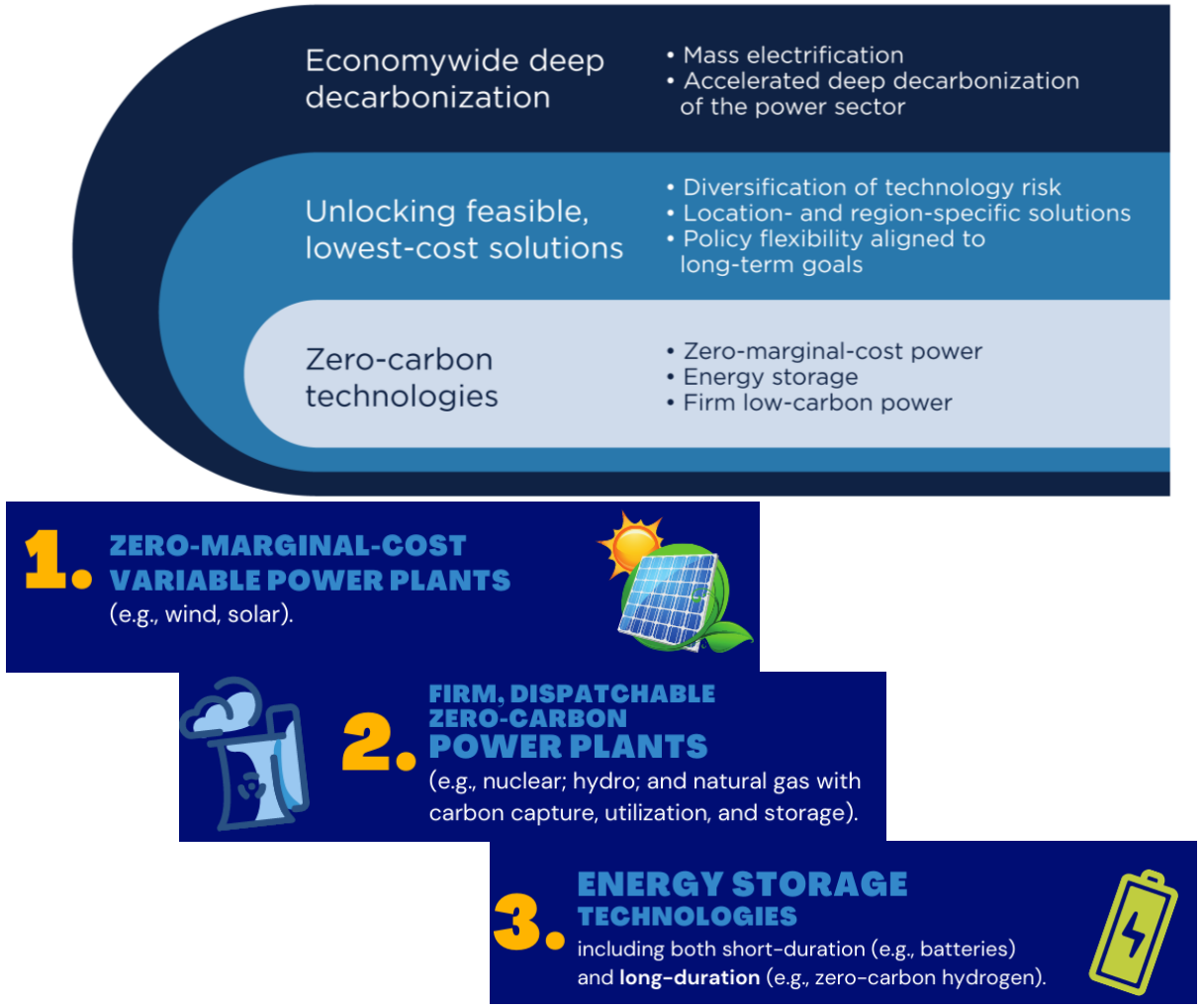
The “Backbone” of Decarbonization is Electricity



Getting to net-zero

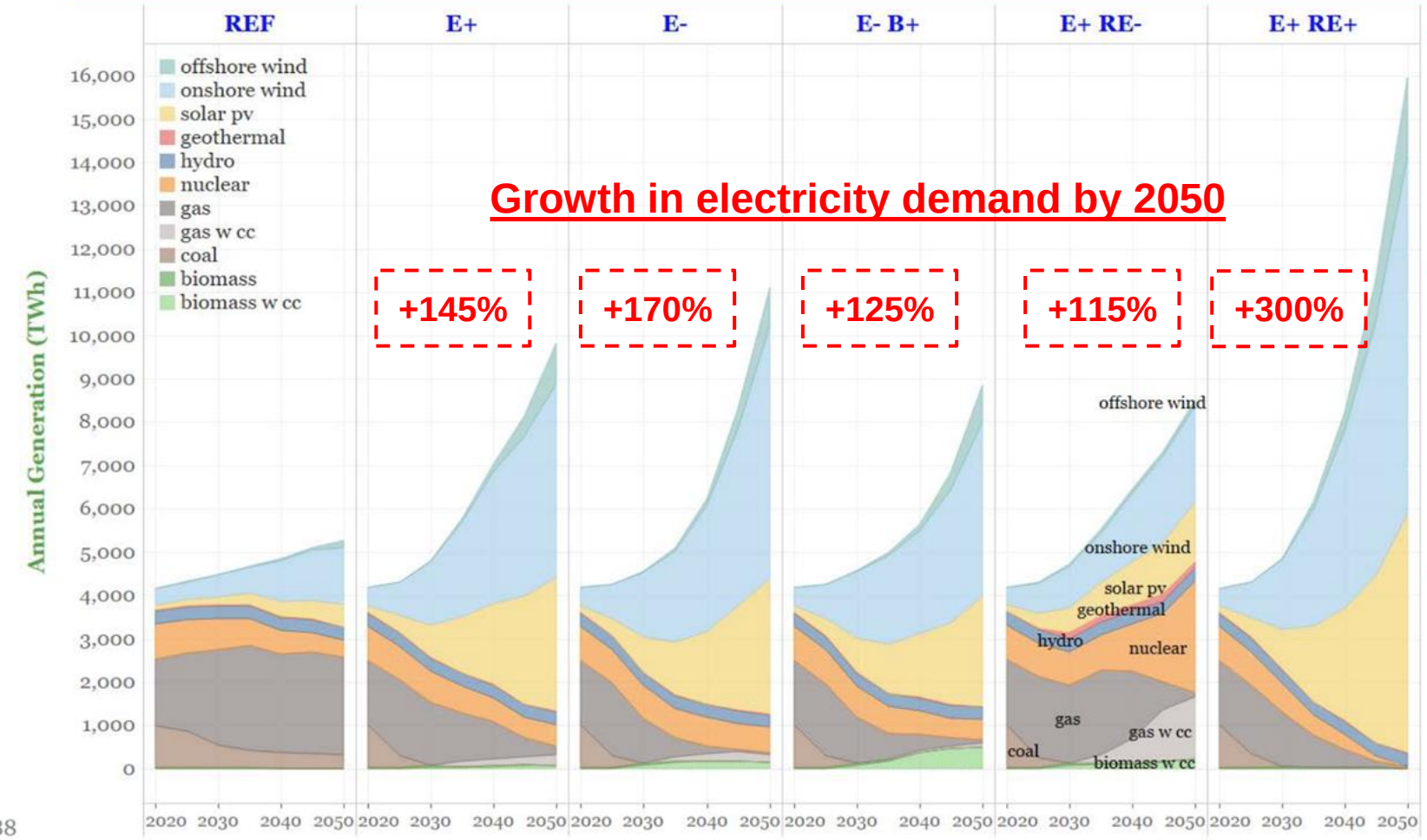
- To get to an net-zero **economy**, we use a LOT more electricity.
- That electricity supply (i.e., our power plants) becomes zero-carbon very quickly. **It leads in (and is essential to) the energy transition.**
- Scenarios and analysis show that – in order to keep our energy systems both **affordable** and **reliable** – we use a set of technologies with different characteristics in order to meet this goal.
- Variable renewables (e.g., wind and solar) play a huge role. As do batteries. But they aren't enough if we want to keep costs low and the lights on…
- We need to move quickly to achieve stated goals



Ref: Lott and Smith (2021). Energy Transition Fact Sheet: Pathways to 100% Clean Electricity
https://www.energypolicy.columbia.edu/research/article/energy-transition-fact-sheet-pathways-100-clean-electricity

Net-zero scenarios include a lot more electricity demand…

Solar and wind generated electricity have dominant roles in all net-zero pathways



- Share of electricity from carbon-free sources roughly doubles from ~37% today to 70-85% by 2030 and reaches 98-100% by 2050.
- Wind + solar grows >4x by 2030 to supply ~½ of U.S. electricity in all cases except E+RE-; in that case, growth is constrained, but still triples by 2030 to supply ⅓ of electricity.
- By 2050, wind and solar supply ~85-90% of generation in E+, E-, and E-B+. In E+RE-, 44%; in E+RE+, 98%.

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Source: E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020

A central challenge in getting to net-zero: The gaps between supply and demand

"This literature, combined with real-world experience with increased RE deployment, points to two main challenges associated with achieving 100% RE across all timescales:(1) economically maintaining a balance of supply and demand and (2) designing technically reliable grids using largely inverter-based resources. The first challenge results in a **highly nonlinear increase in costs as the system approaches 100% RE**, in large part because of seasonal mismatches."

~Denholm et al., The challenges of achieving a 100% renewable electricity system in the United States, Joule (2021), https://doi.org/10.1016/j.joule.2021.03.028

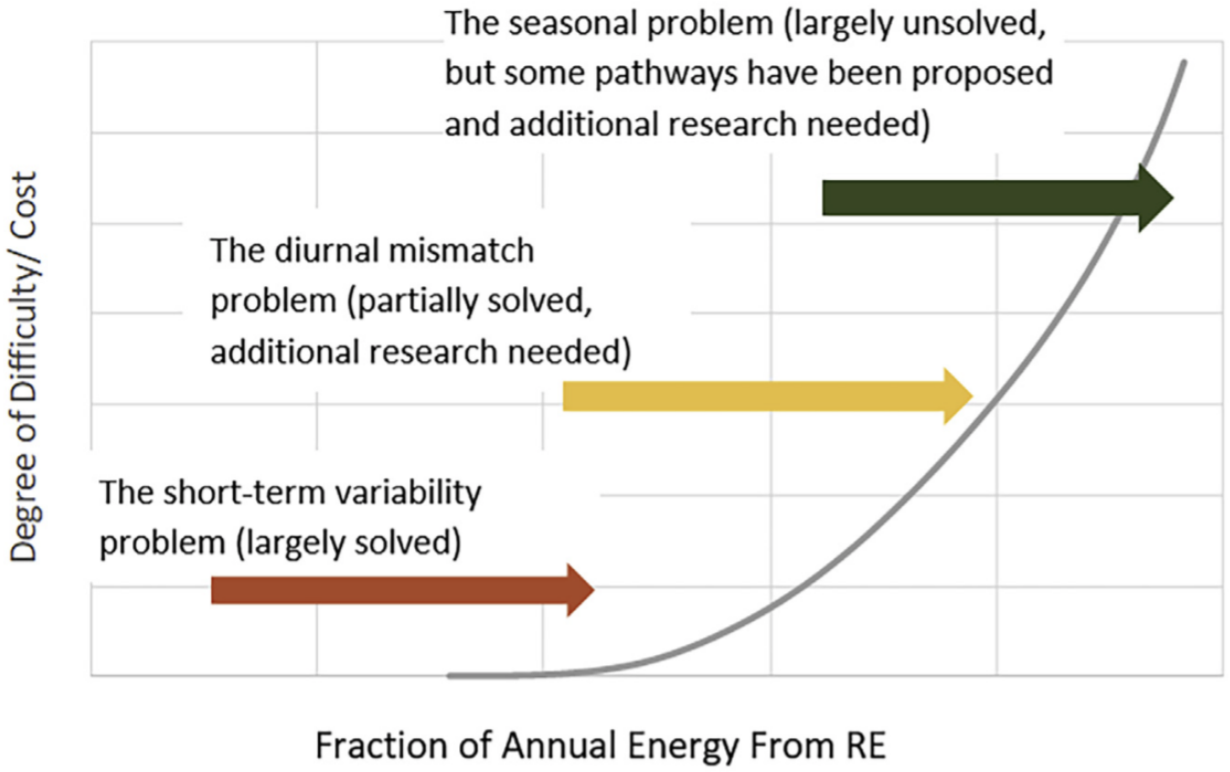
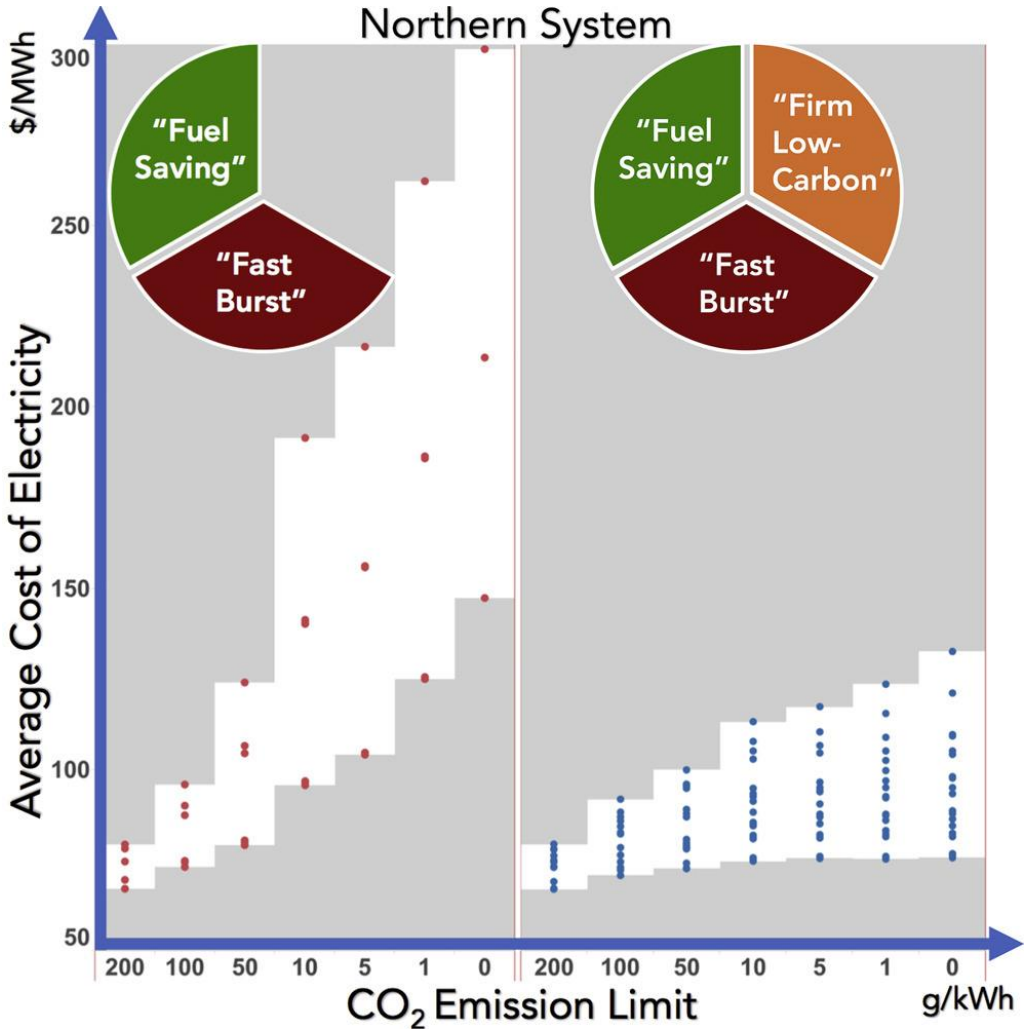


Figure 1. A simple framework for discussing the degree of difficulty and cost of increased RE deployment associated with the balance challenge

A central challenge: The gap between supply and demand

"Across all cases, the least-cost strategy to decarbonize electricity includes one or more firm low-carbon resources. Without these resources, electricity costs rise rapidly as CO_2 limits approach zero. Batteries and demand flexibility do not substitute for firm resources. Improving the capabilities and **spurring adoption of firm low-carbon technologies are key research and policy goals.**"

~ Sepulveda, N. A., Jenkins, J. D., de Sisternes, F. J. & Lester, R. K. The role of firm low-carbon electricity resources in deep decarbonization of power generation. Joule 2, 2403–2420 (2018).



Why a 24/7 approach?

1. Mismatches between supply and demand are frequently ignored in the analysis done by some organizations as well as in current annual procurement methods used by many companies
2. This leaves “gaps” --- and emissions --- because organizations are not receiving zero-carbon electricity when they need it, leaving them to rely on fossil fuel power plants (with emissions)
3. Companies are not maximizing their ability to drive progress toward an affordable, reliable, and net-zero electricity system
4. The broader grid is not being driven toward a 100%, net-zero set of technologies (ambition vs. reality)
5. Hourly (24/7) approaches to procurement and policy offer many advantages - including allowing organizations to achieve their decarbonization goals and drive the grid to net-zero

GraphicCredit: Canva.com

24/7 Zero-Carbon Electricity Framework: Identifies Existing Gaps and Needs to Reach Net-Zero

This research analyzed the existing gap between current procurement processes and what would be needed to achieve decarbonization goals.

Heat Map of a Big Box Store in New England Supplied with 50% Wind and 50% Solar and 1 MW Battery: Net Weekly Deficits and Surpluses

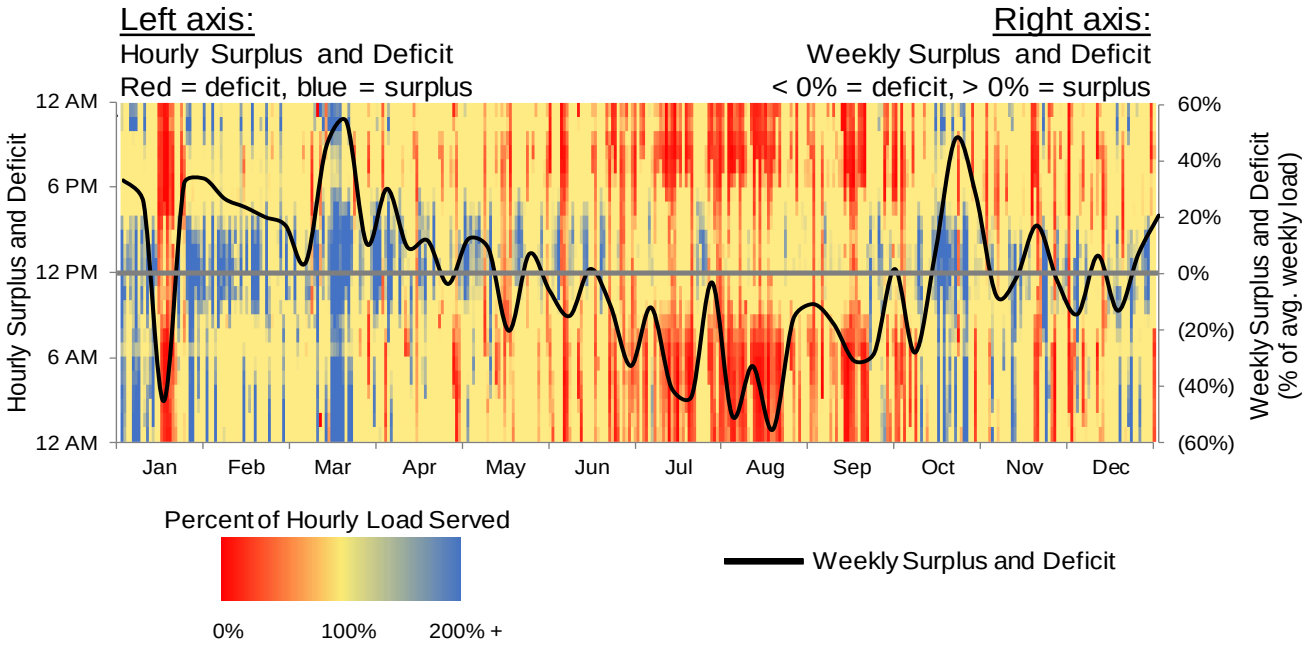


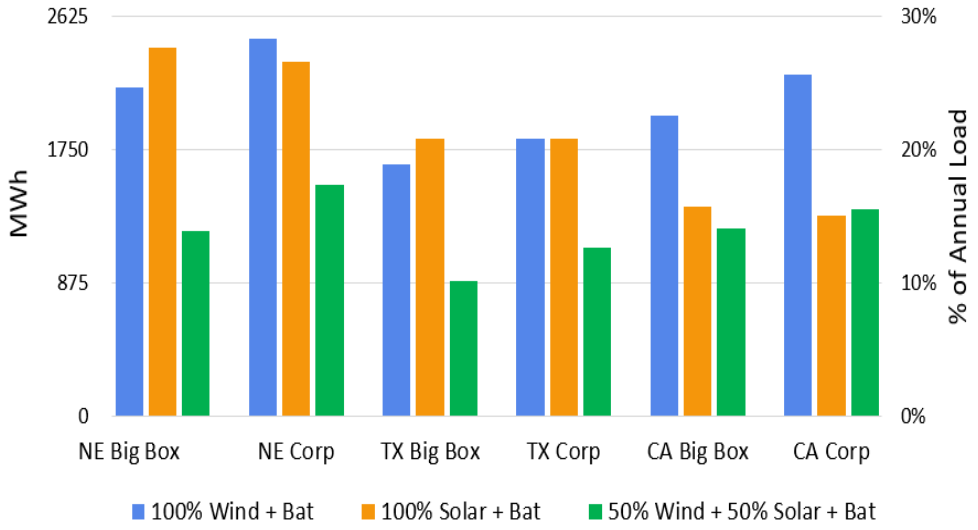
Table 2: Number of Hours Supplied by Grid Power for A Big Box Customer in New England

Supply Portfolio	% of Load Taken from the Grid	% of Hours Relying on the Grid	Carbon Emissions from Grid Power[37] (tons of CO_2/year)
100% Wind	34%	52%	839
100% Solar	50%	72%	1,225
50% Wind + 50% Solar	26%	56%	644
50% Wind + 50% Solar + 1 MW Battery	14%	28%	340

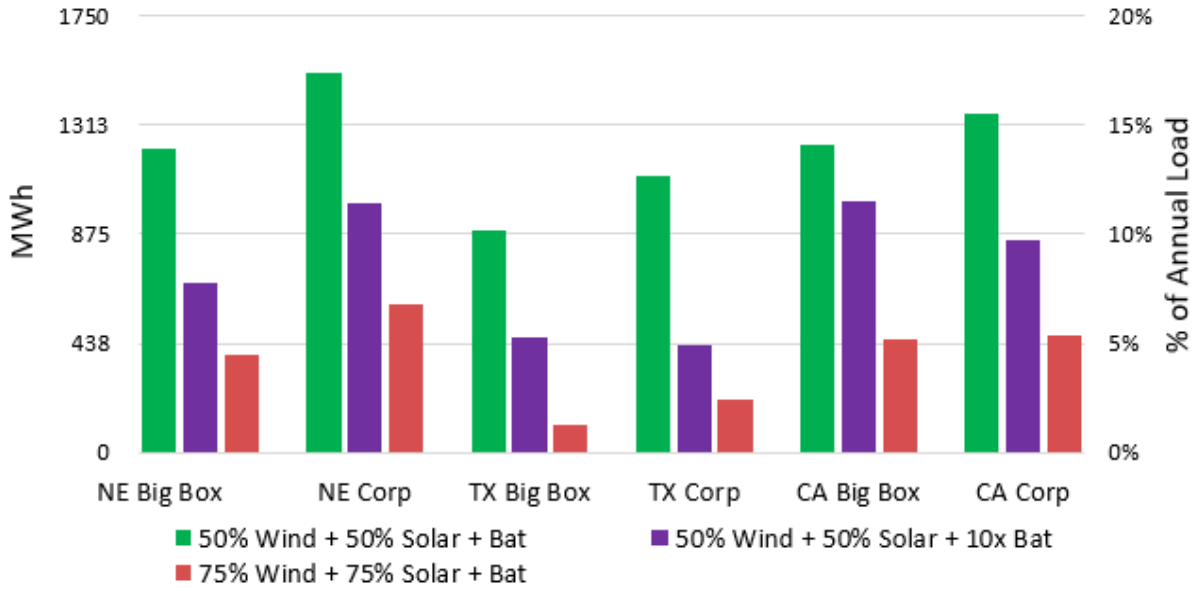
24/7 Zero-Carbon Electricity Framework: Commercial and Industrial Procurement

Across all the customer types, we see significant periods of time where supply and demand don't balance.

Annual Deficits for the Six Region – Customer Load Profiles



Annual Deficits with additional renewables or additional storage



The opportunity in 24/7 zero-carbon electricity procurement

- Ability to achieve stated goals
  - Verifiable emissions reductions
  - Company can get to a true net-zero
  - Organizations can drive grid-wide progress to net-zero
- Lower cost, Lower risk
  - Adding options in any market lowers costs and risks to operation, performance.
  - The mix **might** end up being 100RE --- but it shields the company if not.
- Avoid accusations of greenwashing
  - Rapid growth of scrutiny of company strategies will reveal failure of RE100 to deliver ZC operations
  - Verifiable emissions reductions --- avoids accusations of “greenwashing”
  - Best-in-class ESG
- Tools for local engagement
  - Some jurisdictions are wary of 100% RE and may be amenable to improved partnerships
  - Possible tool for engagement with government, utilities, advocacy/green groups, organized labor…
- Aligned with new state and national policies
  - Aligned with new state and national policies around the US and globe

Policy and market tools are also essential

- Policy makers seeking paths to accelerate the transition to zero-carbon electricity should emphasize the importance of all three technology pillars when choosing decarbonization targets and designing strategies to achieve them.
- Policy makers can take the following concrete actions to support a rapid and affordable transition to zero-carbon power:
  - Keep existing zero-carbon technologies such as nuclear power plants and hydropower facilities operating for as long as possible.
  - Frame policies to support 100 percent zero-carbon power, including an **array of zero-carbon technology options** across the three technology pillars and other tools (e.g., demand response) to ensure 24/7 affordable, reliable power.
  - Support research, development, and deployment of new and improved zero-carbon technologies across the three technology pillars.
  - Support investments in the transmission and distribution grid to advance the efficient movement of zero-carbon electricity from power plants to communities (i.e., location matching).
- Market structures that enable straight-forward procurement of 24/7 zero-carbon electricity is important.

Want to learn more about how we move our electricity to net-zero?

Check out The Big Switch – a free podcast from the Center on Global Energy Policy

Season 1: Building a net-zero grid

Thank You

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