Electricity Demand Growth and Forecasting in a Time of Change

NASEO WEBINAR

PREPARED BY

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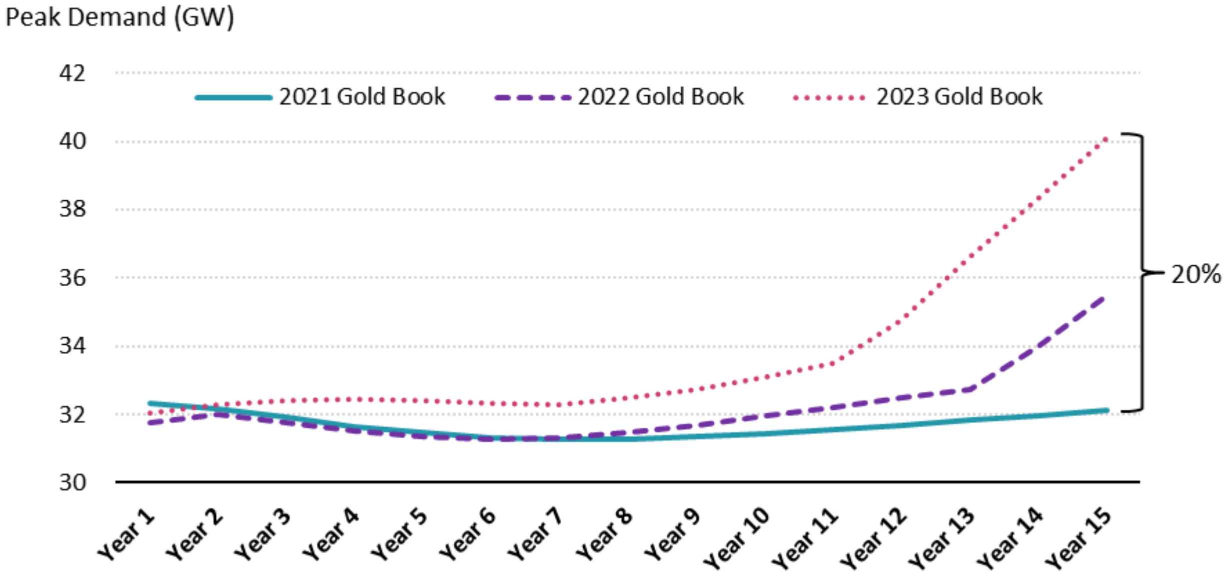
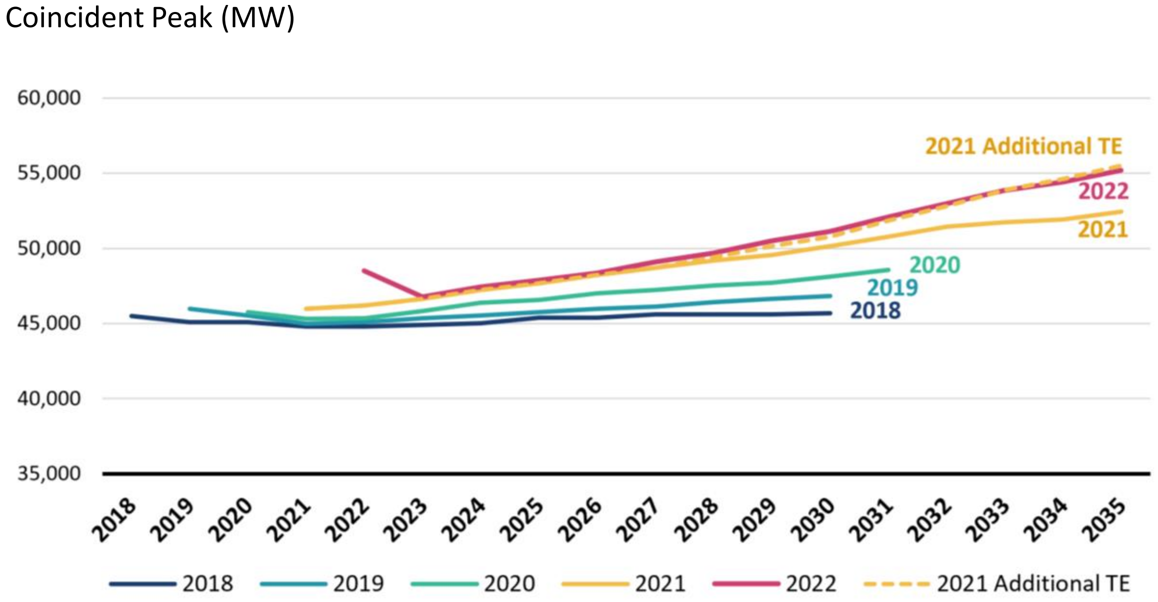
Brattle

Recent Forecasts Herald an Era of High Electricity Growth

NEW YORK PEAK DEMAND FORECASTS



CALIFORNIA DEMAND FORECAST CHANGES OVER TIME



The New Drivers of Electric Demand

DATA CENTERS

Data centers underpin the online economy technology sector and support the growth of artificial intelligence.

Current capacity: ~19 GW
Estimated electricity demand increase by 2030: +16 GW

ONSHORING & INDUSTRIAL ELECTRIFICATION

Electrification of the industrial sector is a major pathway to reduce emissions. New sources of electric demand are triggered by the onshoring of manufacturing activity, hydrogen production (e.g., electrolyzers), indoor agriculture, and carbon dioxide removal.

Current capacity: ~116 GW
Estimated electricity demand increase by 2030: +36 GW

CRYPTOCURRENCY MINING

Cryptocurrency mining is the process by which networks of computers generate and release new currencies and verify new transactions. Load from cryptocurrency mining is challenging to estimate because of its unique operational characteristics.

Current capacity: ~10–17 GW
Estimated electricity demand increase by 2030: +8–15 GW

BUILDING ELECTRIFICATION

Electrification is a major pathway to decarbonize buildings and can include space heating (e.g., heat pumps), water heating (e.g., heat pump water heaters), and cooking (e.g., electric/induction cook stoves).

Current capacity: ~50 GW
Estimated electricity demand increase by 2030: +7 GW

TRANSPORTATION ELECTRIFICATION

A growing number of customers purchase electric passenger vehicles as a more climate-friendly alternative to gas vehicles; medium- and heavy-duty vehicles, motorcycles, and ferries can all operate on electricity.

Current capacity: ~7 GW (electric vehicles)
Estimated electricity demand increase by 2030: +8 GW

The potential gaps between short run and long run forecasts are very large

Partially offset by:

- **DG Solar**
- **Flexible Loads/VPPs**
- **Energy Efficiency**

How Electric Forecasts Are Changing

- Electricity forecasters from many different types of organizations (utilities, RTO/ISOs) are starting to adapt their forecasting methods
- These efforts vary widely in terms of improvement techniques and the level of maturity of the effort
- Several utilities and RTO/ISO have made changes to their forecast approaches to incorporate new demand drivers, resulting in sometimes substantial changes in their load forecasts over the course of a few vintages
- Only a few entities include forecasts of these Type B drivers at the distribution level

INCORPORATION OF SELECTED MAJOR DEMAND DRIVERS BY VARIOUS FORECASTING ENTITIES

		Demand-Side Resources			Type B Load		Type A Load			
		EE	DR	DG	EVs	Electric Heating	Data Center	Indoor Agriculture	Electrolyzer	Industrial Onshoring
AZ	Arizona Public Service (APS)	✓	✓	✓	✓		✓			✓
AZ	Salt River Project (SRP)	✓	✓	✓	✓	✓	✓			
CA	City of Palo Alto	✓	✓	✓	✓	✓				
CA	CleanPowerSF	✓	✓	✓	✓	✓				
CA	Los Angeles Department of Water and Power	✓	✓	✓	✓	✓				
CA	Pacific Gas & Electric (PG&E)	✓	✓	✓	✓	✓				
CA	Southern California Edison (SCE)	✓	✓	✓	✓	✓				
CA	San Diego Gas & Electric (SDG&E)	✓	✓	✓	✓	✓				
CA	Sacramento Municipal Utility District (SMUD)	✓	✓	✓	✓	✓	✓	✓*		
CO	Black Hills	✓	✓	✓			✓*			
CO	Colorado Springs Utilities (CSU)	✓	✓	✓	✓	✓				
CO	Public Service Company of Colorado (PSCO)	✓	✓		✓	✓				

The Costs of Over- and Under-Forecasting

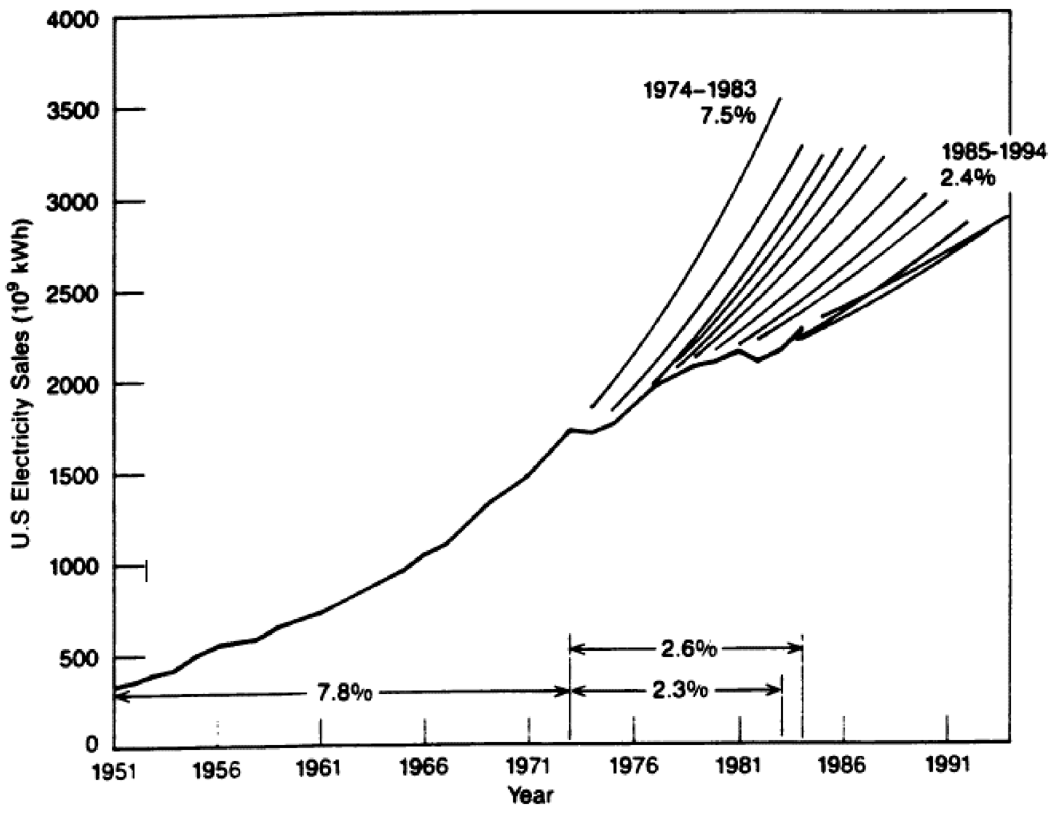
There are costs and risks to both over-forecasting (an issue historically) and under-forecasting.

Traditional practice: weigh probabilities of over-/under-forecasting with the associated costs.

Avoiding both is important, but ***the current environment introduces additional costs for under-forecasting***: long lead times to connect new generation projects, and long(er) time required to build transmission projects.

Where short-term demand is limited by the pace of supply expansion, you're actually forecasting supply not demand.   Integrated S and D forecasting, by time period, is especially important.

THE NERC FAN



Key Takeaways

> *Electric forecasting entities of all types should be evolving their forecasts to incorporate major changes in electricity use in the coming decades*

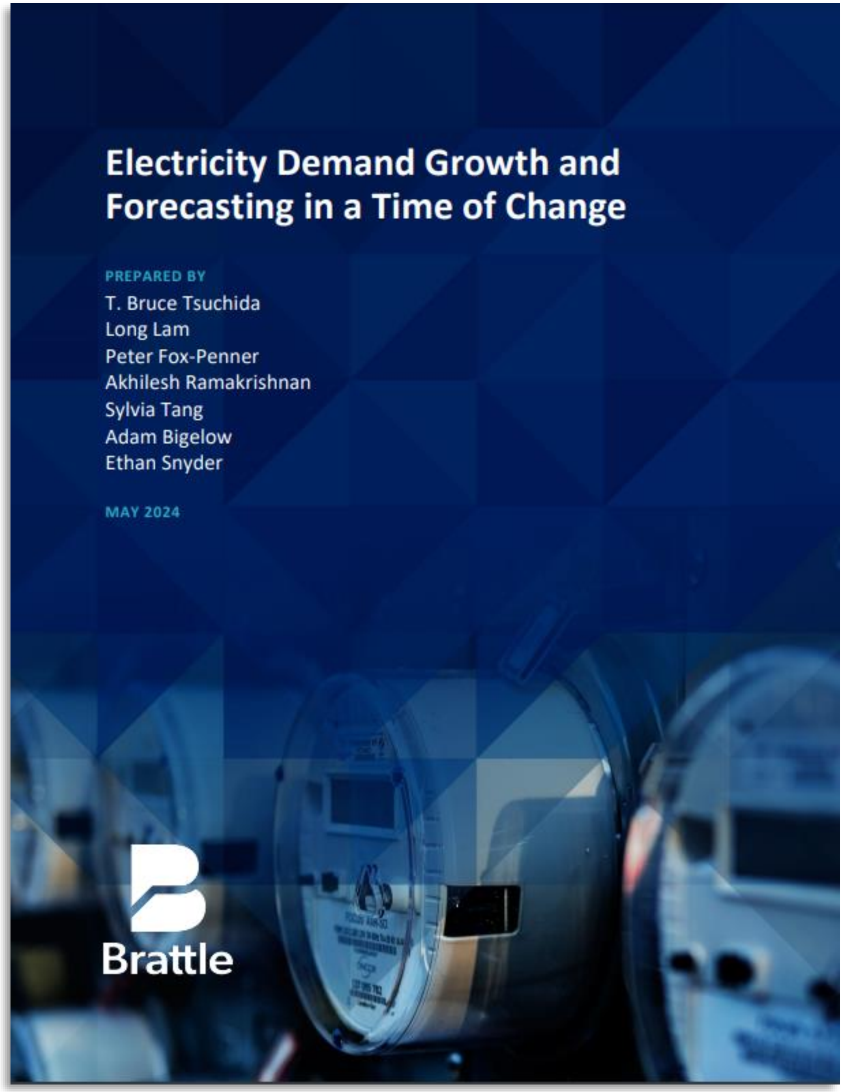
- *Many forecasters have made substantial progress updating their forecasting methods, but overall much progress still needed*

> *There is now a high potential cost of under-forecasting. We need more forward-looking, proactive electric system planning*

> *Integrated supply and demand forecasting by time period is important*

> *Explicitly consider expansion optionality and the full range of options in all generation and transmission plans*

- *Incorporate the full effects of demand-side resources (including flexibility) and non-wire alternatives*
- *Optimize usage of existing infrastructure (e.g., via the adoption of grid-enhancing technologies)*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Dr. Fox-Penner is a Senior Advisor to The Brattle Group. He is also a Partner and Chief Impact Officer at Energy Impact Partners, a dedicated clean energy financing platform. He was the founding Director of Boston University's Institute for Sustainable Energy (ISE) – now the Institute for Global Sustainability (IGS) – and is now an IGS Senior Fellow.

Between 1997 and 2015, Dr. Fox-Penner served as a Principal at The Brattle Group. During that time, he served in various roles including Office Director, as a member of the Board of Directors and as Chairman of the Board. He has also served as a Senior Official at the US Department of Energy and the White House Office of Science and Technology Policy, and he was a Professor of Practice at BU's Questrom School of Business.

Dr. Fox-Penner has testified on energy-related expert matters in more than 100 proceedings, including in front of federal courts, the Federal Energy Regulatory Commission, state courts, arbitrations, and at least 12 state public service commissions. He is also a frequent public speaker on energy topics and the author of numerous published articles and books, including Power after Carbon (Harvard University Press, 2020), Market Power and Market Manipulation in Energy Markets (with co-authors Tayle, Ledgerwood, and Broehm, PUR Press 2015), and the highly acclaimed Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities (Island Press, 2010). His research has been widely cited, including in one US Supreme Court decision.

Mr. Tsuchida specializes in the analysis of wholesale electric markets and modeling, including operations, valuations of transmission and generation assets, deliverability analyses, RTO cost benefit analyses, market power studies, and contract evaluations.

His experience spans a wide range of utility consulting projects, including the analysis of operations for power markets, ranging from integration studies for intermittent resources such as wind and solar power, ancillary service studies, operational logic studies, and analyses required for regulatory proceedings. These studies range from large interconnected systems to small island systems.

Mr. Tsuchida also has extensive experience in the analysis and modeling of wholesale marketing restructuring for the electric industry and power systems. For the US Department of Energy, he has been involved in the modeling of the entire Eastern Interconnection for the National Interest Electric Transmission Corridors. He has also performed cost benefit analyses of various RTOs, and analyses of RTO options for utilities and RTO seams eliminations. He has evaluated both transmission and generation assets and contracts for electric power markets throughout North America, as well as in the UK, Spain, the Netherlands, and Saudi Arabia.

Dr. Lam has expertise in the development and implementation of decarbonization strategies and in the design and analysis of clean energy policy.

His work for large companies and governments with net-zero commitments and for regulated utilities, market operators, and regulators focuses on several areas, including: emissions reduction strategies and implementation program development for entities pursuing large-scale decarbonization, granular accounting of Scope 2 emissions and clean energy procurement, including defining future-ready contractual arrangements and policies, the design and evaluation of smart rates, distributed energy resources, and load flexibility programs, development and analysis of pathways for an orderly clean energy transition.

In addition, Dr. Lam has led many assignments to develop greenhouse gas (GHG) abatement cost curves and abatement measure prioritization, analyze programs to effectively integrate clean energy resources, and evaluate the economic benefits of grid modernization and transportation electrification programs.

Mr. Ramakrishnan specializes in policy analysis, regulatory economics, and strategic planning related to electrification and distributed energy resources (DERs).

He has supported a range of clients, including utilities, regulators, renewable developers, and technology companies. Mr. Ramakrishnan has led efforts to evaluate the electric grid impacts of electrification and DER adoption. He has worked with utilities to conduct cost-benefit analyses of electrification programs, design electric rates for customers with emerging technologies, and develop integrated resource plans. He has also worked with technology companies and developers to illustrate the value of DERs and load flexibility to the electric system.