Optimizing Grid Infrastructure and Proactive Planning to Support Load Growth and Public Policy Goals

PRESENTED BY

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Motivation

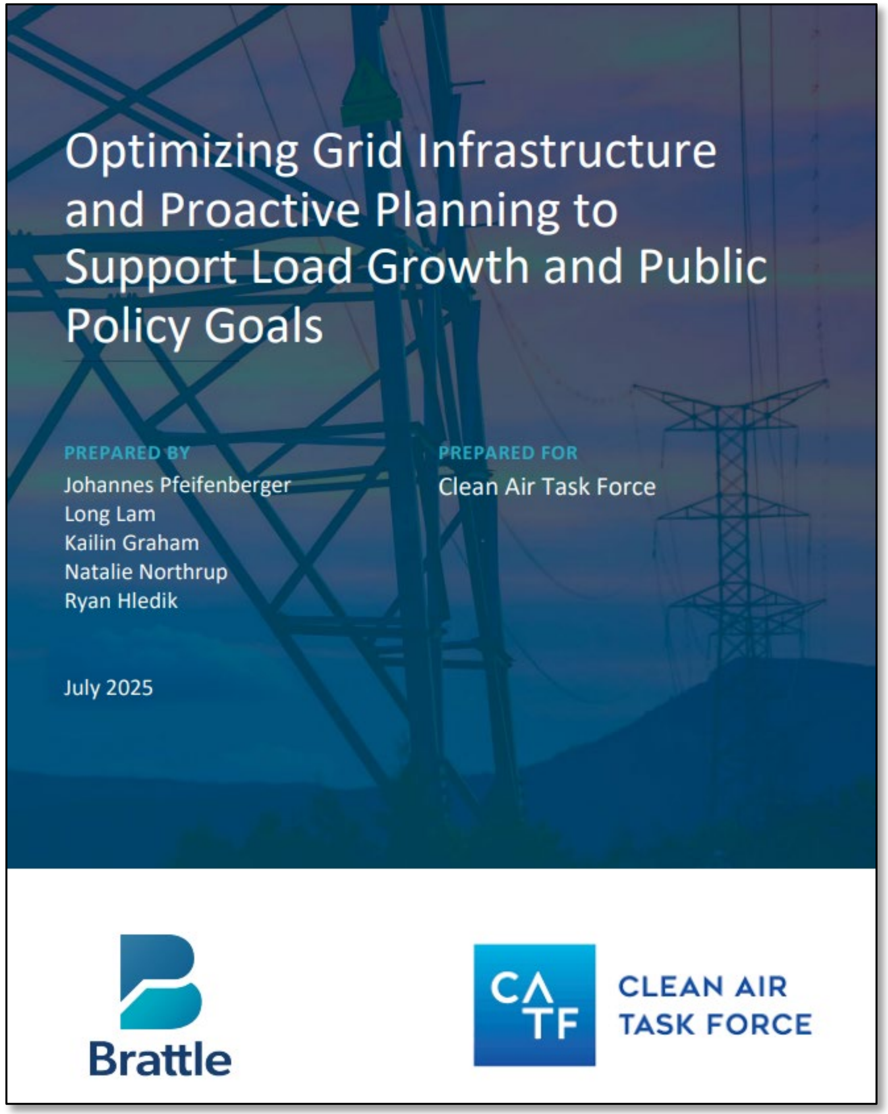
A recent whitepaper by Brattle experts laid out solutions for how utilities, system planners, policymakers, and regulators can collaborate to serve new loads more quickly and cost-effectively, while still meeting state and corporate energy goals such as reliability and affordability.

Many electric power systems are entering a period of rapid and transformational change due to:

- Accelerating electrification of buildings and transportation
- Re-shoring of industrial activity
- Unprecedented surge in demand from data centers
- Aging grid and generation infrastructure

Meeting this demand will require significant investments grid infrastructure, which can be costly and take a long time:

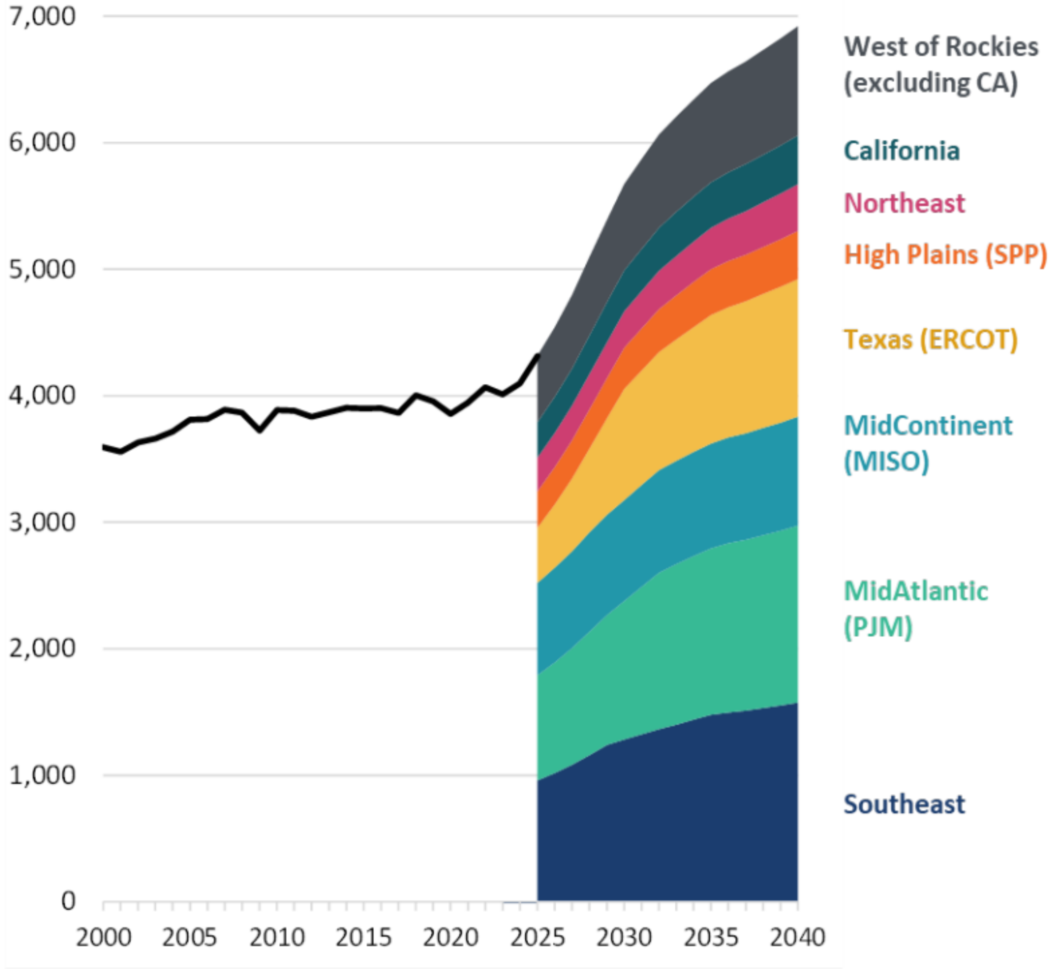
- Many new large customers are prepared to pay a premium or invest in this infrastructure themselves to avoid interconnection delays
- Capital needs likely exceed the financial capabilities of many utilities
- Affordability challenges and impacts on existing customers create challenges and regulatory risks



Report link

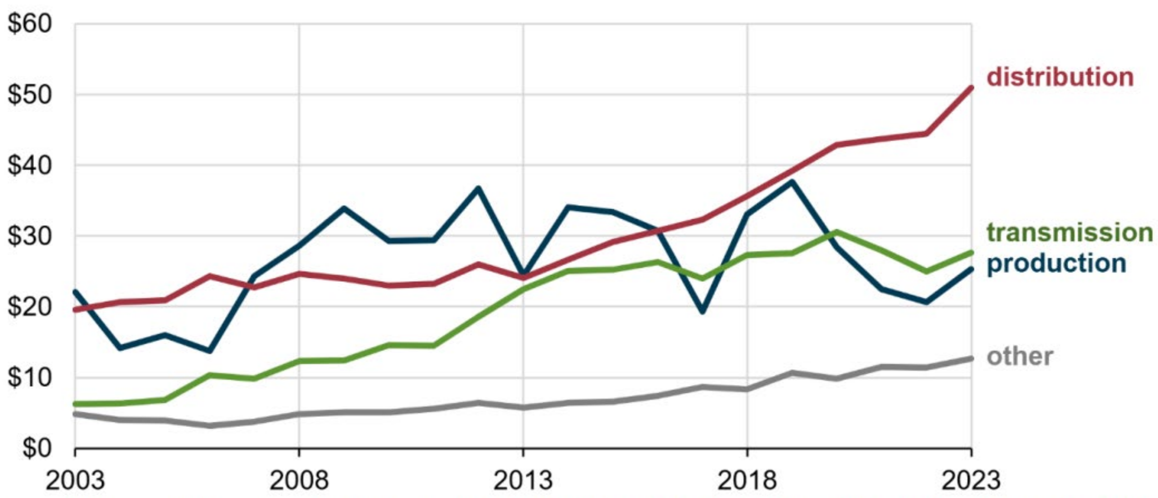
Challenge: Accelerating Load Growth and Capital Needs

FIGURE 1: FORECASTED GROWTH OF US ELECTRIC ENERGY DEMAND (TWH/YR)



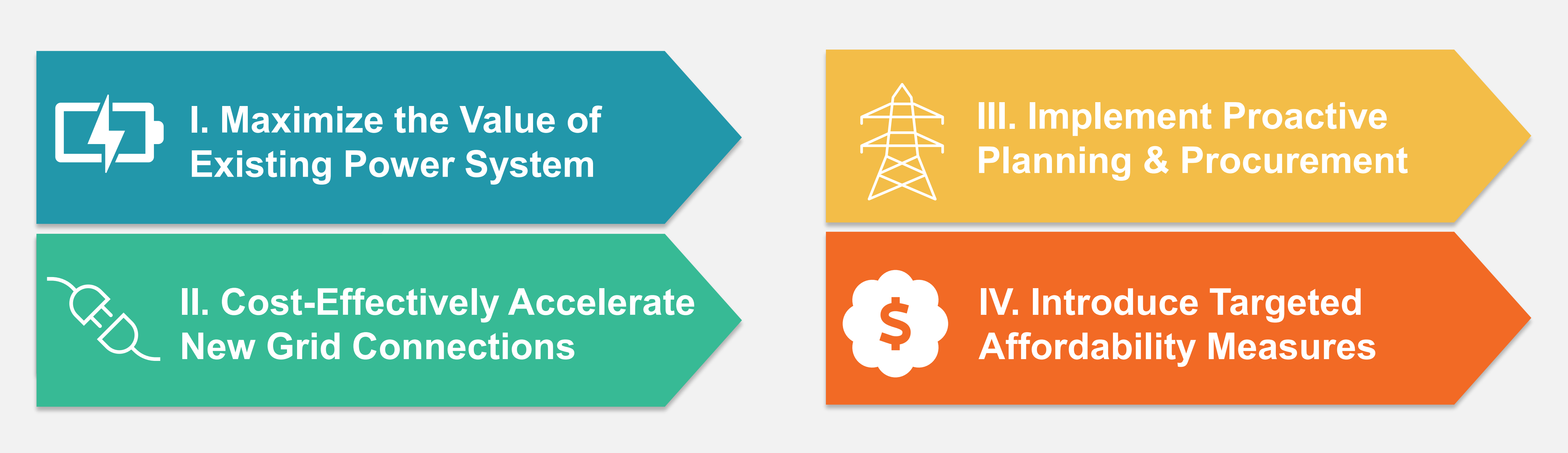
Source: The Brattle Group, based on an aggregation of individual regional transmission organizations (RTOs) and independent system operators (ISOs) and utilities' most recent forecasts.

FIGURE 2: ANNUAL US CAPITAL ADDITIONS BY SECTOR (2003–2023)
(2023 $billions)



Source: US Energy Information Administration (EIA) (2024), *Grid infrastructure investments drive increase in utility spending over last two decades*. Data sourced from US EIA and FERC financial reports as accessed by Ventyx Velocity Suite.

Pillars to Support Load Growth and Policy Goals Quickly and Efficiently



For each of these key areas, the full report offers case studies, cross references to industry experience and commercially-available technologies, and a discussion of best practices.

Success Will Require Coordination & Collaboration among Key Stakeholders

SOLUTION	REGULATORS	UTILITIES	GRID PLANNERS /OPERATORS	GOVERNORS LEGISLATORS	OTHERS
I. Maximize the Value of Existing Power System	☑	☑	☑	☑	Third-party DER aggregators
II. Cost-Effectively Accelerate New Grid Connections	☑	☑	☑	☑	Energy park developers
III. Implement Proactive Planning & Procurement	☑	☑	☑	☑	Power procurement authorities; state energy offices
IV. Introduce Targeted Affordability Measures	☑	☑		☑	State energy offices

(See more detailed table in Executive Summary of the full report.)

I. Maximize the Value of the Existing Power System

A. Enhance distributed and demand-side resources

- Deploy proven demand-side programs (e.g., EV managed charging, virtual power plants and aggregations of DERs)
- Create incentives for (new) large customers to provide flexibility

B. Enhance rate options

- Offer time-of-use rates, critical peak pricing, real-time pricing more widely
- Leverage customers' load flexibility by tapping into their behind-the-meter resources

C. Utilize GETs, ATTs, and RASs

- Create additional grid capacity by promoting grid-enhancing technologies, advanced transmission technologies, and remedial action schemes
- Consider "loading order" that prioritizes increasing existing grid capacity ahead of the construction of new transmission lines

D. Capitalize on grid upsizing opportunities

- Identify and capitalize on opportunities to upsize existing transmission lines where added transmission capability is needed now and where the refurbishment of aging lines becomes necessary now

E. Facilitate interregional trade

- Pursue intertie optimization in operation and planning to take advantage of available interregional transfer capability in real time and achieve production cost savings

(See discussion, references, and case studies in Section III of the full report.)

II. Cost-Effectively Accelerate the Grid Connection of New Loads

A. Enhance customer-sponsored generation

- Encourage and allow customers to self-supply to enhance system reliability, address transmission constraints, and promote the adoption of efficient on-site technologies
- Design self-supply tariffs to avoid shifting costs of incremental grid investments to other customers without inadvertently creating barriers to customer self-supply

B. Co-locate new generation and load

- Support the development of precisely controllable "energy parks" (i.e., large microgrids) to minimize or avoid entirely the need for transmission upgrades, increasing speed to market while reducing system and customer costs
- Adopt interconnection processes that reflect the operation of co-located load and generation, and offer expedited screening processes given the controllable, non-firm nature of their grid injections

C. Streamline generator interconnection processes

- Continue to improve the interconnection study process through greater integration with transmission planning and other aspects of generator interconnection
- Accelerate interconnection requests for shared interconnection points and shovel-ready projects at grid locations with existing or planned interconnection capacity

(See discussion, references, and case studies in Section IV of the full report.)

III. Implement Proactive Planning and Procurement Processes to Accelerate the Necessary Investments

A. Proactively plan generation and transmission

- Adopt proactive, scenario-based planning practices that allow for the identification of more flexible, cost-effective generation and transmission solutions
- Develop “least-regrets” solutions that maximize long-term cost savings while minimizing over- and under-investment risks

B. Reform generator procurement processes

- Consider frequent procurement and accelerating their competitive procurement processes, differentiating between procuring energy and capacity needs, and evaluating system impacts in bid evaluations
- Structure procurements to be technology-neutral and inclusive of all cost-effective options

C. Proactively plan distribution systems

- Pursue scenario-based planning that facilitates the prebuilding of projects in constrained parts of the grid
- Develop spatially and temporally granular load forecasts

D. Improve load interconnection processes

- Revise interconnection processes and rate structures to reflect economic and energy policy objectives
- Explore how a multi-criteria load auction may be a useful tool to allocate system headroom

(See discussion, references, and case studies in Section V of the full report.)

IV. Introduce Targeted Affordability Measures

A. Offer energy efficiency and bill assistance

- Prioritize energy efficiency and conservation programs for low-income and vulnerable customers
- Provide targeted bill assistance programs to further support to low-income customers and energy-burdened households

B. Implement specialized rates for new large loads

- Consider tariff structures designed for large customers and provisions to protect against stranded asset risks (e.g., by requiring long-term commitments to pay for contracted energy and/or capacity)

C. Explore alternative financing

- Explore levelized cost recovery frameworks and performance-based ratemaking, as well as securitization of investment costs
- Consider public-private partnership models to assist with reducing financing costs and expedited construction of energy projects

(See discussion, references, and case studies in Section VI of the full report.)

Conclusions

The electricity industry faces significant challenges today:

- Unprecedented load growth (demand from new data centers, re-shoring of manufacturing, the electrification of end uses), which creates the need for speed
- Ambitious state energy policy goals
- Supply chain challenges and the need to refurbish an aging grid, which exacerbates capital investment needs
- Already-existing cost pressures and affordability challenges for customers

Addressing these challenges is possible but require significant collaboration between utilities, system planners, policymakers, regulators, and market participants

It is possible (with experience and commercially-available tools that already exist) to:

- Maximize the value of the existing power system
- Cost-effectively accelerate the grid connection of new resources and loads
- Implement proactive planning and procurement processes to identify flexible, least-regrets solutions
- Introduce targeted affordability measures for low-income and vulnerable customers, while adopting best-practice rate designs for large customers to mitigate stranded-cost risks and minimize risks to existing customers

Thank You!

(Additional Slides)

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John Tsoukalis is a Principal at The Brattle Group with experience assisting clients in across a broad range of issues related to wholesale electric power markets.

John has expertise in analyzing transmission investment opportunities and in North America. He has helped clients assess the transmission investment landscape and forecast the growth of investment in transmission development over the next 10-15 years. He has experience in electric market modeling, analyzing the benefits of regional market participation, market design, the benefits of transmission infrastructure, detection of market manipulation and damages analyses, and electric sector strategic planning. He has led efforts to model the power system to assess the benefits of participation in wholesale power markets, value generation assets, and analyze the benefits of new transmission. John has worked with ISOs and RTOs to develop and implement market rules governing capacity auctions, wholesale power markets, ancillary services, and financial energy products. He has helped ISOs and RTOs design market power mitigation regimes and auction clearing mechanisms.

Brattle Group Publications on Large Load Integration

- Podcast: Principals Dr. Peter Fox-Penner and Tom Chapman joined a recent episode of Electricity Canada's *Flux Capacitor* podcast to discuss electric utility sector challenges and solutions, July 2025.
- Whitepaper: Principal Hannes Pfeifenberger and Ryan Hledik and Managing Energy Associate Long Lam authored a report on optimizing grid infrastructure to support load growth and public policy goals for the Clean Air Force, July 2025.
- Podcast: Senior Consultant Andrew Levitt and Mintz Attorney Steven Shparber discuss the challenges and opportunities of on-site resources in accelerating data center interconnection and reliability, June 2025.
- Whitepaper: Brattle Experts Outline "Clean Capital Efficiency" Approach for Electric Utilities to Navigate Industry Challenges, May 2025.
- Presentation to the Energy Bar Association's 2025 Annual Meeting & Conference: Are Resource Adequacy Markets Adequate?, May 2025.
- Presentation to Uplight Customer Connect: Catalyzing the Customer-Centric Clean Energy Transition: Unlocking Load Flexibility with Rates, May 2025.
- Reports: "Sixth Review of PJM's Variable Resource Requirement Curve," prepared by Principals Dr. Kathleen Spees and Dr. Samuel Newell, Energy Associate Dr. Andrew W. Thompson, Energy Specialists Ethan Snyder and Xander Bartone and "Brattle 2025 CONE [Cost of New Entry] Report for PJM," coauthored by Dr. Newell and Dr. Thompson, Principal Dr. Bin Zhou, Energy Analyst Nathan Felmus, and Research Analyst Harsha Haribhaskar along with consultants from Sargent & Lundy, April 2025.
- Report: "Accelerating Integration of New Co-located Generation and Loads," prepared for Bloom Energy, April 2025.
- Whitepaper: Brattle Consultants Examine the Challenges & Opportunities Associated with Meeting Load Growth Surge, April 2025.
- Report: "A Wide Array of Resources is Needed to Meet Growing US Energy Demand," prepared by Principal Dr. Sam Newell, Managing Energy Associate Dr. Wonjun Chang, Senior Energy Analyst Paige Vincent, and Energy Research Associate Sam Willett, February 2025.
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Pfeifenberger, Bay, et al., The Need for Intertie Optimization: Reducing Customer Costs, Improving Grid Resilience, and Encourage Interregional Transmission, October 2023.
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Brattle Group Practices and Industries

ENERGY & UTILITIES

- Competition & Market Manipulation
- Distributed Energy Resources
- Electric Transmission
- Electricity Market Modeling & Resource Planning
- Electrification & Growth Opportunities
- Energy Litigation
- Energy Storage
- Environmental Policy, Planning and Compliance
- Finance and Ratemaking
- Gas/Electric Coordination
- Market Design
- Natural Gas & Petroleum
- Nuclear
- Renewable & Alternative Energy

LITIGATION

- Accounting
- Analysis of Market Manipulation
- Antitrust/Competition
- Bankruptcy & Restructuring
- Big Data & Document Analytics
- Commercial Damages
- Environmental Litigation & Regulation
- Intellectual Property
- International Arbitration
- International Trade
- Labor & Employment
- Mergers & Acquisitions Litigation
- Product Liability
- Securities & Finance
- Tax Controversy & Transfer Pricing
- Valuation
- White Collar Investigations & Litigation

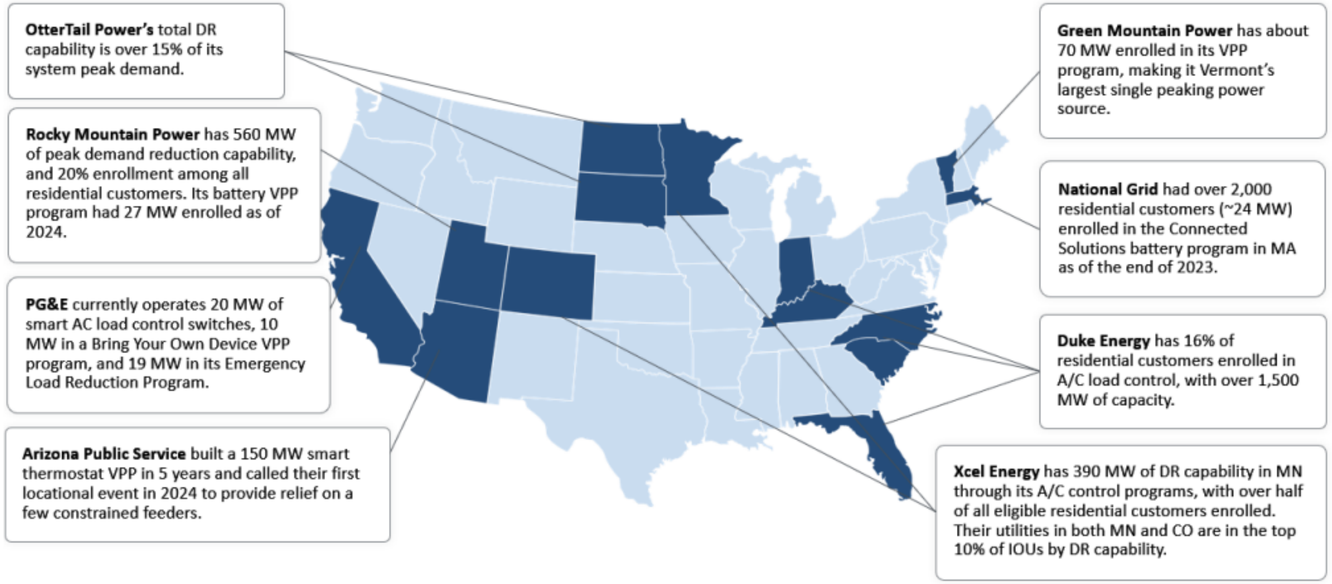
INDUSTRIES

- Electric Power
- Financial Institutions
- Infrastructure
- Natural Gas & Petroleum
- Pharmaceuticals & Medical Devices
- Telecommunications, Internet, and Media
- Transportation
- Water

TABLE ES-1: STAKEHOLDER ACTION MATRIX

	Solutions	Regulators	Utilities	Grid planners / operators	Governors and Legislators	Others
Maximize the Value of the Existing Power System *(Section III)*	*A. Enable distributed and demand-side resources*	✓	✓	✓		Third-party DER aggregators
	B. Enhance rate options	✓	✓		✓	
	C. Utilize GETs, ATTs, and RASs	✓	✓	✓	✓	
	D. Capitalize on transmission upsizing opportunities	✓	✓	✓		
	E. Facilitate interregional trade			✓	✓	
Cost-Effectively Accelerate the Grid Connection of New Loads *(Section IV)*	*A. Enable customer-sponsored generation*	✓	✓	✓	✓	
	B. Co-locate new generation and load	✓	✓	✓	✓	Energy park developers
	C. Streamline generator interconnection processes	✓	✓	✓		Transmission owners
Implement Proactive Planning and Procurement Processes to Accelerate the Necessary Investments *(Section V)*	*A. Proactively plan generation and transmission*	✓	✓	✓	✓	Power procurement authorities; State energy offices
	B. Reform generator procurement processes	✓	✓	✓	✓	Power procurement authorities; State energy offices
	C. Proactive plan distribution systems	✓	✓			
	D. Improve load interconnection processes	✓	✓		✓	State energy offices
Introduce Targeted Affordability Measures *(Section VI)*	*A. Offer energy efficiency and bill assistance*	✓	✓		✓	State energy offices
	B. Implement specialized rates for new large loads	✓	✓		✓	
	C. Explore alternative financing	✓	✓		✓	Private developers

FIGURE 3: EXAMPLES OF DEMAND RESPONSE PROGRAMS



Sources: Figures from Hledik, R. et al. (2024), *Distributed Energy, Utility Scale: 30 Proven Strategies to Increase VPP Enrollment*. For detail about individual programs, please see Energy and Environmental Economics (2023), *Charging Forward: Energy Storage in a Net Zero Commonwealth*; *Power Magazine* (2024), "Peak Performance: APS's Virtual Power Plant Saves Big During Brutal Heatwave"; Rocky Mountain Power (2024), *Demand Side Management 2023 Annual Energy and Peak Load Reduction Report*; and RMI (2024), *Virtual Power Plant Flipbook*.

FIGURE 4: EXAMPLES OF DEMAND RESPONSE AGGREGATORS

Residential Focus

EnergyHub
1.4 million devices; 2 GW of capacity
Energy Hub helps utilities manage their smart thermostat, battery, and EV programs. In 2023 they enrolled 100,000 customers (90 MW) in Ontario's smart thermostat program in just 6 months.

RenewHome
3 GW of capacity
RenewHome helps customers manage their energy use. They work with 100+ utilities and are partnering with NRG to build a 1 GW virtual power plant in Texas.

Uplight
7.8 GW of capacity
Uplight provides utilities a platform to manage customer DERs. They worked with Consumers Energy's thermostat program to enroll 10,000 customers per week.

Commercial and Industrial Focus

CPower
7 GW of capacity
CPower helps customers manage and monetize their DERs. They have a portfolio of large customers, with 7 GW of capacity at more than 28,000 sites across the U.S.

Voltus
7 GW of capacity
Voltus helps customers manage and monetize their DERs. They have over 13,000 sites enrolled across over 60 programs to provide grid services.

Electric Vehicle Focus

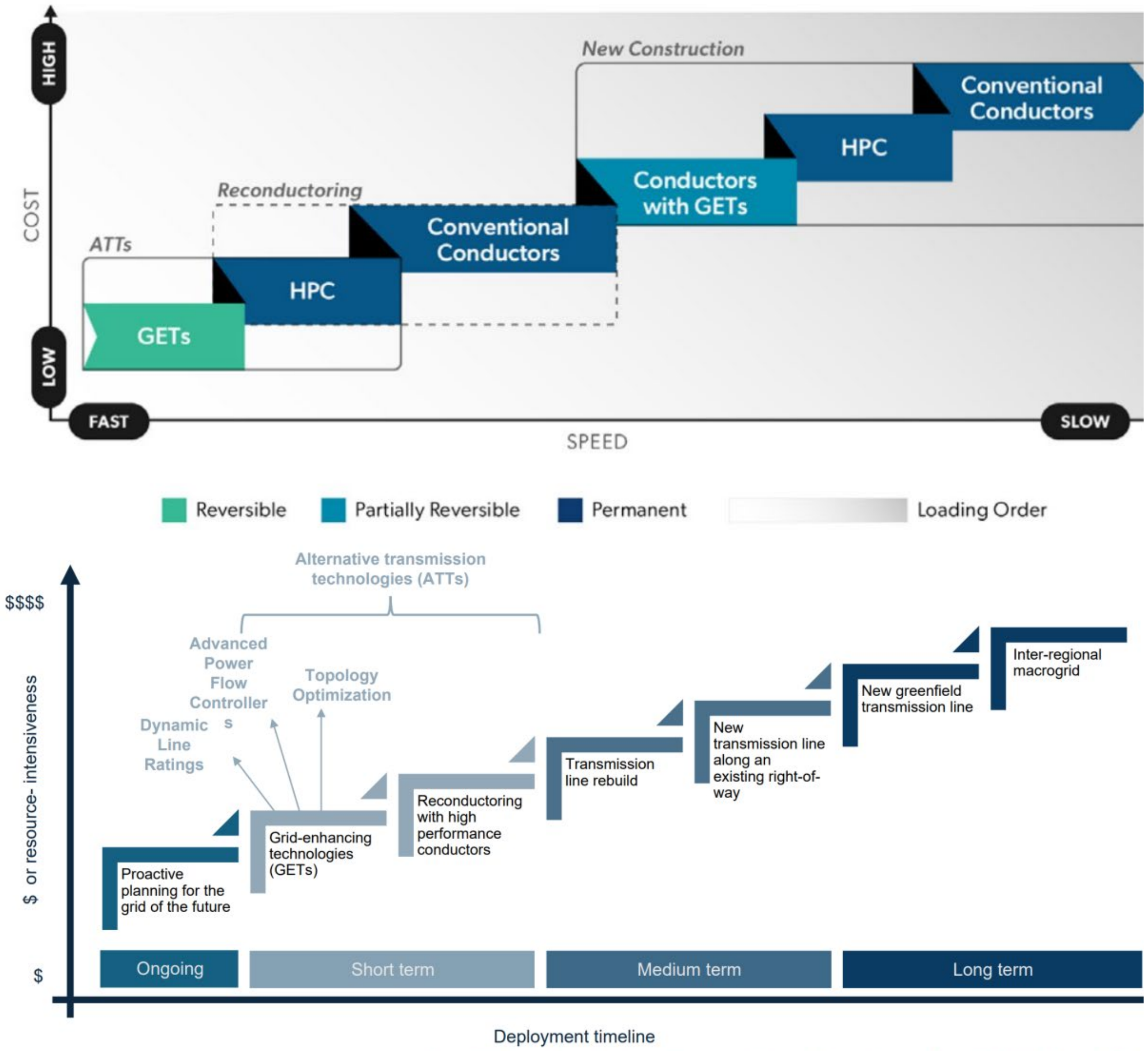
ev.energy
200,000 EVs under management
ev.energy smart charging helps EV drivers optimize their charging schedules to reduce costs and carbon emissions and take advantage of off-peak rates. ev.energy has partnered with 55+ utilities across the globe and connected over 200,000 drivers, reducing peak charging load by over 90%.

WeaveGrid
Supports over 30 utilities and OEM partners
WeaveGrid leverages vehicle telematics, chargers, and utility data for managed charging and supports utilities serving more than 40% of EVs in the U.S. In 2022, it partnered with PG&E to launch the Resilient Charging Pilot, where about 5,000 EVs were provided passive and active managed charging options to enhance grid resilience.

TABLE 1: SUMMARY OF RECOMMENDATIONS FOR GENERATION PROCUREMENT REFORM

Recommendation	Benefit
1. Increase procurement frequency and shorten procurement process	Accelerates load interconnection
2. Assess bids on their impact on capacity needs	Ensures that generation procurement is aligned with capacity needs
3. Include demand-side resources	Enables quick deployment of low-cost, utility-scale customer-side energy and capacity resources
4. Prioritize grid locations that have available or pre-planned capacity	Minimizes cost of infrastructure investments needed to service new generation
5. Prioritize resources that help alleviate transmission constraints	Ensures that procured generation lowers costs for ratepayers by avoiding congestion and reducing the need for and cost of congestion management
6. Consider intentionally supporting promising clean, dispatchable generation technologies (e.g., geothermal)	Invests in the development of industries that may offer significant value for the future electricity system
7. Allow utility self-build proposals to compete with third-party proposals	Allows the advantages of both public and private entities to compete to deliver the most cost-effective solution, and facilitates innovation in public-private partnerships

FIGURE 5: "LOADING ORDER" OF GETS, ATTS, AND NEW TRANSMISSION



Sources: Tsuchida, T.B. (2025), *Incorporating GETs and HPCs into Transmission Planning Under FERC Order 1920* and RMI (2024), *Alternative Transmission Technologies in Order 1920 and PJM.*

BOX III-A: EXAMPLES OF GETS DEPLOYMENT IN OTHER JURISDICTIONS

PPL's and GRE's Dynamic Line Rating Implementation

Instead of rebuilding or reconductoring two congested 230-kV lines, a Pennsylvania utility, PPL, deployed dynamic line rating at a total cost of less than $300,000 over the course of a year.[48] By fully integrating DLR ratings into PJM's nodal day-ahead and real-time energy markets and operations, PPL avoided approximately $50 million in transmission expansion costs and immediately began generating congestion savings of approximately $20 million per year, with one line seeing winter congestion costs reduced from over $60 million to $1.6 million. DLR increased the transfer capability ratings of the lines by an average of 19% for the lines' "normal" ratings and by 9–17% for the lines' "emergency" ratings. Similarly, Great River Energy (GRE) had deployed DLR on nine lines and integrated with MISO regional market operations, when savings during a single hour with high wind generation were over $3 million, more than paying for the entire DLR investment.[49]

These types of DLR investments are significantly more widespread in Europe. For example, the Belgian grid operator, Elia, uses DLR on a system-wide basis involving 35 transmission lines. Elia's operational experience shows that DLR is more effective and more reliable than ambient-adjusted ratings (AAR), capable of increasing transmission ratings above static ratings on average by 27–30% over the course of a year.[50]

NewGrid Topology Optimization

A Brattle review of 22 case studies where the NewGrid Router topology optimization software was used found that the software expanded the grid's effective capability between 5% and 25% while meeting all reliability requirements by identifying grid reconfigurations that alleviated system constraints.[51] Case studies included Alliant Energy, whose use of NewGrid's software delivered US$24 million in net cost savings to customers in Iowa over a two-year period, and MISO, where a reconfiguration solution to facilitate the maintenance of a major 345 kV line generated congestion cost savings of US$3.5 million and production cost savings of US$1.1 million over a three-week period while also reducing wind curtailments by 86%.

SCE Deployment of High-Performance Conductors

Southern California Edison (SCE) chose an HPC solution to upgrade 137 miles of its Big Creek transmission corridor, increasing transmission capacity by 40%. Being able to reuse the existing towers saved SCE $50,000 per tower, streamlined the utility's permitting and environmental impact studies, and reduced construction time from 48 to 18 months.[52]

BOX IV-A: SLEEVING CONTRACTS, RETAIL ACCESS, AND ENERGY PARKS IN OTHER JURISDICTIONS

NV Energy Clean Transition Tariff: Google & Fervo Energy Geothermal

NV Energy—in partnership with Google—sought and recently received approval from regulators for a new "Clean Transition Tariff" that allows customers with average hourly load larger than 5 MW to pay a higher rate for clean, firm generation from emerging technologies.[70] Google supported the tariff as a means to finance a Fervo Energy geothermal project to supply its forthcoming data center load. NV Energy would buy electricity from the in-development 115-MW geothermal plant and sell it to Google at a set rate. In exchange, Google would have the plant's generation and capacity credited against the energy and demand charges, respectively, on the bill of its data centers.[71] This type of arrangement allows the customer to benefit from clean, firm supply while shouldering the incremental cost of the new generation instead of the utility.

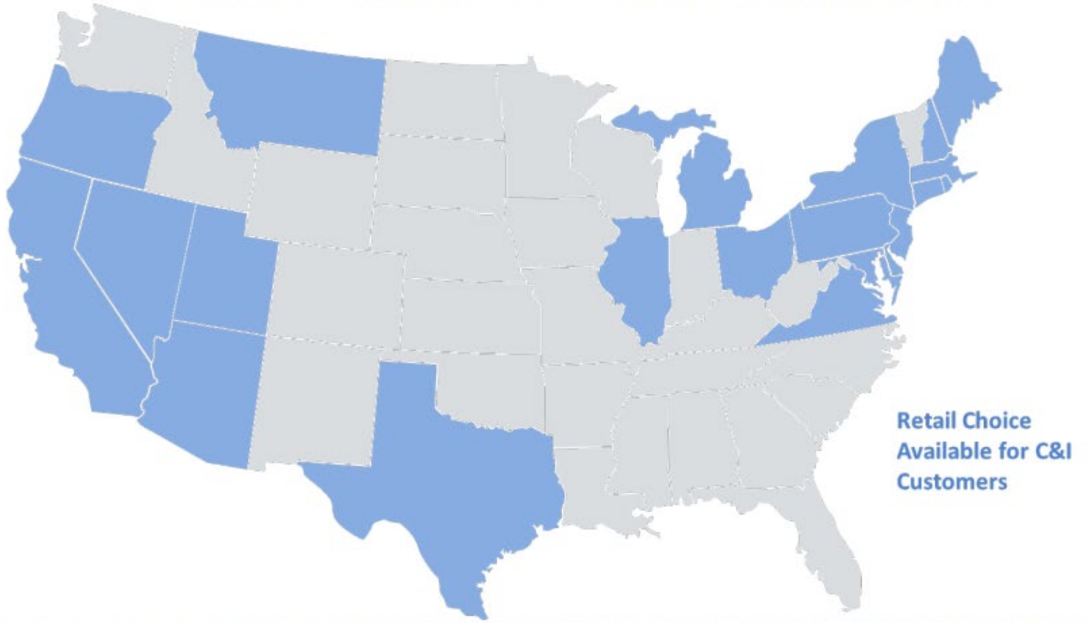
Oregon Direct Access Program

Oregon allows retail access for large non-residential customers.[72] These customers may opt to purchase electricity from a public utilities commission (PUC)-certified electricity service supplier (ESS) other than their utility. The ESS is responsible for procuring generation and transmission service, while the local utility service provider is responsible for distribution. There are seven ESSs eligible to serve customers in Oregon.[73]

Intersect Power Energy Parks Projects

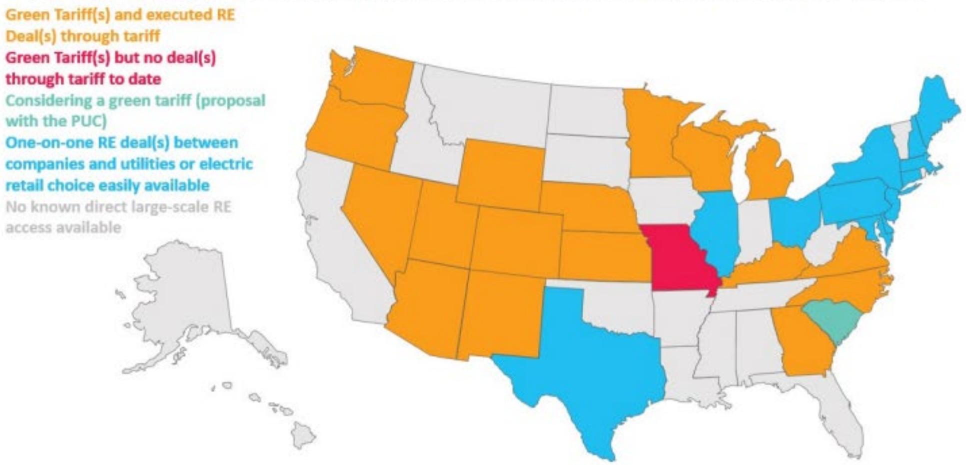
Energy parks are sites where large electricity consumers are co-located with generation assets that can be dispatched for grid-related needs, which can offer significantly faster grid access for new loads. Intersect Power has two energy parks in development. The $1 billion Meitner Project in Texas is developing 460 MW of wind and 340 MW of solar to power 400 MW of hydrogen electrolyzers.[74] Similarly, Google is investing a total of $20 billion in energy parks by the end of the decade to power data centers using solar and battery storage, with the first project expected to be operational in 2026 and complete in 2027.[75]

FIGURE 7: STATUS OF RETAIL CHOICE ACCESS FOR C&I CUSTOMERS IN THE US



Source: Adapted from Hibbard, P. (2023), *At the Crossroads: Improving Customer Choice for Products in the U.S. Electricity Sector, Analysis Group*, Figure 1, and Utah State Legislature (2025), S.B. 132 Electric Utility Amendment.

FIGURE 8: EXAMPLE GREEN TARIFFS AND RENEWABLE ENERGY DEALS IN THE US



Source: Clean Energy Buyers Association (CEBA), "Availability of Utility Green Tariff Programs," accessed Jan. 2023.

BOX III-B: CASE STUDIES OF INTERTIE OPTIMIZATION AND INTERREGIONAL RESOURCE ADEQUACY FRAMEWORKS

Western US Energy Imbalance Markets (WEIM & WEIS)

In the Western US, two energy imbalance markets—the Western Energy Imbalance Market (WEIM) and the Western Energy Imbalance Service (WEIS)—have been created to optimize the real-time dispatch of resources across Western BAAs. Dispatch schedules of resources that are made available to the imbalance markets are adjusted to economically utilize the remaining available transmission between BAAs, optimizing the real-time interchange schedules of these interties. This optimization across BAAs has resulted in significant cost savings, with the WEIM (the older of the two markets) generating $6.6 billion of estimated benefits between its inception in 2014 and January 2025.[65]

European Flow-Based Market Coupling

Since 2006, power system operators in Central and Western Europe have engaged in an innovative effort to "couple" their power markets to optimize cross-border energy exchanges. Initial coupling efforts were limited to day-ahead markets and relied on system operators' estimates of the transfer capability across each border, but the framework evolved to rely on detailed power flow representations of the European grid (referred to as "flow-based market coupling" or FBMC) as well as include a cross-border intraday trading platform. FBMC is now used by system operators for both day-ahead and intraday trading, and studies have shown that this approach currently generates a welfare gain of around €116 million per year.[66]

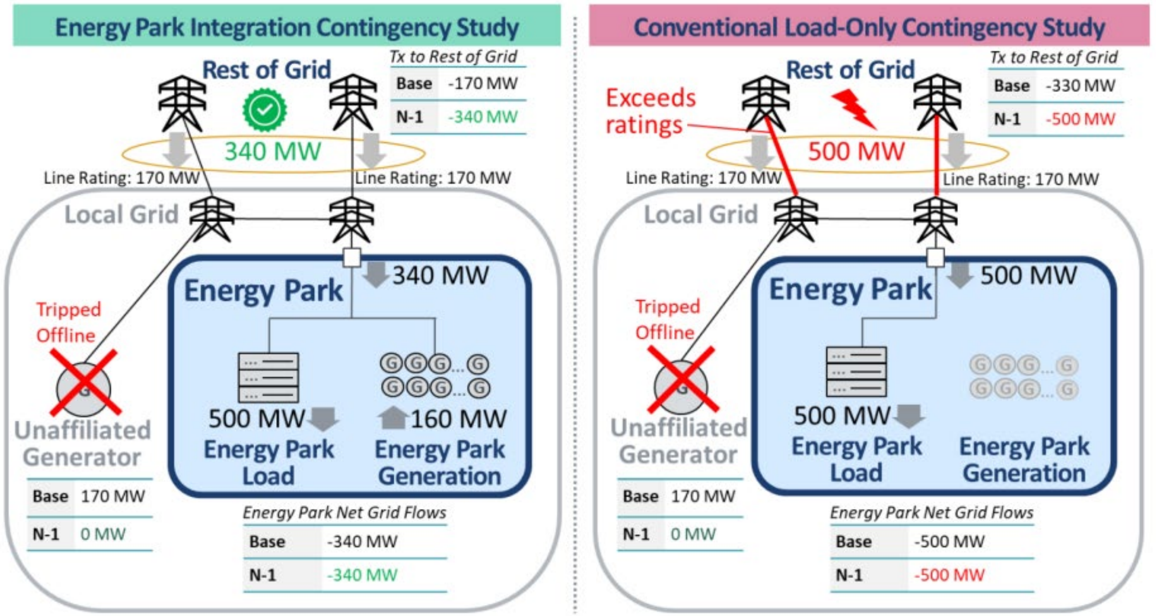
NYISO Treatment of Interregional Transmission during Resource Adequacy Assessments

As part of its annual installed reserve margin (IRM) study, the New York ISO (NYISO) uses a resource adequacy model to quantify the incremental capacity needed to meet its loss of load expectation criterion. In the study, NYISO explicitly models its neighboring regions of PJM, ISO-NE, Hydro-Quebec, and IESO—including their load, capacity mixes, and interties (and corresponding firm capacity imports) to NYISO—to appropriately represent the incremental assistance that may be available from these neighboring regions during a resource adequacy event. The IRM study also models "emergency assistance" that NYISO may be able to receive from its neighbors. Thus, NYISO allows for capacity imports while also accounting for the resource adequacy value of any additional "uncommitted" capacity imports from its neighbors.[67]

European Resource Adequacy Assessment

Since 2021, the European Network of Transmission System Operators for Electricity (ENTSO-E), an association that represents European TSOs, has conducted an annual pan-European probabilistic resource adequacy assessment known as the European Resource Adequacy Assessment (ERAA). TSOs provide ENTSO-E with data on their forecasted load and resource mixes, and ENTSO-E conducts the 10-year analysis using a flow-based market representation of transfer capabilities between regions. This approach maximizes the efficiency of simultaneous interchanges between regions and provides a comprehensive understanding of resource adequacy concerns while recognizing the value of interregional trade (enabled by its aforementioned market coupling reforms).[68]

FIGURE 9: ILLUSTRATIVE CONTINGENCY ANALYSIS UNDER CONVENTIONAL INTERCONNECTION APPROACH (RIGHT) AND BRATTLE'S PROPOSED ENERGY PARK INTEGRATION APPROACH



BOX IV-B: ENERGY PARK INTEGRATION PROCESSES IN OTHER JURISDICTIONS

ERCOT Interconnection Process for Private Use Networks

ERCOT has an integrated process for connecting load and generation that is co-located behind the same point of interconnection (referred to as Private Use Networks, or PUNs). The PUN interconnection process studies the PUN as independent load, independent generation, and a combination of load and generation in an integrated process.[84] Over 16 GW of PUN capacity is currently online in ERCOT, a quarter of which has been added in the last 10 years. While PUNs have historically been large industrial facilities, there is increased interest in PUNs as large loads such as data centers. ERCOT's Large Flexible Load Task Force has also recently proposed that large loads with co-located generation that are not registered as PUNs (and therefore cannot interconnect via the PUN process) also undertake a single interconnection study process, as opposed to separate load and generator interconnection processes.[85] Finally, Texas passed legislation requiring all large loads over 75 MW to be curtailable during emergency conditions,[86] which will provide strong incentives to enable on-site backup generation to support grid-related needs.

BOX V-A: EXAMPLES OF SCENARIO-BASED, LEAST-REGRETS PLANNING IN OTHER JURISDICTIONS

Australia's Integrated System Planning Process

The Australian Energy Market Operator (AEMO) employs best-in-class proactive, scenario-based long-term planning. Its Integrated System Plan[120] (ISP) is updated every two years and consists of a scenario-based analysis that considers long-term uncertainties and (least-regrets) risk mitigation over the next 30 years. The ISP identifies (1) actionable projects to address needs that are present across enough scenarios to have a high degree of certainty, and (2) future projects that are likely needed at some point in the future. The process values optionality (e.g., projects that can be built/expanded in stages; "early works" that make projects shovel-ready and enable them to be constructed quickly in the future) and builds in extensive stakeholder consultation.

The ISP is planning grid infrastructure for designated **Renewable Energy Zones** (REZs)—areas of high renewable resource potential within individual states that are targeted for large-scale renewable energy development.[121] First identified in 2018, these REZs are refined and updated by the AEMO through the ISP consultation process and by working with state and federal governments to account for changes in policy and infrastructure development.

CAISO's Flexible Offshore Wind Transmission Solution

In its most recent transmission plan, the CAISO designed an onshore grid solution that can flexibly address highly uncertain needs to connect offshore wind generation to its underdeveloped grid along the California North coast.[122] The now-approved transmission plan allows for connecting 1,600 MW of north-coast offshore wind generation by constructing two new 500 kV alternating current (AC) lines, one of which is designed to be converted to HVDC technology (with sufficient right of way to add a second line). This design allows offshore wind interconnection capability to first be expanded—if and when necessary—to 3,200 MW by converting the AC line to HVDC. By adding a second HVDC line (on the right-of-way of the first line) and other HVDC facilities, the transmission design ultimately could be expanded to connect up to 8,000 MW of offshore wind generation.

BOX V-B: EXAMPLE PERMITTING REFORMS FROM OTHER JURISDICTIONS

State-level Permitting Reforms: New York, California, and Massachusetts

In recent years, several states have passed legislation to speed up the permitting process for clean energy projects. New York and California are notable examples, with New York passing the Accelerated Renewable Energy Growth and Community Benefit Act[123] in 2020 and California passing Assembly Bill 205[124] in 2022. These reforms ensure that siting and permitting decisions for renewable energy are confined to a single decision-making body and establish statutory time limits for issuing permits—one year from application completion in New York and seven months in California. They also mandate the provision of community and employment benefits to establish local buy-in early and mitigate local opposition. New York introduced further reforms in the 2024 "RAPID" Act, which brought permitting of transmission under the same entity as permitting of renewable energy generation, ordered the development of uniform standards for renewable and transmission facilities to avoid or minimize adverse environmental impacts, and required enhanced host community engagement and involvement.[125]

Similar permitting reforms were recently approved by the Massachusetts legislature.[126] Under the new laws, the state's Energy Facilities Siting Board is authorized to review the permitting process for clean energy projects with a capacity greater than 25 MW and set time frames for review "based on the complexity of the facility." It also requires the board to issue a final decision on the permit application within 15 months. Local governments will retain permitting control over smaller clean energy projects, but they are required to issue a permitting decision within 12 months.

BOX V-C: NEW YORK'S PROACTIVE DISTRIBUTION PLANNING

The **New York State Public Service Commission** has launched a proceeding to develop a unified, proactive framework to anticipate and manage grid infrastructure needs driven by the rapid growth of EV adoption and building electrification.[135] As part of this initiative, utilities are required to submit a proposal outlining a long-term, coordinated planning process to evaluate and implement necessary grid upgrades. The proceeding also establishes a mechanism for utilities to propose urgent grid upgrades to be implemented within two years. Recognizing the importance of granular load forecasting, regulators direct utilities to conduct bottom-up modeling of EV charging load in a way that is consistent with top-down forecasting efforts. This proactive approach is designed to lower utility costs and accelerate electrification, supporting New York's climate objectives and economic development goals.

BOX VI-A: BILL DISCOUNT AND ENERGY EFFICIENCY PROGRAMS IN OTHER JURISDICTIONS

National Grid (MA) Discount Program

National Grid currently offers a 32% discount on electricity bills and a 25% discount on gas bills for eligible customers. Customers with household incomes below 60% of the state median income (SMI, approx. US$87,000 for a family of four) are eligible to apply; they are also eligible if they receive benefits from another means-tested public benefit program or are eligible for LIHEAP (the US's federal bill assistance program). Roughly 160,000 customers received discounts on their monthly bills as of August 2024, of a total of 390,000 eligible.[143]

The MA DPU recently ordered National Grid to implement a tiered discount program for electricity by June 2025, starting at 71% for customers below the federal policy line and decreasing to the current 32% at 60% of SMI.[144]

PG&E California Alternate Rates for Energy (CARE)

PG&E offers 30–35% discounts on electricity bills and 20% discounts on gas bills for households earning less than 200% of the federal poverty level (i.e., US$62,400 for a four-person household).[145] Households are also eligible if they receive benefits from other public assistance programs, including Food Stamps, Supplemental Security Income (SSI), Medicaid, and others. In 2023, roughly 1.4 million customers were eligible, with PG&E administering US$988 million in discounts; administrative expenses were US$9.5 million.[146]

EmPOWER Maryland Limited Income Energy Efficiency Program

Maryland's EmPOWER program provides energy efficiency upgrades and equipment at no charge to households with a total household income below 80% SMI (US$97,800 for a family of four).[147] Eligible households receive an energy audit that identifies ways to reduce household energy costs (including behavioral changes), and recommended work is scheduled with a contractor. A follow-up audit evaluates energy efficiency improvements once the work is complete. Households are also automatically eligible if they receive assistance from any of a range of state and federal programs, including utility bill assistance, SNAP (food stamps) benefits, SSI, and Medicaid. In 2023, approximately 14,000 low-income homes and 2,500 multifamily properties were weatherized through the program at a total cost of US$24.2 million, with average energy savings per participant of 478 kWh.[148]

BOX VI-B: EXAMPLE LARGE-LOAD TARIFFS FROM OTHER JURISDICTIONS

Indiana Michigan Power (I&M) Industrial Power Tariff

Proposed in November 2024, the tariff would require large loads with more than 70 MW of on-site capacity (or 150 MW aggregated across a company) to enter into long-term contracts with the utility for at least 12 years.[152] These contracts include a monthly demand charge equal to either 80% of the contract capacity or 80% of the customer's largest monthly demand (whichever is greater) to protect against generation and grid investments becoming stranded assets if the load does not fully materialize. Large loads can terminate their contracts or reduce them by more than 20% by paying an exit fee. The proposal is supported by data center stakeholders and consumer advocates and is subject to Indiana regulators' approval. The agreement also requires Amazon Web Services, Microsoft, and Google to each give US$500,000 per year for five years to the Indiana Community Action Association to support low-income Indiana residents.

AEP Ohio Proposed Data Center Tariffs

AEP Ohio proposed to require data centers larger than 25 MW to pay for 85% of the kW demand they expect to need each month for 12 years.[153] If the project is canceled or the data center cannot meet the obligations of its electric service agreement contracts, it must pay an exit fee equivalent to three years of minimum charges. The proposed tariff also includes minimum credit ratings on customers and provides the opportunity for customers to reassign up to 25% of their contracted capacity to another customer when exiting the system.

BOX VI-C: EXAMPLES OF PERFORMANCE-BASED RATEMAKING

Hawaii's Performance-Based Ratemaking Framework

The PBR framework for Hawaiian Electric Companies went into effect in 2021, consisting of a suite of mechanisms to promote policy goals such as renewable energy adoption, customer affordability, and customer service quality.[162] At the core of the framework is a five-year rate plan, with annual revenue targets (and consequently rates) adjusted annually using a formula that incorporates variables such as inflation, productivity, exogenous events, and customer dividend. The framework also includes performance incentive mechanisms ("PIMs") that provide additional revenue opportunities if the utility meets certain performance outcomes related to reduced interconnection times for DER systems, improved customer engagement, and effective utilization of advanced metering infrastructure, among others.[163] In addition, the framework introduces a process for expedited review for innovative pilot projects and programs.

Guidance on Performance-Based Ratemaking to State Legislatures

The National Conference of State Legislatures (NCSL) released in 2023 the report *Performance-Based Regulation: Harmonizing Electric Utility Priorities and State Policy*.[164] The report explores how state lawmakers can pursue PBR to utility regulation to reflect industry changes, meet consumer demands, and support state energy policy goals. It provides an overview of the most common performance-based approaches to utility regulation and an introduction to state legislatures' role in defining the goals and expected outcomes from transitioning from traditional cost-of-service regulation to a performance-based regulatory framework. As of 2023, at least 17 states and Washington, DC had enacted legislation that either allows for PBR or requires utilities to operate under PBR.

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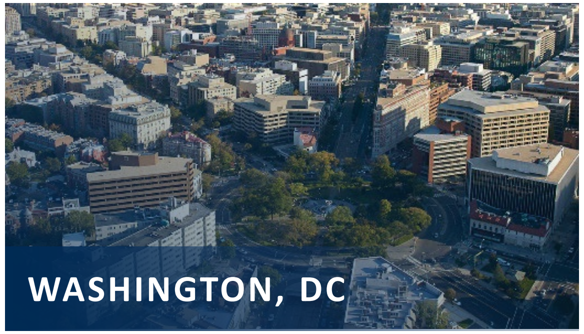

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