Title

State Approaches for Distribution System Planning, including Grid Modernization

Author

Schwartz, Lisa C

Publication Date

2023-12-14

State Approaches for Distribution System Planning, including Grid Modernization

Presentation for Massachusetts Grid Modernization Advisory Council

April 13, 2023

Lisa Schwartz, Lawrence Berkeley National Laboratory

This work was funded by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Disclaimer

Copyright Notice

Grid Modernization and Distribution Planning

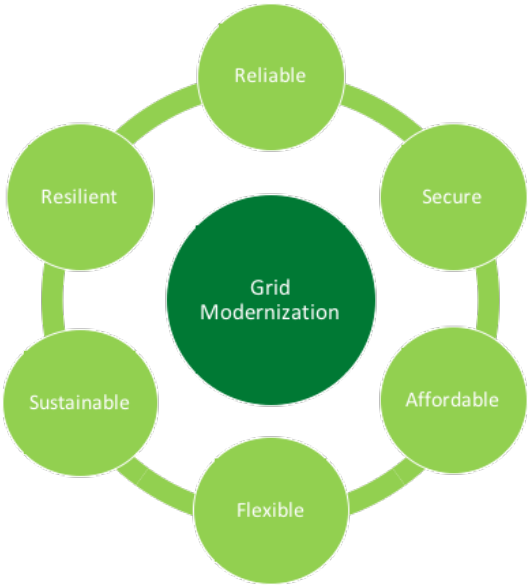
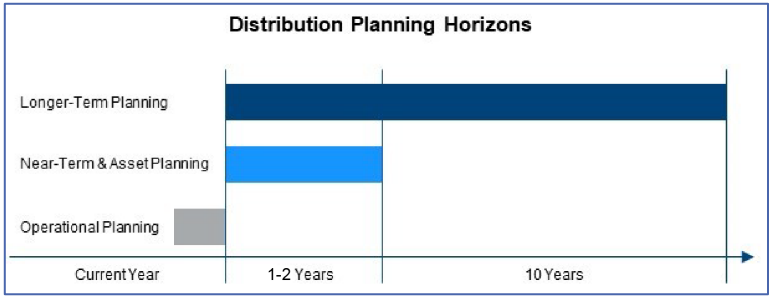


Figure source: U.S. Department of Energy's *Grid Modernization Multi-Year Program Plan*

Types of grid plans

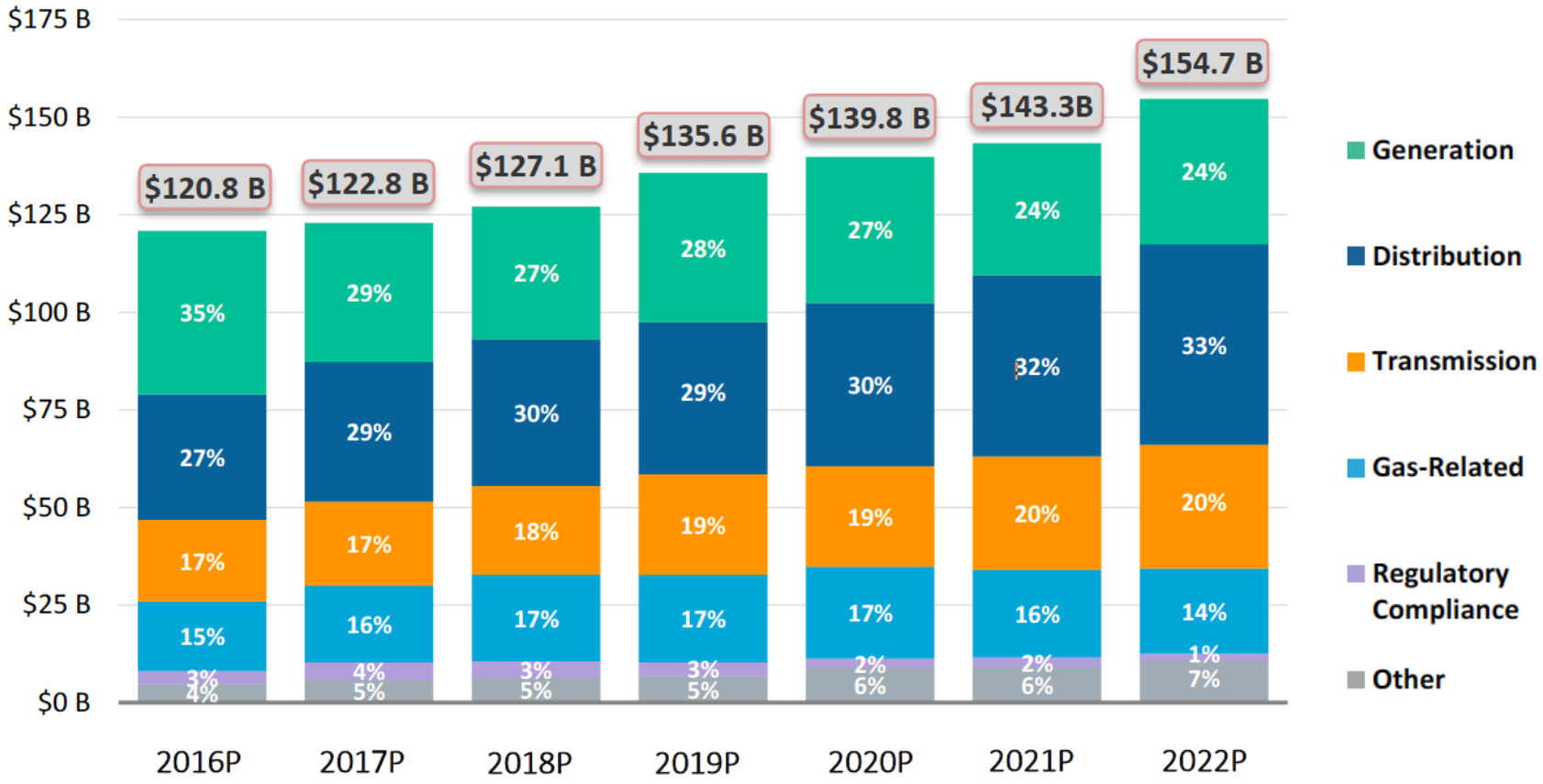
- **Distribution system plan** - Assesses needed physical and operational changes for the local grid*
  - Annual process, 1–2 year planning horizon
  - Longer-term utility capital plan, 5–10 years
    - Solutions and cost estimates updated every 1 to 3 years



- **Grid modernization plan** - Presents a reasoned strategy that links a proposed technology deployment roadmap to stated objectives
- **Integrated Distribution System Planning** (IDSP) - Provides a systematic approach to satisfy customer service expectations and state grid planning and design objectives — e.g., reliability, resilience, safety, operational efficiency, and integration and utilization of distributed energy resources (DERs).
  - Includes a grid modernization strategy and DER planning
  - In vertically integrated states, these plans may coordinate across generation, transmission and distribution (e.g., Hawaii — HECO's 2023 draft Integrated Grid Plan).
  - See *Berkeley Lab's Integrated Distribution System Planning website*

*Operational planning addresses immediate concerns (intraday through the current year).

One reason states are increasingly interested in electric distribution system planning

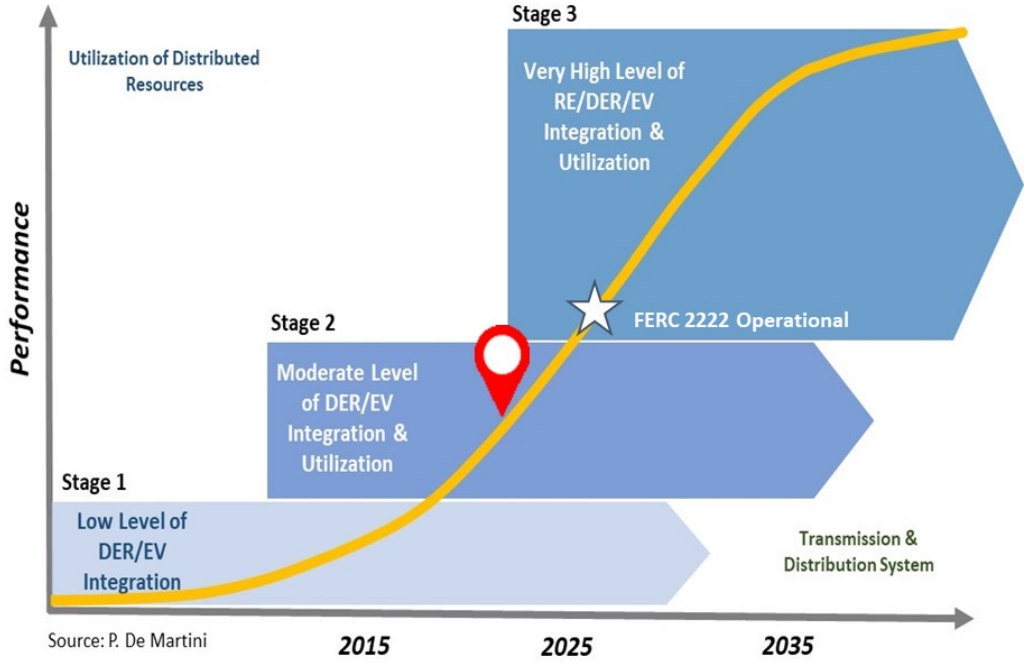


Distribution system investments account for the largest portion (33%) of capex for U.S. investor-owned utilities: $51.3B (projected) in 2022.

Source: Edison Electric Institute

Potential benefits from improved distribution planning processes

- Makes transparent utility plans for distribution system investments holistically, before showing up individually in general rate cases
- Provides opportunities for meaningful regulatory and stakeholder engagement
  - Can improve outcomes — more data, community input, review
- Considers uncertainties under a range of possible futures (scenarios)
- Considers all solutions for least cost/risk (including DERs)
- Motivates utility to choose least cost/risk solutions
- Enables consumers and 3rd party providers to propose grid solutions and participate in providing grid services



See *Extra Slides* for a description of the three stages of distribution system evolution

Start with state principles and objectives instead of picking technologies

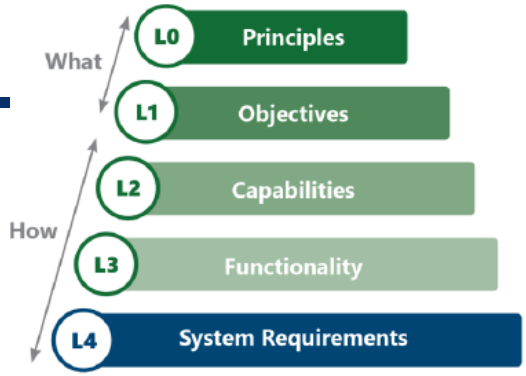


Figure: DOE 2020

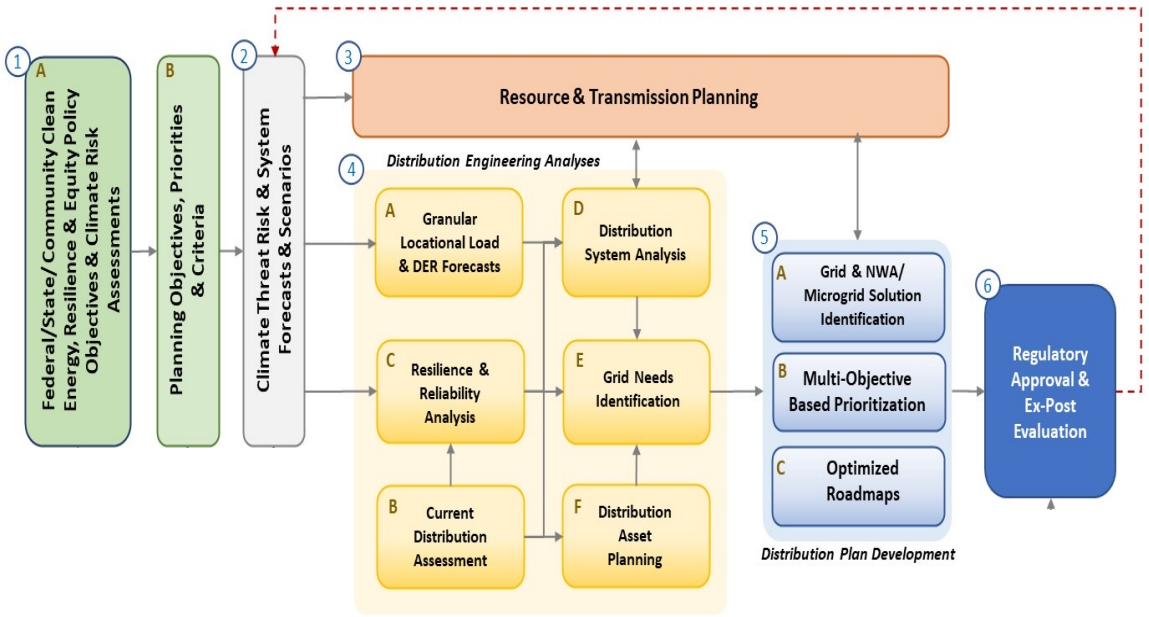
- Grid modernization planning starts with state principles and objectives and capabilities needed to achieve them. They determine functionality and system requirements.
- Holistic, long-term planning for grid modernization — in the context of distribution system planning:
  - Supports state goals — e.g., reliability, resilience, affordability, clean resources, climate and electrification, economic development
  - Addresses interdependent technologies and systems, including core components (e.g., Advanced Distribution Management System, Geographic Information System, Outage Management System) and applications to enable other grid modernization projects.*
  - Considers proactive grid upgrades to facilitate customer choice
- Other types of plans feed into distribution and grid modernization plans:
  - *Transmission plan* identifies future transmission expansion needs and options
  - *Electrification plan* informs grid needs for EV charging and building electrification
  - *Energy security plan* informs strategies for resilience from physical and cybersecurity threats
  - *Demand-side management plan* specifies capabilities that distribution technologies and systems should provide to achieve multi-year targets for demand flexibility and energy efficiency

* See "Layering of Core Components and Applications" in *Extra Slides*.

Key process elements for IDSP

1. Planning Objectives, Priorities and Criteria
2. Forecasting
   - System Forecasts & Scenarios
   - Risks from Climate Threats
3. Resource & Transmission Planning*
4. Distribution Engineering Analyses
5. Solution Identification, Evaluation and Prioritization
6. Regulatory Review & Ex Post Evaluation

Stakeholder engagement throughout



*Integration with integrated resource planning (IRP) and transmission planning where applicable

Source: Paul De Martini, Newport Consulting

State Requirements

Procedural elements (1)

- Frequency of filing
  - Typically annual or biennial
  - Every 3 years (e.g., NV)
  - *Considerations:* alignment with utility distribution capital planning, IRP filing cycle, workload, tracking progress on goals and objectives
- Planning horizon
  - 2-4 year action plan – OR (+ 5-10 year roadmap for investments, tools and activities)
  - 3 year action plan — NV (+ 6-yr forecasts), DE (+ 10-yr long-range plan)
  - 5 years – NY, CA (+ 10-yr grid modernization vision), HI (+ plan to 2045), MI (+ 10-15 yr outlooks), MN (+ 10-yr Modernization & Infrastructure Investment Plan)
  - 5-7 years – Indiana T&D and storage system improvements
- Stakeholder engagement and equity (*later in presentation*)

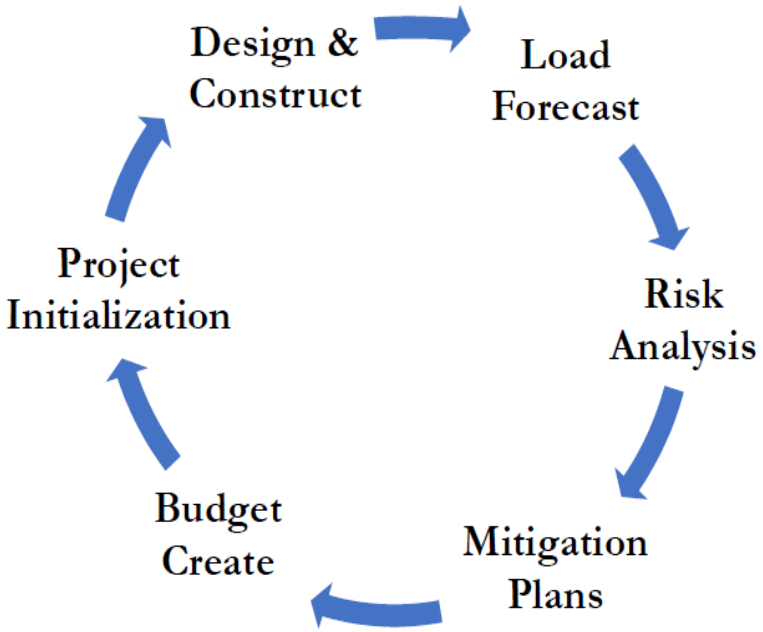
Procedural elements (2)

- Confidentiality for security or trade secrets — for example:
  - Level of specificity for hosting capacity maps
  - Peak demand/capacity by feeder
  - Values for reliability metrics
  - Contractual cost terms
  - Bidder responses to solicitations for non-wires alternatives (NWA)*
  - Proprietary model information

*DERs that provide specific grid services at specific locations to defer some traditional infrastructure investments

Substantive elements (1)

- Baseline information on current state of distribution system
  - Such as system statistics, reliability performance, equipment condition, historical spending by category
- Description of planning process
  - Load forecast – projected peak demand for feeders and substations
  - Risk analysis for overloads and plans for mitigation
  - Budget for planned capacity projects
    - Asset health analysis and system reinforcements
    - Upgrades needed for capacity, reliability, power quality
    - New systems and technologies
    - Ranking criteria (e.g., safety, reliability, compliance, financial)
- Distribution operations — vegetation management and event management



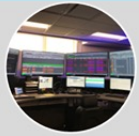
Source: Xcel Energy 2021

Substantive elements (2)

- DER forecast
  - Types, amounts and locations
- Hosting capacity analysis
  - Including maps
- Grid needs assessment and NWA analysis to identify:
  - Existing and anticipated capacity deficiencies and constraints
  - Traditional utility mitigation projects
  - A subset of these planned projects that may be suitable for NWA to defer or avoid infrastructure upgrades for load relief, voltage, reducing interruptions, resilience

Substantive elements (3)

- Grid modernization strategy
  - Technology roadmap
  - Financial forecast associated with grid modernization plans
  - May include request for certification for major investments
- Action plan
- Additional elements
  - Long-term utility vision and objectives
  - Ways distribution planning is coordinated with transmission planning or integrated resource planning
  - Customer engagement strategy
  - Summary of stakeholder and community engagement
  - Proposals for pilots

GRID VISIBILITY AND CONTROLS		Network	Meters
Advanced Distribution Management System (ADMS)	**Fault Location, Isolation and Service Restoration (FLISR)**	**Field Area Network (FAN) & Home Area Network (HAN)**	**Advanced Metering Infrastructure (AMI)**
			
• Advanced centralized software or the "brains," enhances the operation of the distribution grid • Enables improved reliability, management of DERs, and improved efficiency when operating the grid • Enables enhanced visibility and control of field devices (including customer meters via AMI)	• ADMS provides fault location prediction and the automatic operation of intelligent grid devices • Reduces outage durations and the number of customers impacted by an outage • Enabled by intelligent field devices, FAN, and ADMS	• Two-way communications network • Connects intelligent grid devices and smart meters with software • Enables enhanced remote monitoring and control of intelligent field devices and advanced meters	• Focused on the deployment of smart meters and software • Provides near real-time communication between software and meters • Data and AMI functionality enable new products and services and improves customer experience

Source: Xcel Energy 2021

How one state put together the pieces: Minnesota (1)

- Minn. Stat. §216B.2425 (2015) requires the largest utility (Xcel Energy) to submit biennial transmission and distribution plans to the Public Utilities Commission
  - To *"identify … investments that it considers necessary to* ***modernize the transmission and distribution system by enhancing reliability, improving security against cyber and physical threats, and by increasing energy conservation opportunities*** *…."*
  - May ask Commission to **certify priority projects and approve costs through a rider** — a finding that the project is consistent with requirements of statute, not a prudency determination
  - Analyze hosting capacity for *small-scale distributed generation resources* and *identify necessary distribution upgrades to support [their] continued development*
- Xcel Energy 1st grid modernization report (Docket 15-962)
- Xcel Energy 2nd grid modernization report (Docket 17-776)

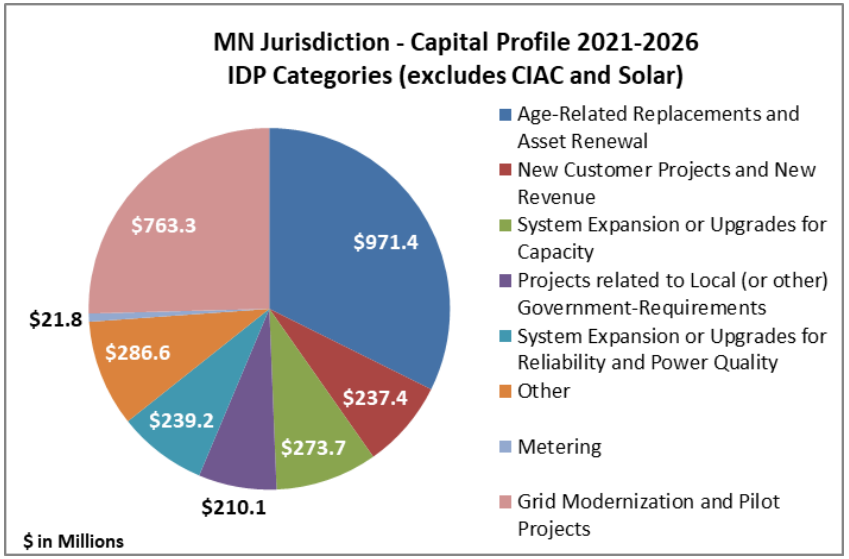
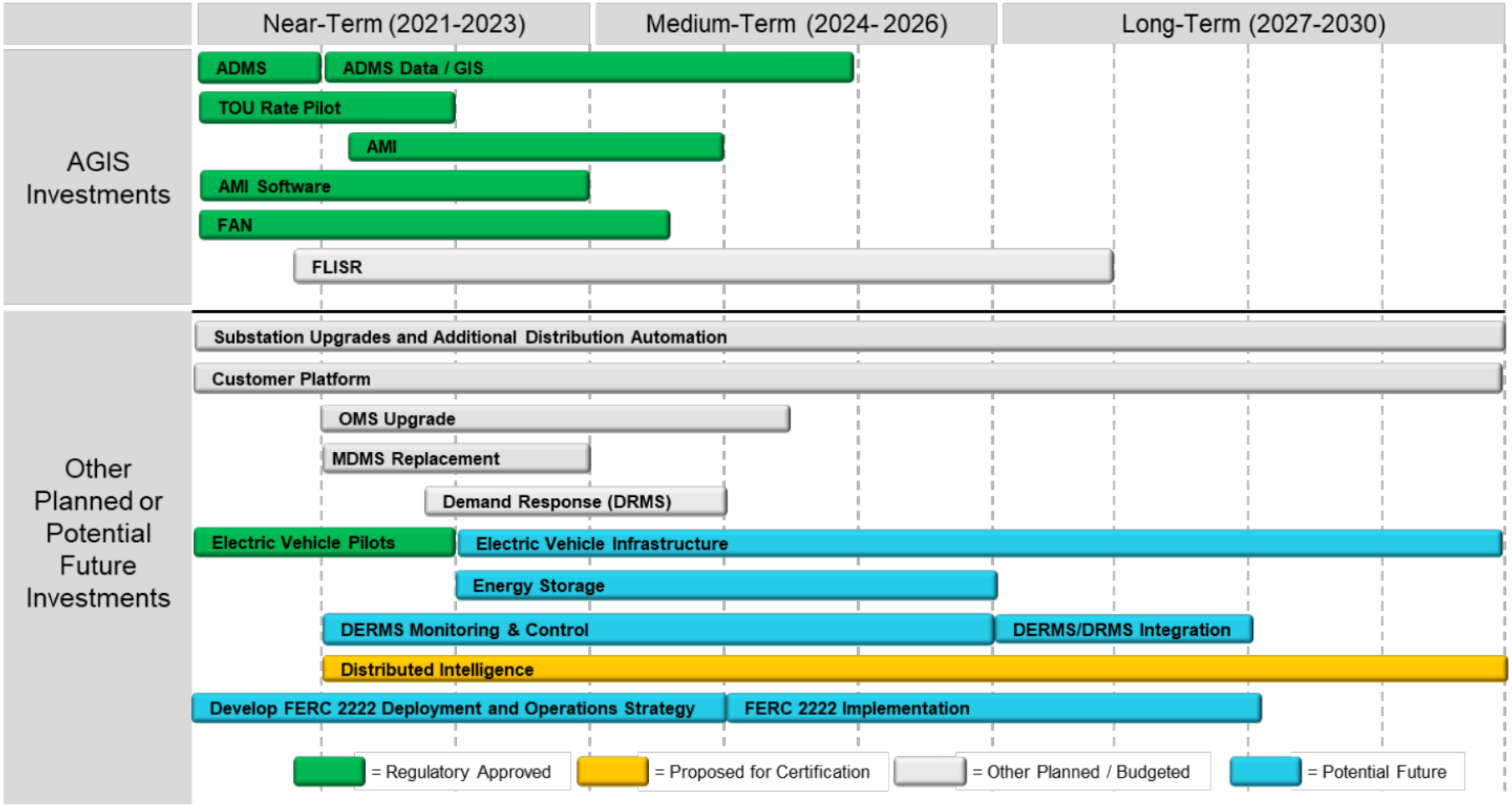


Figure: Xcel Energy 2021

How one state put together the pieces: Minnesota (2)

- Commission inquiry on Electric Utility Grid Modernization focused on integrated distribution planning (Docket CI-15-556)
  - Series of stakeholder meetings
  - Questionnaire to utilities on utility planning practices and stakeholder comments
  - Staff report defined grid modernization, proposed a phased approach, and identified principles to guide it
- The Commission established Integrated Distribution Planning (IDP) requirements for Xcel Energy (Docket 18-251) and smaller regulated utilities (Dockets 18-253, 18-254 and 18-252) — and principles.
- Xcel Energy filed its 1st IDP in 2018 (Docket 18-251), a 2nd IDP in 2019 (Docket 19-666), and a 3rd IDP in 2021 (Docket 21-694).
  - Grid mod plan is now filed *with* biennial IDP filing.
  - Transportation electrification information and data filed in each utility's IDP beginning Nov. 1, 2023

Illustrative Distribution System Investment Plan



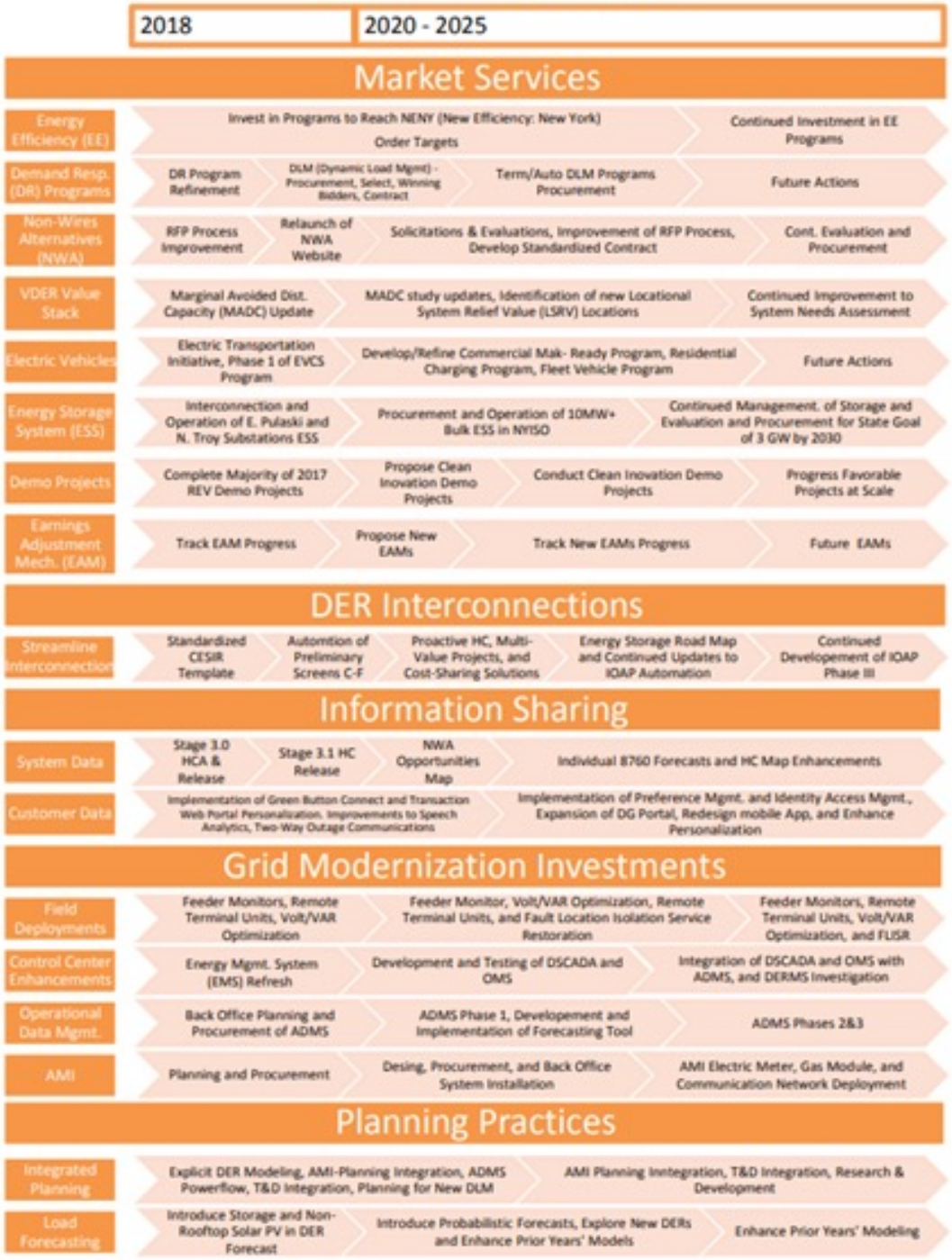
Source: Xcel Energy 2021

AGIS – Xcel Energy's Advanced Grid Intelligence and Security initiative, ADMS – Advanced Distribution Management System, GIS – Geographic Information System, AMI – Advanced Metering Infrastructure, FAN – Field Area Network (visibility and control), FLISR - Fault Location, Isolation, and Service Restoration, OMS – Outage Management System, MDMS – Meter Data Management System, DERMS – DER Management System

New York Distribution System Implementation Plans

- The Department of Public Service (DPS) adopted requirements for five-year DSIPs in 2016 (Case 14-M-0101).
  - Utilities filed initial DSIPs on June 30, 2016.
- DPS updated DSIP requirements in 2017 to provide guidance in 5 focus areas: hosting capacity, interconnection portals, NWAs, privacy of aggregated customer data, and energy storage.
- Proposed updated guidance by DPS Staff (April 2018) covered:
  - Integrated planning, advanced forecasting, grid operations, energy storage integration, EV integration, energy efficiency integration and innovation, distribution system data, customer data, cyber-security, DER interconnection, advanced metering infrastructure (AMI), hosting capacity, beneficial locations for DERs, and procuring NWAs
- Utilities filed DSIP updates on June 30, 2020.
  - NYSEG/RG&E, ConEd, O&R, National Grid, Central Hudson
- The Joint Utilities will file their next five-year plans on June 30, 2023.
  - Staff proposed changes in filing requirements for effective interaction with DPS' Coordinated Grid Planning Proceeding, geared to achieve the state's climate goals.
- Utilities must regularly publish benefit-cost analysis handbooks to provide transparency on methods used to calculate benefits and costs in evaluating NWA and utility programs — e.g., Con Edison's 2020 handbook.

National Grid's Key Progress and Plans (in 2020 New York DSIP Update)



Catalog of State Distribution Planning Requirements

- Available this spring – Interactive map, detailed state-by-state table, document library
- Later this year — Report updating our 2017 and 2018 publications on state engagement in distribution system planning as well as presentations on regulatory approaches
  - Materials will be posted on Berkeley Lab's IDSP website
- **General information and procedural requirements**
  - Planning goals and objectives, type of plan (e.g., grid mod plan, distribution system plan, integrated grid plan, DER plan, T&D improvement plan), frequency of filing, planning horizon, term of action plan, stakeholder engagement & equity, type of commission action on filed utility plans
  - Links to legislation & regulations, commission proceedings & orders, utility plans
- **Substantive requirements**
  - Baseline information required on current distribution system
  - Load and DER forecasting
  - Reliability and resilience analysis and metrics
  - Grid needs assessment & solution identification, including NWA analysis
  - Hosting capacity analysis
  - Grid modernization strategy and roadmap
  - Coordination with other types of planning

Also: **Berkeley Lab/NASEO brief on state energy office engagement in distribution planning**

DERs and Distribution Planning

Proactive planning is more effective.

Tell utility customers where the grid needs help and what services the grid needs. Provide appropriate incentives.

- *DER forecasting* helps planners avoid overbuilding and feeds into analysis of which feeders may be stressed by DERs in the near-term.
- *Hosting capacity* is the amount of DERs that can be interconnected without adversely impacting power quality or reliability under existing control and protection systems and without infrastructure upgrades
  - Maps showing where interconnection costs will be low or high, plus supporting data
  - Targeted efficiency, demand flexibility and storage can make more hosting capacity available.

  Together, these processes identify feeders that are likely to see DER growth and can be considered for proactive upgrades.
- *Non-wires alternatives* are DERs that provide specific services at specific locations to defer some traditional infrastructure investments, leveraging customer and third-party capital.
- *Locational net benefits analysis* systematically analyzes DER costs and benefits to assess the net benefits DERs can provide for a given area of the distribution system.

These analyses also can inform retail rates and tariffs — e.g., location-based retail rates for distribution services and incentives for geo-targeted DERs.

Source: Adapted from Debbie Lew, Emerging distribution planning analyses, prepared for Berkeley Lab, 2020

Hosting capacity analysis use cases

	Use Case	Objective	Capability	Challenges
Hosting Capacity Analysis Use Cases	**Development Guide**	Support market-driven DER deployment	Identify areas with potentially lower interconnection costs	Security concerns; analysis/model refresh; data accuracy and availability
	Technical Screens	Improve the interconnection screening process	Augment or replace rules of thumb; determine need for detailed study	Data granularity; benchmarking and validation to detailed studies
	Distribution Planning Tool	Enable greater DER integration	Identify potential future constraints and proactive upgrades	Higher input data requirements; granular load and DER forecasts

Source: ICF International for DOE

Useful reference: IREC, *Key Decisions for Hosting Capacity Analysis*, 2021

California "Integration Capacity Analysis"

- Models how much new distributed generation — as well as **load** (including EV charging) — can be accommodated on the distribution system at specific locations, using actual grid conditions
  - Understanding capacity for new load is especially important in the context of state electrification initiatives, as well as energy storage projects (load+generation).
- PUC's ruling on Jan. 27, 2021, directed utilities to refine Integration Capacity Analysis maps and include them in data portals: PG&E, SCE (see user guide), SDG&E*

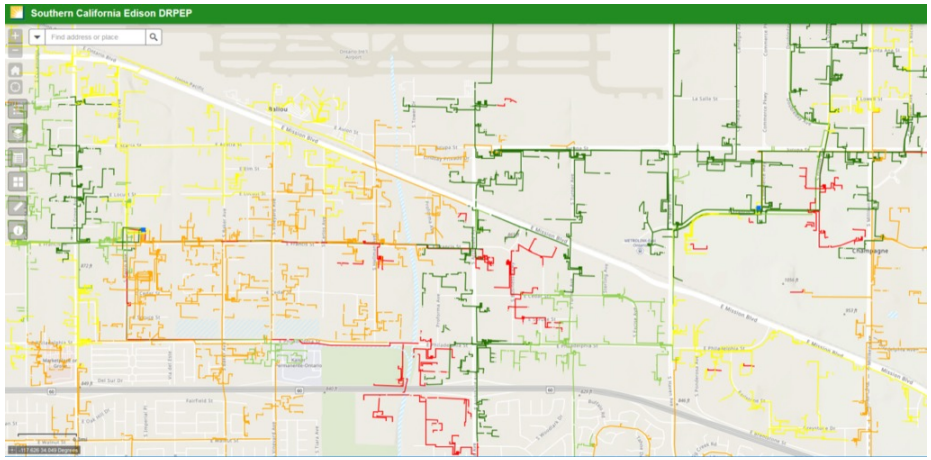
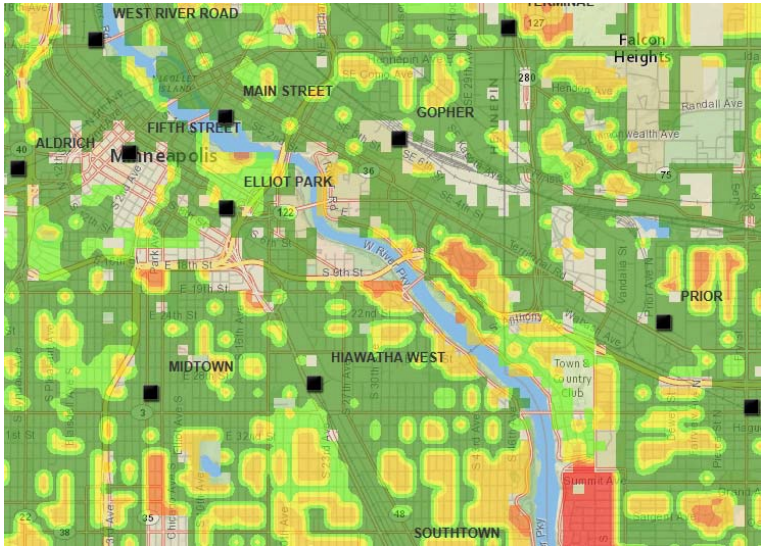


Figure source: Southern California Edison

*In addition to maps, the data portals include the utility's Distribution Investment Deferral Framework map (Grid Needs Assessment + Distribution Deferral Opportunity Report).

Example hosting capacity analysis requirements over time: Minnesota (1)

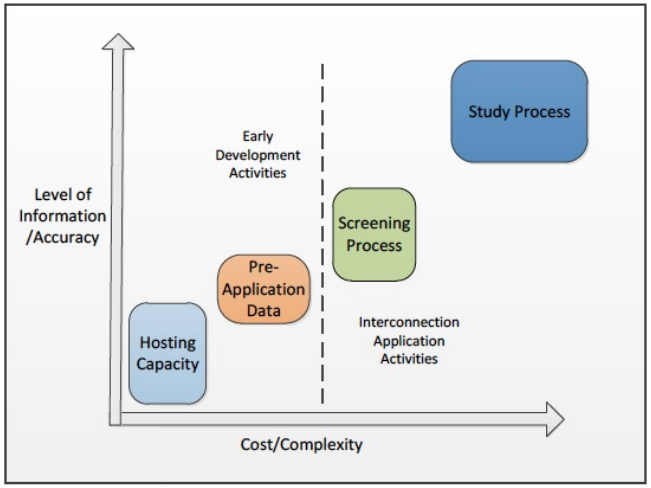
- The PUC requires analysis of each feeder for solar ≤1 MW and potential distribution upgrades necessary to support expected distributed generation levels, based on utility's IRP filings and Community Solar Gardens program.
- Utility filed 1st hosting capacity analysis in 2016 (Docket 15-962)
  - Commission's Aug. 1, 2017 decision requires filing analysis Nov. 1 each year
  - Provided guidance for future analysis, including reliable estimates and maps of available hosting capacity at feeder level
    - Details to inform distribution planning and upgrades for efficient integration of distributed generation
    - Detailed information on data, modeling assumptions and methodologies



Source: Xcel Energy

Example hosting capacity analysis requirements over time: Minnesota (2)

- Aug. 15, 2019, order (Docket 18-684) required further improvements
  - Work with stakeholders to improve value of analysis, with more detailed data in maps
  - Provide spreadsheet with hosting capacity data by substation and feeder, with peak load, daytime minimum load, installed generation capacity, and queued generation capacity
  - For feeders with no hosting capacity, identify "The full range of mitigation options … including a range of potential costs … and financial benefits…." Some solutions are low or no cost.
  - Identify costs and benefits of replacing or augmenting initial interconnection review screens and supplemental review and automating interconnection studies
- July 23, 2020, order (Docket 19-666)
  - Adopts long-term goal to use hosting capacity analysis in interconnection fast-track screens
  - Requires estimating costs for more frequent updates and other use cases (e.g., initial interconnection review screens and supplemental review), considering *load* hosting analysis
- June 1, 2022, order (Docket M-21-694)
  - Modified future requirements to proactively plan investments in hosting capacity and other necessary system capacity to allow distributed generation and EV additions consistent with the utility's forecast for DERs — in coordination with IRP

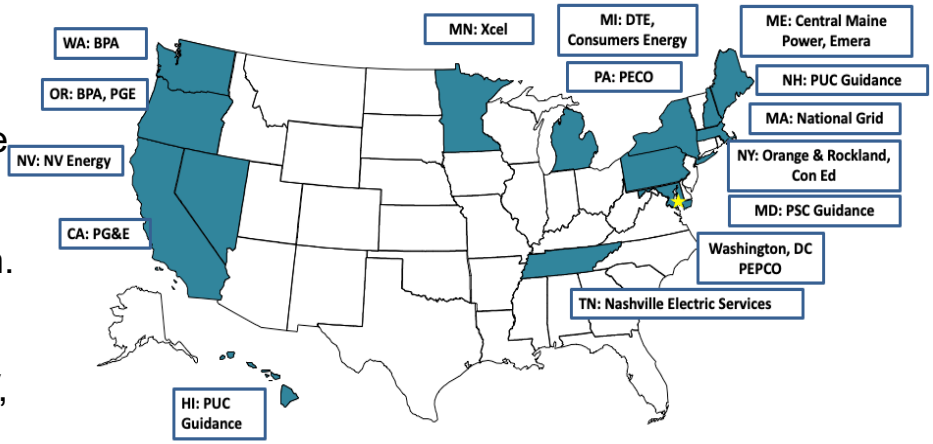


Source: Xcel Energy 2021

Non-wires alternatives

- DERs that provide specific grid services at specific locations to defer some traditional infrastructure investments — e.g., a single large battery or portfolio of DERs that can meet the specified need
- Objectives: Provide load relief, address voltage issues, reduce interruptions, enhance resilience, or meet local generation needs (See New York's suitability criteria in *Extra Slides*)
- Potential to reduce utility costs
  - Defer or avoid infrastructure upgrades
  - Implement solutions *incrementally,* offering a flexible approach to uncertainty in load growth and potentially avoiding large upfront costs for load that may not show up.

- Typically, the utility issues a competitive solicitation for NWA for specific distribution system needs and compares these bids to the utility's planned traditional grid investment to determine the lowest reasonable cost solution.
- Jurisdictions that require NWA consideration include CA, CO, DE, DC, HI, ME, MI, MN, NV, NH, NY and RI.*



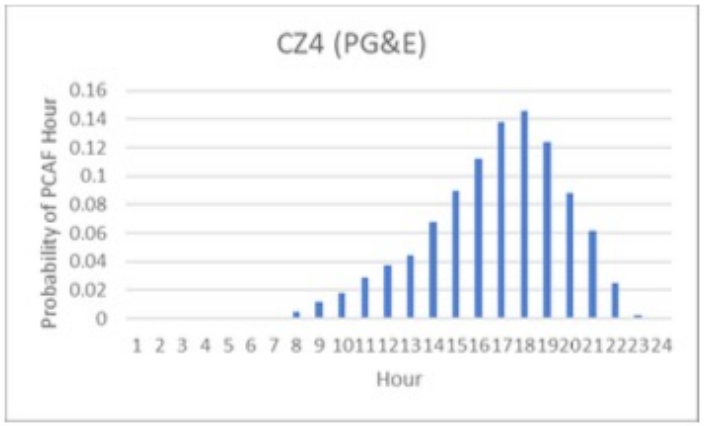
Case studies featured in *Locational Value of Distributed Energy Resources*

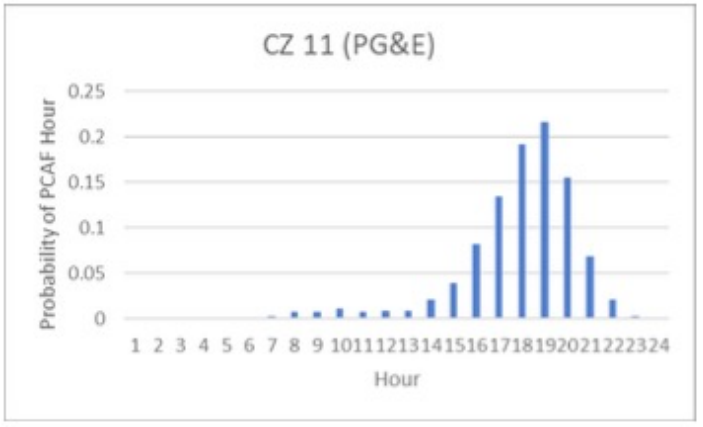
*Other states have related proceedings, pilots or studies underway.

Locational value of DERs

- In addition to analyzing DERs as alternatives to *specific projects*, utilities can conduct *systematic* studies of DER locational value to:
  - Better understand where to target them
  - Calibrate incentive levels
  - Reduce load growth for specific areas of the distribution system
  - Reduce the need for traditional distribution system upgrades
- Locational net benefits analysis analyzes costs and benefits of DERs to determine the net benefits they can provide for a given area of the distribution system.
- These studies can become a routine and transparent part of the distribution planning process. The information also can be used for DER programs and rate designs.

Example PG&E peak capacity allocation factors distribution by hour for climate zone 4 and climate zone 11. Source Avoided Cost Calculator (2021)





Stakeholder Engagement and Equity

Stakeholder engagement for distribution planning (1)

- Of all electricity system infrastructure, people and communities are closest to distribution systems. They also are the source of most outages.
- Stakeholder engagement can:
  - Provide a venue for open discussion
  - Improve the quality of proceedings and their outcomes
  - Develop solutions with broad support
  - Build trust among parties
- Stakeholder engagement for distribution system planning is relatively nascent. Among opportunities to improve it:
  - Inclusive stakeholder process
  - Intervenor and stakeholder compensation, particularly for non-traditional stakeholders
  - Consideration of equity in identifying and assessing grid solutions

…"the Commission has repeatedly pushed Hawaiian Electric to employ best practices, focusing on stakeholder engagement, developing appropriate scenario and sensitivities, and pursuing complete transparency to enable effective review." HI PUC Order 37730

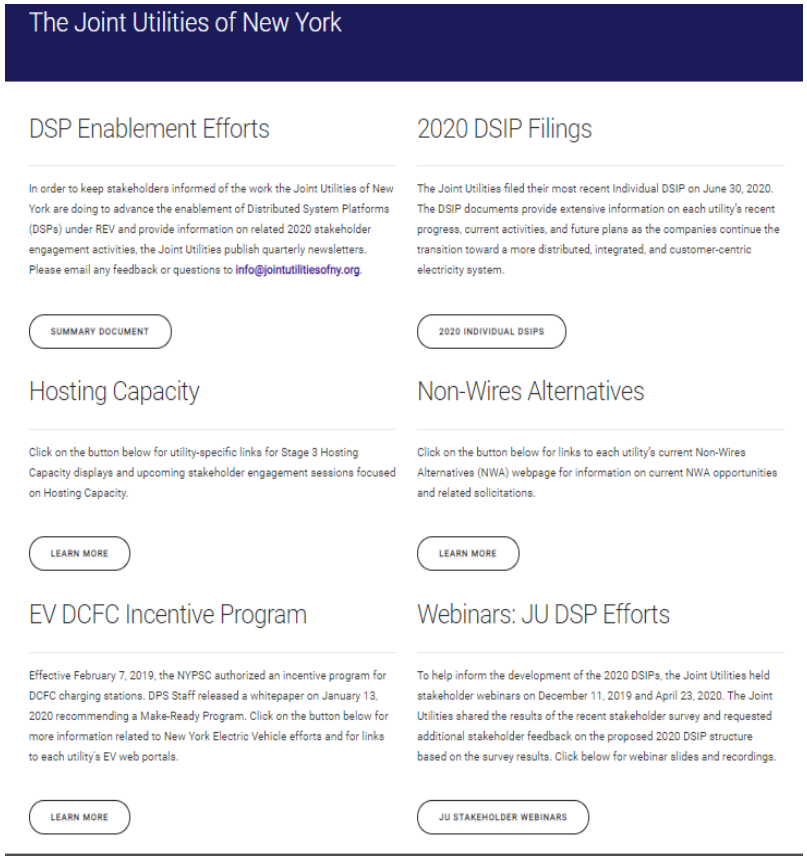
…"the Commission notes that many of the engagement mechanisms described in the Filing appear to be more geared towards the dissemination of utility information…the level of impact of stakeholder information has on the planning process is unclear. " NY PSC Order, September 2021, Case 20-E-197

Source: Natalie Mims Frick and Lisa Schwartz, Berkeley Lab

Stakeholder engagement for distribution planning (2)

- Requirements
  - *Before plan is filed:* Can include significant input through working groups (e.g., CA, DC, HI, MI, NH, NY)
  - *After plan is filed:* Stakeholders can file comments, utility provides periodic updates
- Examples
  - New York - Surveys, newsletters, webinars, meetings, and designated **website** with links to various sources of information
  - Oregon - Utilities must host at least four stakeholder workshops before filing distribution system plan and file a community engagement plan. A technical working group holds regular meetings for stakeholders before and after plan filings.
  - Hawaii - Stakeholder council, technical advisory panel, working groups (*next slide*)

*See *Extra Slides* for Illinois



Hawaii – Integrated Grid Planning
Stakeholder Engagement

Integrated Grid Planning Stakeholder Council - Industry peer group of experts participating voluntarily to advise on processes, methodologies and technologies

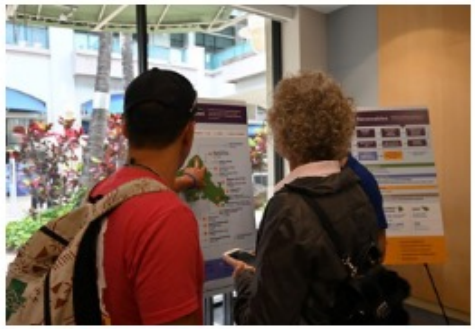
Example meeting slides

Hawaiian Electric IGP Process

Education & Information ⇕ *Input & Feedback*

- **Forecasting assumptions**
- **Resilience**
- **Distribution planning**
- **Market***

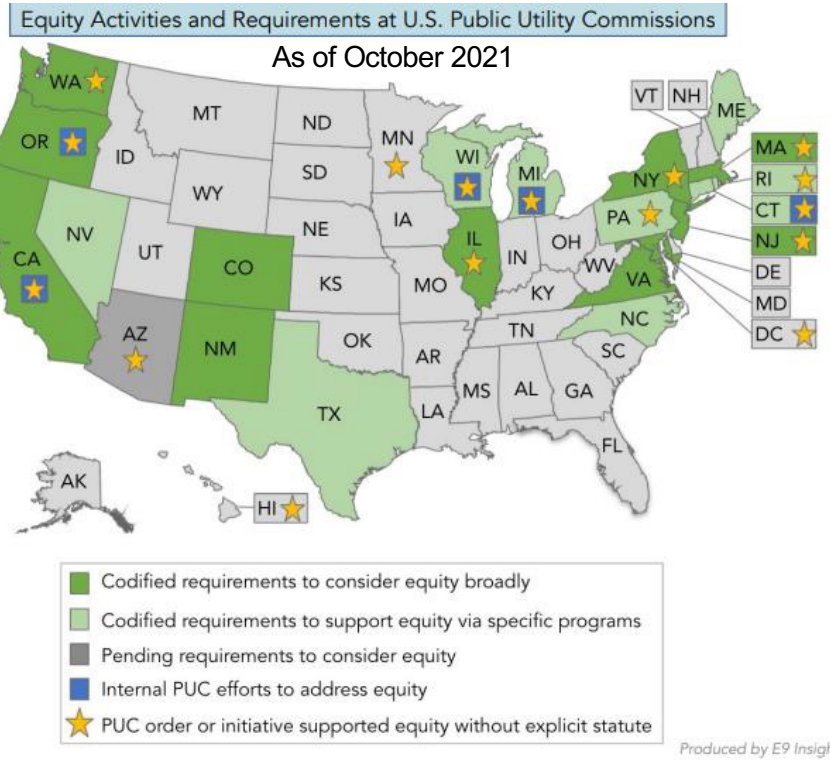
Broad Public Engagement	Stakeholder Council	Working Groups	Technical Advisory Panel



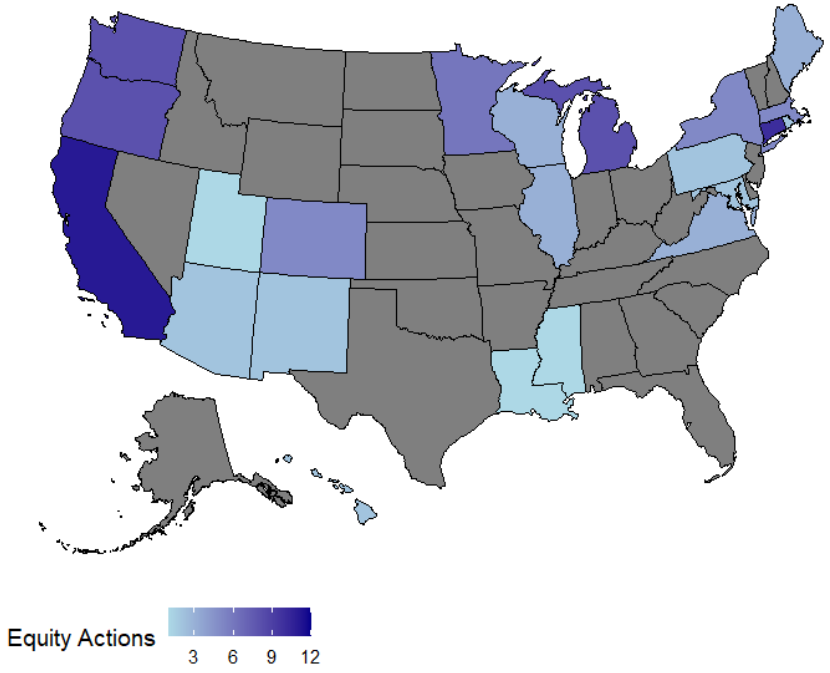
*** To develop standardized contracts and agreements, define grid services, evaluate and optimize grid solutions, and define competitive procurement process**

Energy equity and justice (1)

- Many states are adopting energy equity and justice provisions that apply to utility regulation, including planning.
  - To address social, economic and health disparities
  - Through legislation, governor's executive orders, PUC orders, or actions by other agencies*



Almost half of U.S. states took action on energy equity between January 2020 and July 2022.



*See Farley et al. 2021, McAdams 2023, Hanus et al. 2023

Energy equity and justice (2)

- OR – Its staged approach to stakeholder engagement in distribution planning (Order 20-485) initially requires consultation with community-based organizations (CBOs) before plan filing, plus a community engagement plan.* It evolves to active collaboration with CBOs and environmental justice communities so community needs (energy burden, customer choice, resilience) inform distribution projects.
  - Portland General Electric (PGE) hired CBOs to recruit for and convene community workshops, develop educational materials, and conduct research for the utility's first distribution plan.
  - OR HB 2475 (2021) provides PUC authority to provide financial assistance to environmental justice organizations to participate in regulatory proceedings.
- MN – PUC required Xcel Energy to map reliability and service quality metrics and demographic data to reveal any equity issues (Dec. 18, 2020, order in Docket 20-406).
- ME – New integrated grid planning law requires "An assessment of the environmental, equity and environmental justice impacts of grid plans."

See *Extra Slides* for Washington

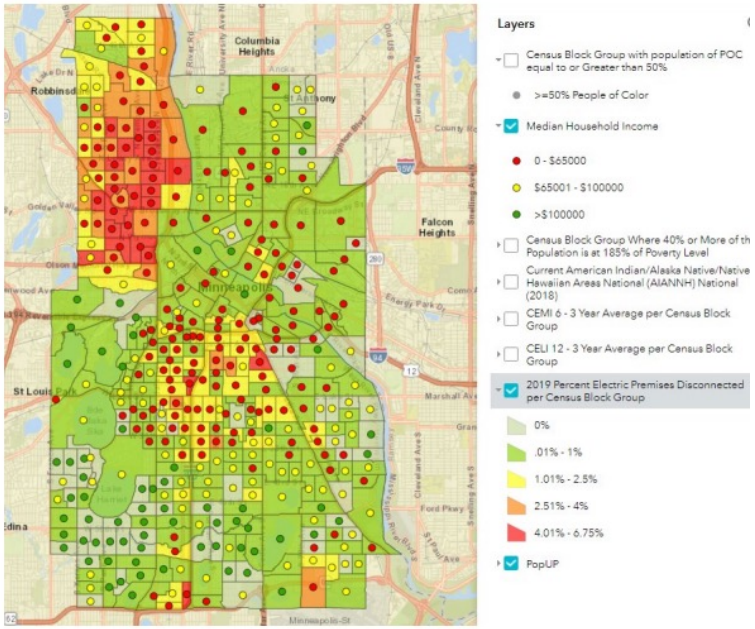


Figure source: Xcel Energy, Oct. 1, 2021, filing, Docket 20-406

*For example, see section 3.4 in PGE's 2021 Distribution System Plan.

Data-Related Requirements

Data-related requirements (1)

- Several Commissions are addressing data access in distribution planning and other proceedings.
- **Customer usage data** - AMI interval data for customers and third parties
  - Some states are requiring utilities to use or evaluate the feasibility of the Green Button framework* (e.g., CA, CO, CT, DC, HI, IL, MI, NH, NY and TX).
    - Download My Data – standard enables customer to download their data
    - Connect My Data – data exchange protocol allows automatic transfer of data from utility to third party on customer authorization
  - Some states require specific aggregation levels for data sharing to protect privacy.
- **System level data** – To support customer and third-party solutions
  - CA, DC, MN, NH, NY and OH are examples of jurisdictions with detailed system data sharing requirements.

*The Green Button initiative is an industry-led effort to provide utility customers with easy and secure access to their energy usage information in a consumer-friendly and computer-friendly format.

Source: Juliet Homer, Pacific Northwest National Laboratory

Data-related requirements (2)

Data platforms are centralized online resources where energy data are aggregated, stored in a common format, and accessible to customers and third parties.

New York

- Joint Utilities data sharing portal provides the following information by utility:

❑ Distributed System Implementation Plans	❑ Load Forecasts
❑ Capital Investment Plans	❑ Historical Load Data
❑ Planned Resiliency / Reliability Projects	❑ NWA Opportunities
❑ Reliability Statistics	❑ Queued DG
❑ Hosting Capacity	❑ Installed DG
❑ Beneficial Locations	❑ SIR Pre-Application Information

- NYSERDA established the Utility Energy Registry for an Integrated Energy Data Resource platform to streamline community access to aggregated data.
  - 15/15 aggregation screen for residential customers and 4/60 screen for other customers.
    - 15/15 rule - An aggregation sample must have more than 15 customers and no single customer's data may comprise more than 15% of the total aggregated data.

New Hampshire

- An April 2021 settlement agreement outlined data platform requirements. The portal for customers and third parties will follow Green Button Connect protocols.

See *Extra Slides* for data access requirements in CA, MN, OH and DC.

Source: Juliet Homer, Pacific Northwest National Laboratory

Resources for more information

U.S. Department of Energy's (DOE) *Modern Distribution Grid*, Vol. IV, 2021

Berkeley Lab's integrated distribution system planning website: https://emp.lbl.gov/projects/integrated-distribution-system-planning

Berkeley Lab's research on time- and locational-sensitive value of DERs

A. Cooke, J. Homer, L. Schwartz, *Distribution System Planning – State Examples by Topic*, Pacific Northwest National Laboratory and Berkeley Lab, 2018

P. De Martini et al., *The Rising Value of Stakeholder Engagement in Today's High-Stakes Power Landscape*, ICF, 2016

P. De Martini et al., *Integrated Resilience Distribution Planning*, PNNL, 2022

T. Eckman, L. Schwartz and G. Leventis, *Determining Utility System Value of Demand Flexibility From Grid-interactive Efficient Buildings*, Berkeley Lab, 2020

N. Hanus et al., *Assessing the Current State of U.S. Energy Equity Regulation and Legislation*, Berkeley Lab/PNNL, 2023

C. Farley et al., *Advancing Equity in Utility Regulation*, Future Electric Utility Regulation Series, Berkeley Lab, 2021

N. Frick, S. Price, L. Schwartz, N. Hanus and B. Shapiro, *Locational Value of Distributed Energy Resources*, Berkeley Lab, 2021

J. Homer, A. Cooke, L. Schwartz, G. Leventis, F. Flores-Espino and M. Coddington, *State Engagement in Electric Distribution Planning*, Pacific Northwest National Laboratory, Berkeley Lab and National Renewable Energy Laboratory, 2017

J.S. Homer, Y. Tang, J.D. Taft, D. Lew, D. Narang, M. Coddington, M. Ingram, A. Hoke, *Electric Distribution System Planning with DERs — Tools and Methods*, Pacific Northwest National Laboratory and National Renewable Energy Laboratory, 2020

ICF, *Integrated Distribution Planning: Utility Practices in Hosting Capacity Analysis and Locational Value Assessment*, 2018

J. McAdams, *State Energy Justice Roundtable Series: Energy Justice Metrics*, NARUC, 2023

Smart Electric Power Alliance, *Integrated Distribution Planning: A Framework for the Future*, 2020

N.L. Seidman, J. Shenot, J. Lazar, *Health Benefits by the Kilowatt-Hour: Using EPA Data to Analyze the Cost-Effectiveness of Efficiency and Renewables*, Regulatory Assistance Project, 2021

Y. Tang, J.S. Homer, T.E. McDermott, M. Coddington, B. Sigrin, B. Mather, *Summary of Electric Distribution System Analyses with a Focus on DERs*, Pacific Northwest National Laboratory and National Renewable Energy Laboratory, 2017

T. Woolf, B. Havumaki, D. Bhandari, M. Whited and L. Schwartz, *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges and Considerations*, Berkeley Lab, 2021

Xcel Energy, *2022-2031 Integrated Distribution Plan*, 2021

ELECTRICITY MARKETS & POLICY

Contact

Lisa Schwartz, lcschwartz@lbl.gov; 510-926-1091 (cell)

For more information

Download publications from the Electricity Markets & Policy: https://emp.lbl.gov/publications
Sign up for our email list: https://emp.lbl.gov/mailing-list
Follow the Electricity Markets & Policy on Twitter: @BerkeleyLabEMP

Extra Slides

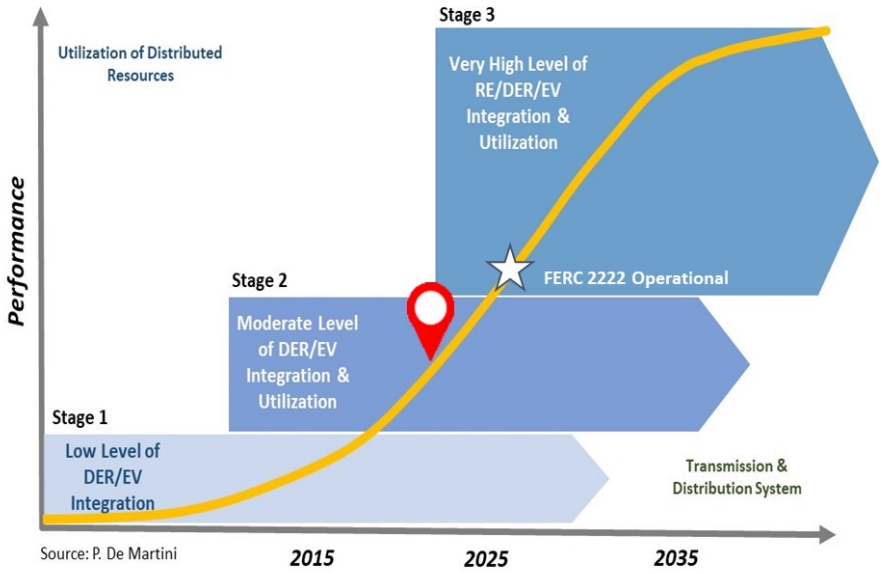
Distribution system evolution

DER integration & utilization and electrification are expanding across the U.S., at different rates.

Stage 3: *Large-scale adoption of DERs (>20% of peak*), including for wholesale & distribution services, plus community microgrids.* Utilization of DER aggregations (virtual power plants) is optimized to support grid service requirements for distribution and transmission systems. Multi-use/community microgrids help support local energy supply and resilience. Ultimately, distribution system level energy transactions are enabled. This stage of DER utilization requires coordination across jurisdictions (e.g., FERC Order 2222) and infrastructure to support both grid and market operations.

Stage 2: *Moderate adoption of DERs (5-20% of peak) including for wholesale & distribution services.* DERs — individually and in aggregations — are increasingly used as load-modifying resources for both distribution non-wires alternatives (NWAs) and wholesale capacity and ancillary services. Integrated distribution system planning and grid modernization are needed to enable real-time observability and operational use of DERs.

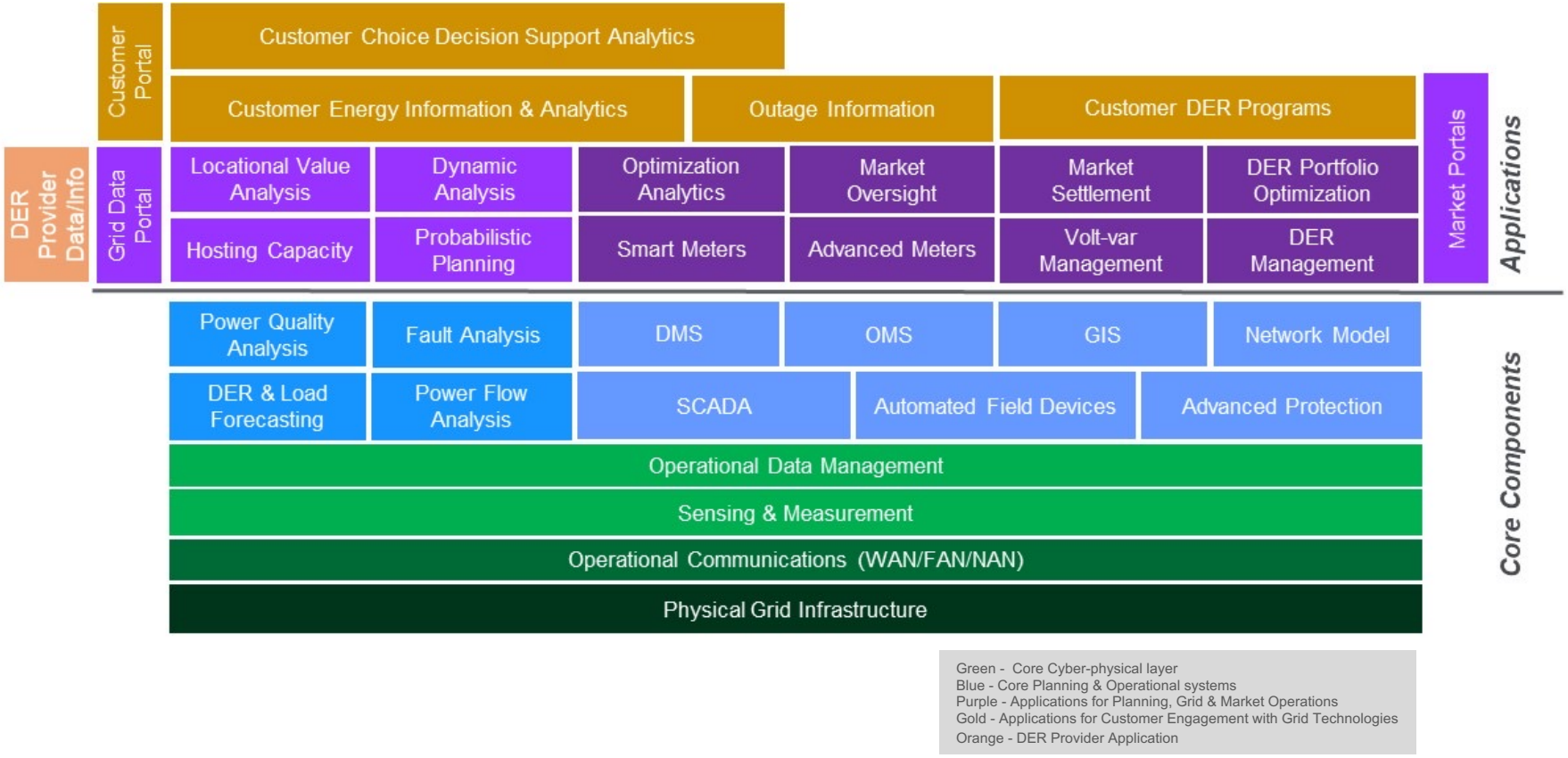
Stage 1: *Low DER adoption (<5% of peak)*. DER levels can be accommodated within existing distribution systems without material changes to infrastructure, planning and operations. Grid modernization addresses reliability, resilience, safety, and operational efficiency and enabling DER integration and utilization at low levels.



*Installed DER capacity as a percent of distribution system peak

Source: Paul De Martini, Newport Consulting

Layering of core components and applications



Source: U.S. Department of Energy-Office of Electricity Delivery and Energy Reliability, 2017. *Modern Distribution Grid, Volume III: Decision Guide*.

New York's suitability criteria for non-wires alternatives

- As part of annual capital planning, each utility must routinely identify candidate projects (load relief, reliability) for NWA, post information to websites and issue requests for proposals. Utilities jointly provided suitability criteria (March 2017) for NWA projects and described how criteria will be applied (May 2017) in capital plans and procurement processes.

Criteria	Potential Elements Addressed	
Project Type Suitability	Project types include Load Relief and Reliability*. Other categories currently have minimal suitability and will be reviewed as suitability changes due to State policy or technological changes.	
Timeline Suitability	**Large Project**	36 to 60 months
	Small Project	18 to 24 months
Cost Suitability	**Large Project**	≥ $1M
	Small Project	≥ $300k

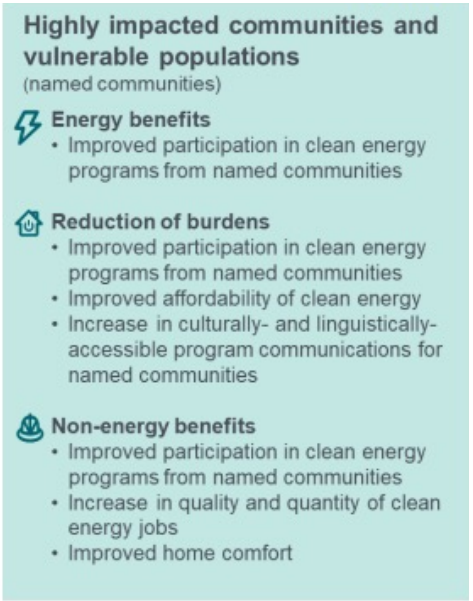
Illinois – Stakeholder engagement in multi-year Integrated Grid Plans

- The Illinois Commission adopted multi-year integrated grid plan rules in December 2021 that apply to Ameren and ComEd (state's two largest utilities). A significant stakeholder engagement process informs the utility grid plans.
  - Before the workshops begin, utilities must provide the Commission with prescribed information, including preliminary proposals on capital investments the utility plans to make in the near future. The Commission will make the information publicly available on their website.
  - Workshops are designed to encourage diverse stakeholder representation, held during day and evening hours in a variety of locations and allow for remote access.
  - The workshop process should allow stakeholders to effectively and efficiently provide feedback and input to the utility. Stakeholders can submit data requests to the utility prior to each workshop on the topics addressed in the workshop, and the utility must respond within 14 days.
  - Minimum of six workshops administered and run by an independent facilitator
- At the conclusion of workshops, the facilitator prepares a draft report describing the process and areas of consensus and disagreement and provides recommendations to the Commission regarding the utility's plan. Stakeholders can comment on the report.

Source: Natalie Mims Frick, Berkeley Lab

Energy equity and justice - Washington

- Washington's Clean Energy Transformation Act (SB 5116, 2019) requires utilities to file Clean Energy Implementation Plans that, in part, ensure equitable distribution of energy and non-energy benefits of the transition to clean energy.
  - The plans must include customer benefit indicators to demonstrate the utility's progress toward meeting this requirement in the following categories:
    - Energy benefits, non-energy benefits, reduction of burdens for highly-impacted communities and vulnerable populations, public health, environment, reduction in cost, reduction in risk, energy security, resilience
  - Utilities also must file multiyear rate plans that include equity performance measures.
  - The Act defines "vulnerable populations" and "highly impacted communities" — collectively "named communities" — and the process utilities must follow to map and engage with them.
    - Each utility has convened an Equity Advisory Group of CBOs and, in consultation with its advisors, listed specific characteristics for mapping and defining named communities.



Source: PSE 2021. Also see Avista's Plan.

Data-related requirements – California (1)

By order, utilities must make datasets available as part of Grid Needs Assessments & Distribution Deferral Opportunities filings.

- Grid needs
  - By circuit, substation, and sub-transmission capacity service
    - Peak load (five years)
    - DER growth (EE, DR, PV, EV, storage)
    - Facility loading %
    - Current year demand
    - Five-year forecasted demand
    - Forecasted percentage deficiency above the existing rating over five years
    - Forecasted MW deficiency over five years
    - Anticipated season or date by which distribution upgrade must be installed
- Distribution deferral opportunities
  - Planned investments
    - Project description
    - Distribution service required
    - Type of traditional capital investment equipment to be installed
    - In-service date
    - Deferrable by DERs? (Y/N)
    - Number and composition of customers
  - Candidate deferrals
    - Expected performance and operational requirements
    - Specific locational values
    - Distribution service required
    - Expected magnitude of DER service provision (MW/kWA)
    - Duration and timing of the deficiency and associated DER service requirements
    - Unit cost of traditional mitigation
    - Contingency plans

Source: Juliet Homer, Pacific Northwest National Laboratory

Data-related requirements – California (2)

- Privacy screens vary by purpose and level.
  - Some data are aggregated across time (e.g., monthly data) or across the utility's service territory (e.g., consumption data by city or zip code).
  - Residential customer usage data - Summarized monthly and aggregated by zip code using a 100/* screen (aggregated data must contain 100 customers, with no limit on the percentage of load that one customer can represent)
  - Commercial, agricultural and industrial data - 15/15 screen
  - Industrial customers - 5/25 screen
  - Local, state, and federal government agencies or academic researchers - 15/20 screen for residential, commercial, and agricultural customer monthly data, anonymized by census block
  - Zip code-level data is posted on utility websites (no data requests required).
  - Standard nondisclosure agreements and consent forms are used for other data requests.

Source: Littell, D., Regulatory Assistance Project. "Aggregate and Anonymized Data: Similarities & Differences, Regulatory Opportunities & Barriers." MI Power Grid Customer Education and Participation Workgroup. June 22, 2021

Data-related requirements in Other States

Minnesota* - In November 2020, the Commission approved open access data standards proposed by Citizens Utility Board to release customer energy use data to third parties. The standards apply to utilities with >50,000 customers for a specific set of applications (Docket M-19-505).

- To collect and share aggregated or anonymized, disaggregated customer energy use data for use by third parties
- Data provided at closest level of geographical specificity possible to maintain customer anonymity and at the finest practicable time interval

Ohio – An order on a multi-utility settlement (October 2021) requires utilities to provide access to customer data including:

- ≥24 months of energy usage data in 15, 30, or 60 minute intervals made available on a best-efforts basis within 24 hours of performing industry-standard validation, estimation and editing processes
- ≥24 months of summary billing history data, including date of bill, usage, bill amount, due date

*Report requested by Commission Staff, *Access to Aggregated or Anonymized Customer Energy Use Data* (October 2021): (1) discusses key aspects of data access and privacy policies and issues raised in the proceeding and (2) highlights the importance of access to aggregated customer energy use data for meeting climate targets, building benchmarking, and DER participation in wholesale markets, retail choice, and community choice aggregation

Source: Juliet Homer, Pacific Northwest National Laboratory

Data-related requirements – District of Columbia

The PSC required a dedicated data sharing website following working group recommendations. Some data sets require secure access.

Data Type	Frequency	Granularity	Availability
Capital Investment Plan – General Overview	Annual, 10 year forecast period	System	Current; Public (Pepco's Annual Consolidated Report)
Load forecast	Annual, 10 year forecast period	Substation	Current; Public (Pepco's Annual Consolidated Report)
Reliability statistics (SAIFI, CAIDI)	Annual (ACR)	Feeder level	Current; Public (Pepco's Annual Consolidated Report)
Planned resiliency/ reliability projects	Annual	Varies by project	Current; Public (Pepco's ACR and Rate Case Construction Report)
Load data	Annual (ACR)	Feeder (Historic)	NDA
Hosting Capacity	Quarterly	Feeder level	Hosting Capacity Map; Website
Beneficial Location	N/A	N/A	Not Available
Existing DER Capacity	Monthly	Feeder level	Heat Map; Website

The PSC reviewed the Customer Impact Working Group's Green Button Connect My Data Report in an order (Sept. 2021) and made decisions on issues such as data fields, contents of authorization forms, revocation process, process for customers without Internet access, development of a Connect My Data tariff, and platform certification by Green Button Alliance.

Data Type	Frequency	Granularity	Availability
Circuit Capacity/ Design Criteria	Static (updated as projects are implemented)	Feeder level	Critical Energy Infrastructure Information (CEII); Secure access required.
Physical Attributes	Static (updated as projects are implemented)	Node level	Critical Energy Infrastructure Information (CEII); Secure access required.
Protective devices	Static (updated as projects are implemented)	Feeder level	Critical Energy Infrastructure Information (CEII); Secure access required.
Voltage profile	Static (updated as projects are implemented and with changes in load information)	Feeder level	Critical Energy Infrastructure Information (CEII); Secure access required.
Circuit impedance models	Static (updated as projects are implemented)	Feeder level	Critical Energy Infrastructure Information (CEII); Secure access required.

Source: Juliet Homer, Pacific Northwest National Laboratory