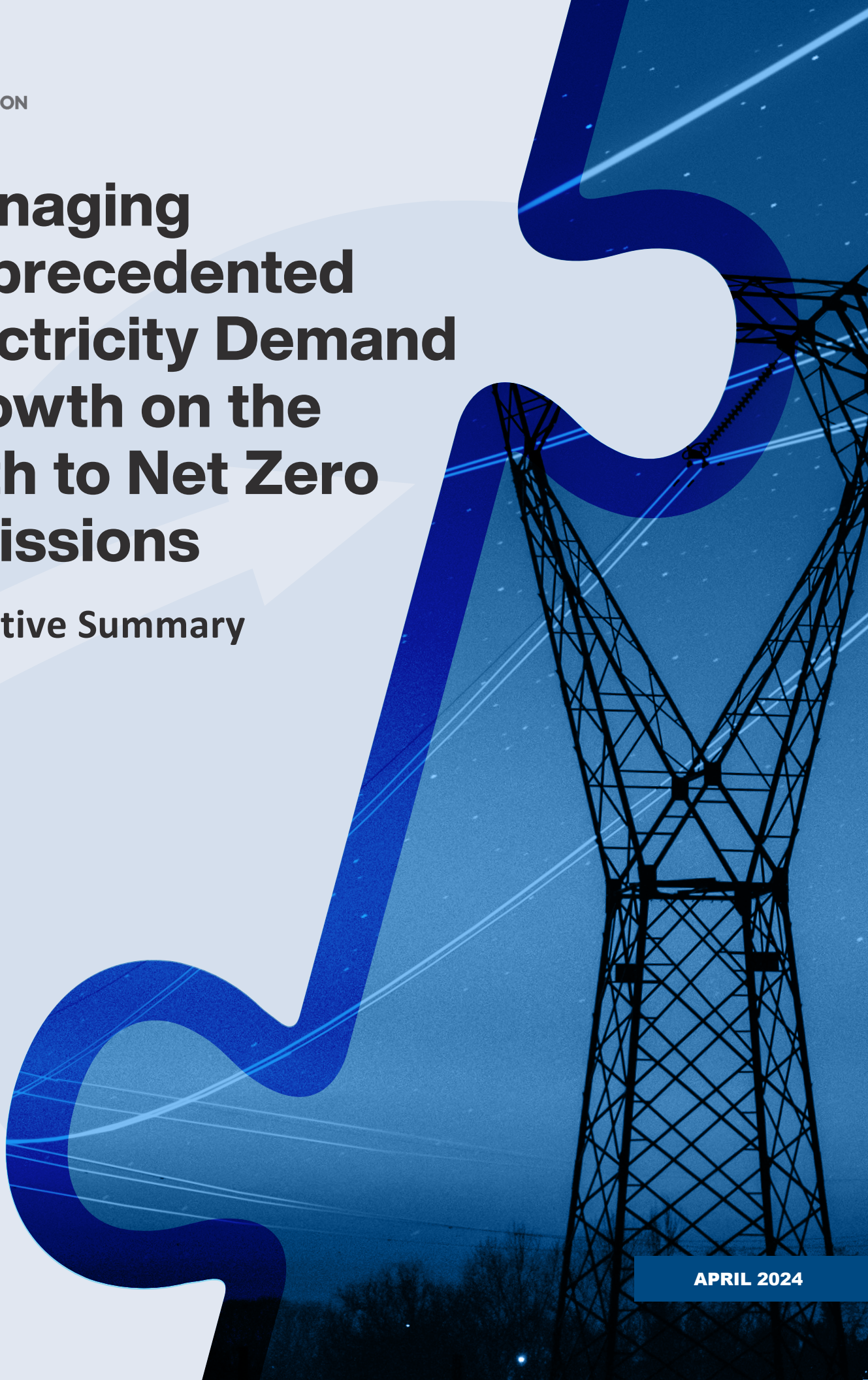
EFI FOUNDATION

Managing Unprecedented Electricity Demand Growth on the Path to Net Zero Emissions

Executive Summary



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The EFI Foundation advances technically grounded solutions to climate change through evidence-based analysis, thought leadership, and coalition-building. Under the leadership of Ernest J. Moniz, the 13th U.S. Secretary of Energy, the EFI Foundation conducts rigorous research to accelerate the transition to a low-carbon economy through innovation in technology, policy, and business models. EFI Foundation maintains editorial independence from its public and private sponsors.

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Executive Summary

As the United States works to address the climate crisis, the urgent push for decarbonization stands in stark contrast to the immediate challenges of managing near-term electricity load growth. Recent incentives to re-shore clean energy supply chains in legislation like the Inflation Reduction Act (IRA), the Infrastructure Investment and Jobs Act (IIJA) and the CHIPS and Science Act have prompted some of these new load demands, many of which will require firm power 24/7. Data center proliferation is also a major driver of near-term load growth, and the rapid expansion of AI is exacerbating their load requirements. In the mid- to long-term, increased electrification of end uses, such as vehicles, heat pumps and some industrial processes, compound the issue. To capitalize on these economic development opportunities, states and regions are seeking creative solutions to deal with load growth such as building out grid infrastructure and investing in projects that accelerate clean energy innovations.

The load growth dilemma is intensifying the strain on existing infrastructure, and addressing it requires inventive solutions and strategic foresight. Many utilities have dramatically increased their projected electricity load growth and have proposed meeting this in the near term by increasing their use of existing and/or new thermal plants. The tension between economic development and the associated increased electricity load and declared utility decarbonization targets in the 2030-time frame has stimulated important discussions.

On Feb. 12, 2024, the EFI Foundation hosted a group of nearly 30 senior-level experts from utilities, system operators, industry, and nongovernmental organizations, as well as former policymakers and regulators, consumers, and equipment (e.g., turbine) manufacturers to discuss the implications of recent public announcements of unprecedented load growth across many regions of the country.[1,2,3]

Several challenges were identified at the workshop that will need to be addressed in an era of dramatic acceleration in load growth. They are as follows.

1. Load growth is not uniform across the country and regionality impacts the tools available to address it. Regional differences in resource availability, including the appropriate geology for carbon storage and access to water resources, as well as the availability of generation resources like wind and solar means that strategies for addressing load growth must be tailored to regional resources, infrastructure needs, and limitations, particularly in the near term.

2. Load growth is likely to further accelerate. Data centers dominate the headlines today, but new manufacturing combined with electrification of transportation, space heating, and industry will place even greater strain on the grid in the coming decades.

3. Ensuring reliability and resiliency is paramount. While grid-enhancing technologies and storage solutions may lessen near-term load growth challenges, new gas-fired generation capacity will come online to provide firm power. As a result, power sector emissions may rise in the short term, while

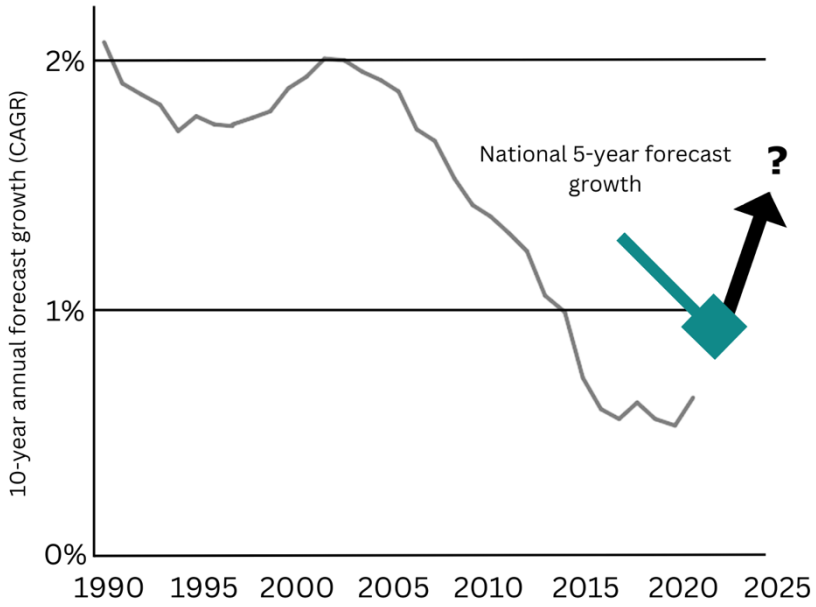
generation and transmission with longer lead times will address emissions in the longer term.

4. Policies need to be harmonized. New proposals seek to limit power sector emissions in the wake of recent policies promoting electrification. These proposals may constrain the sector's ability to meet increasing load demands. If the U.S. continues to encourage electrification, complementary policies will be needed to expedite grid modernization.
5. Very large, unexpected loads like gigawatt-sized data centers could require utilities to rethink their five-year plans. Longer term, grid managers may also need to create the frameworks and the associated regulatory structures to enable more proactive infrastructure buildout.
6. Though the threat of litigation has long been considered a serious impediment to building out new infrastructure, it has increased in prevalence and now seems to pervade the entire political spectrum.

The economywide transition to net zero emissions will rely heavily on successfully decarbonizing the power sector. For years, relatively flat power demand provided grid operators a clear and certain view of the scale of clean energy resources needed to reach zero carbon emissions. Now, driven in part by massive incentives in domestic manufacturing; trends in electrification of transportation, buildings, and industry; clean energy targets across the economy; and new investments in data centers and artificial intelligence, the pace of electricity load growth could nearly double or even triple over the next five years (Figure 1).[4,a] These load growth trends have potentially paradigm-shifting implications for the power sector, affecting system-wide reliability in the near-term and changing the course of deep decarbonization in the mid-term.

[a] Electricity load is the amount of power required to meet the demands of all customers on the grid. For example, a new data center may require 750 megawatts (MW) of power capacity. Once it is connected to the grid, the data center adds 750 MW of load. Grid managers are now facing the challenge of serving an unexpected growth in new load.

Figure 1. North American Electric Reliability Corporation's 10-year load growth forecast trend



For the last decade, grid planners have forecast only 0.5% annual electricity load growth, as reported by the North American Electric Reliability Corporation. However, in 2023, that forecast changed to 0.9%, as indicated by the blue box in the graph. Regional utility profile filings have revealed that electricity load will likely increase even more than that. Adapted from: North American Electric Reliability Corporation, Long-Term Reliability Assessment, December 2022, p. 20, Supplemental Table F, https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_2022.pdf.

Held under Chatham House Rule[b], the private EFI Foundation Load Growth Workshop was designed to elicit stakeholder discussion of both the opportunities and challenges of these recent trends, addressing the following questions:

- What is contributing to the potentially paradigm-shifting changes in near- and midterm load growth forecasts?
- What are the immediate needs for meeting electricity demand in the next one to five years, and how can stakeholders stay on track to decarbonize the sector by midcentury?
- How can longer-term planning and coordination efficiently enable the transition to a reliable, carbon-free electricity grid by midcentury?

The workshop discussion made clear that stakeholders are grappling with a new reality. Previously unforeseen load growth presents challenges with respect to continuing coal plant retirements, integrating renewables, and maintaining reliability. However, on the path to long-term climate goals, utilities, system operators, and policymakers also have

[b]Unattributed quotes throughout the report originate from the workshop discussion.

an opportunity to proactively collaborate and plan for a future that supports technologies that are clean, reliable, and affordable.

Four major themes emerged during the conversation:

1. **Recent projections are likely underestimating actual load growth.** Participants agreed that the projection that the pace of electricity load growth will double in five years is likely an underestimate as more utilities update their load growth forecasts.[5] This reinforces the idea that the era of flat demand is truly over for the near- and mid-term.
2. **Region-specific approaches are necessary for managing near-term load growth.** Regions across the U.S. are experiencing different paces of load growth and have varying options for its management. It is clear that reliable and affordable electricity cannot be compromised as cities, states, and regions work to meet climate goals. However, few existing technologies can provide cleaner, reliable, and affordable electricity. To meet near-term demand, natural gas generation with lower carbon intensity is an option consistent with various federal policies including the Inflation Reduction Act's (IRA) methane emissions fee. Grid-enhancing technologies, demand-side management, transmission and distribution system investments, and energy storage can also help. In parallel, continued investment in research, development, and demonstration projects is crucial to commercializing and deploying advanced clean energy technologies like CCS, clean hydrogen, small modular reactors, and long-duration energy storage.
3. **Stakeholder alignment is critical to meet the dual challenges of load growth: manage reliability and plan for deep decarbonization.** While the issue of certainty was discussed along many dimensions, what is clear is that the key stakeholders that collectively manage significant new loads must be aligned for the necessary investments in generation, transmission and distribution, and other resources that help manage the system. For example, how can policymakers and regulators unlock large amounts of private capital for projects? New large loads need to be developed in close coordination with grid planners and operators.
4. **Stakeholders are seeking flexibility to manage load growth uncertainty.** Investors, grid managers, and end users are all seeking certainty: Will new demand materialize to justify investments in generation and transmission infrastructure, and will it do so on the anticipated timeline? If electricity prices rise (which some stakeholders expect), will that reduce future load growth in turn? Increased transparency and collaboration can reduce uncertainty. Durable policies are also critical for investors to feel confident deploying large amounts of capital to projects.

Given the cross-cutting nature of many of the topics, some themes recur throughout this workshop report as they did in the conversation. Such cross-cutting themes demonstrate that these issues—along with many others—must be considered holistically by decision-makers.

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