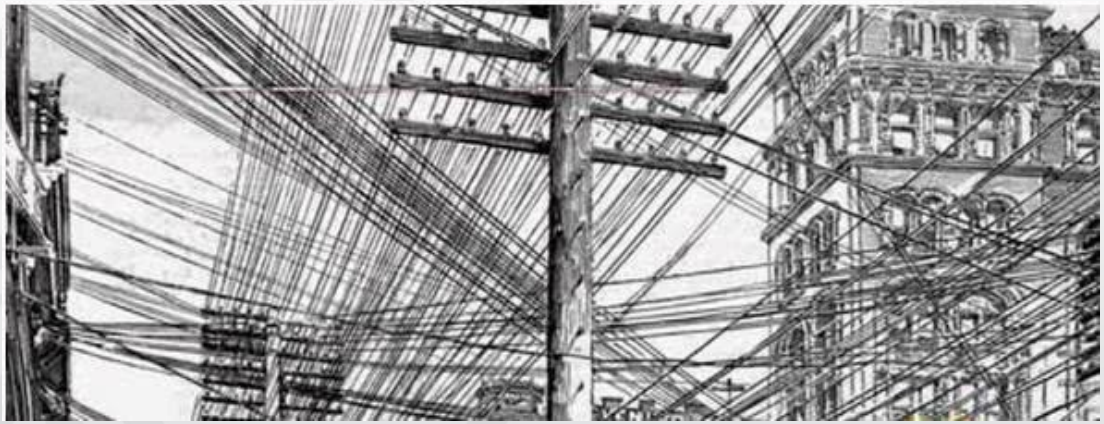

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PUC Distribution Planning Practices

Lisa Schwartz, Lawrence Berkeley National Laboratory
Juliet Homer, Pacific Northwest National Laboratory

Distribution Systems and Planning Training
for Mid-Atlantic Region and NARUC-NASEO Task Force on Comprehensive Electricity Planning
March 7-8, 2019

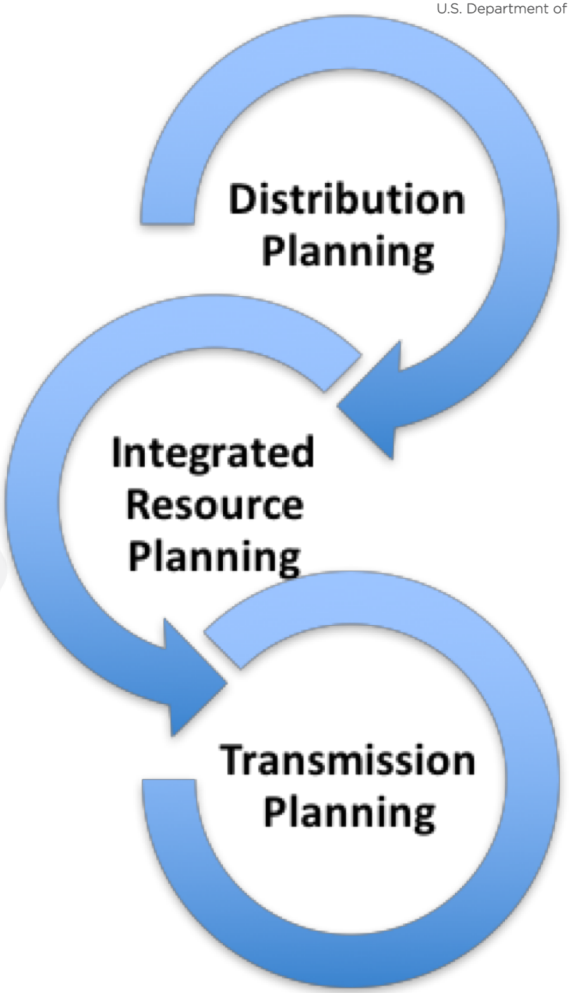
In this presentation

- Grid planning
  - Electric grid planning activities
  - Integrated distribution system planning
  - Emerging distribution planning elements
- Increasing state engagement in distribution system planning
  - Drivers for improved distribution planning and potential benefits
  - Barriers to state engagement in distribution system planning — and potential solutions
  - Considerations for establishing a regulatory process
- Variety of state approaches
- Possible places to start
- Some takeaways
- Resources for more information
  - Technical assistance, publications
- Extra slides
  - Additional state approaches, additional information on states covered in main deck

Grid planning

Electric grid planning activities

- *Distribution planning* is focused on assessing needed physical and operational changes to local grid.
  - Can support growth of distributed energy resources (DERs) and grid modernization
- *Integrated resource planning* (IRP — in vertically integrated states) is focused on identifying future investments to meet bulk power system reliability and public policy objectives at a reasonable cost.
  - Can consider scenarios for DERs and impacts on need for, and timing of, utility investments
- *Transmission planning* is focused on identifying future transmission expansion needs and options for meeting those needs.
  - Can begin anticipating operational challenges at transmission-distribution interface* and solutions



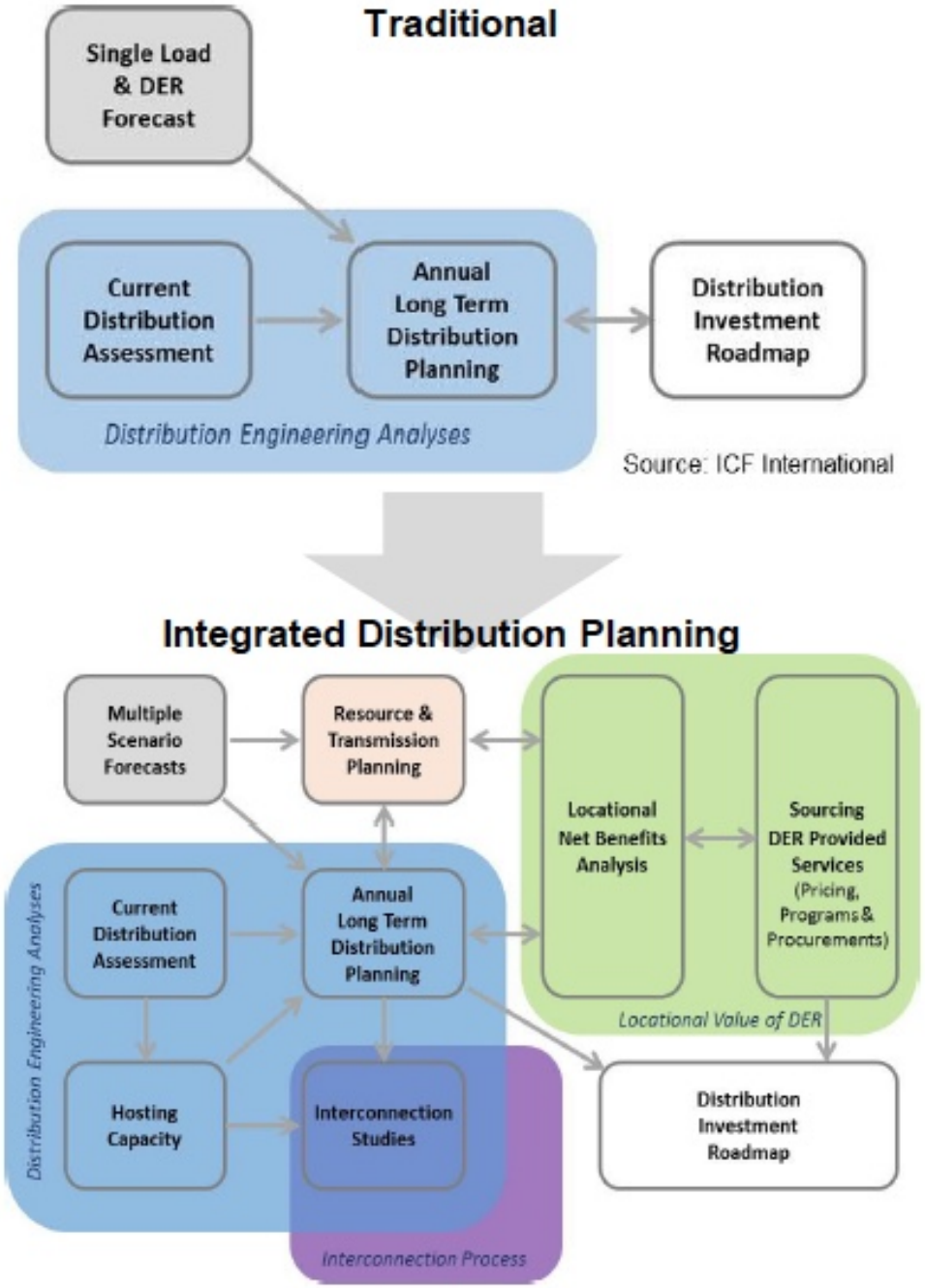
**Boundary between wholesale & retail markets; meshed high-voltage network & radial, lower-voltage feeders; and federal & state regulatory jurisdiction*

Planning enhancements: "Integrated distribution planning"

- Develop multiple scenarios to address uncertainty in customer loads and DER growth and types
- Identify distribution hosting capacity
- Identify potential to use services from DER providers and the grid investments required to enable these services
- Evaluate alternatives to grid upgrades (e.g., for load relief)
- Engage stakeholders
- Coordinate distribution planning with other processes

[DOE's Modern Distribution Grid initiative]

I. Customer and State Policy Driven Functionality
II. Advanced Technology Market Assessment
III. Decision Guide



Emerging distribution planning elements

- Projecting loads and DERs in a more granular way
- Analyzing hosting capacity — amount of DERs that can be interconnected without adversely impacting power quality or reliability under existing control and protection systems and without infrastructure upgrades
- Assessing locational value of DERs
- Analyzing non-wires alternatives (NWAs) to traditional investments

  Investments in energy efficiency, demand response, distributed generation (DG) and storage that provide specific services at specific locations to defer, mitigate or eliminate need for traditional distribution infrastructure
- Increasing visibility into distribution system
- Better representing distribution system in models for planning and operations
- Engaging stakeholders

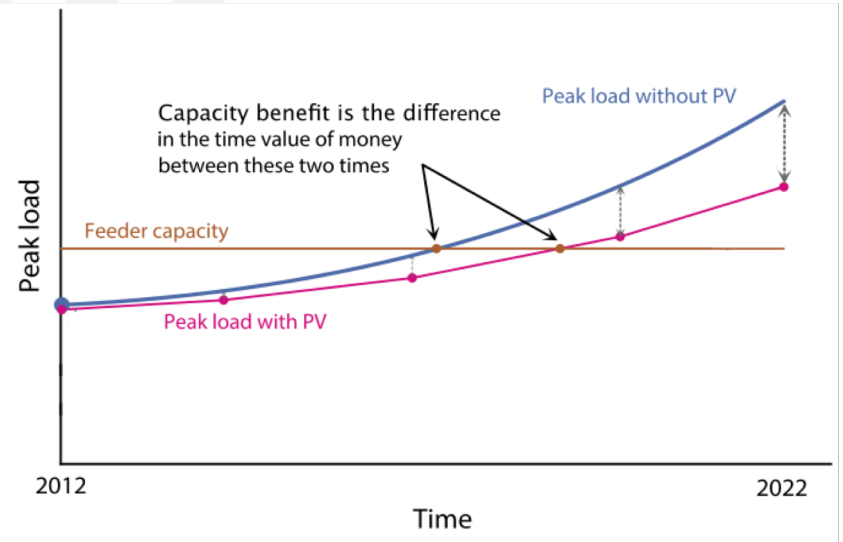


Figure adapted from Cohen, M.A., P.A. Kauzmann, and D.S. Callaway. 2016. "Effects of Distributed PV Generation on California's Distribution System, Part 2: Economic Analysis." *Solar Energy*, Special Issue: Progress in Solar Energy, 128(April): 139–152.

Increasing state engagement in distribution system planning

State drivers for improved distribution planning

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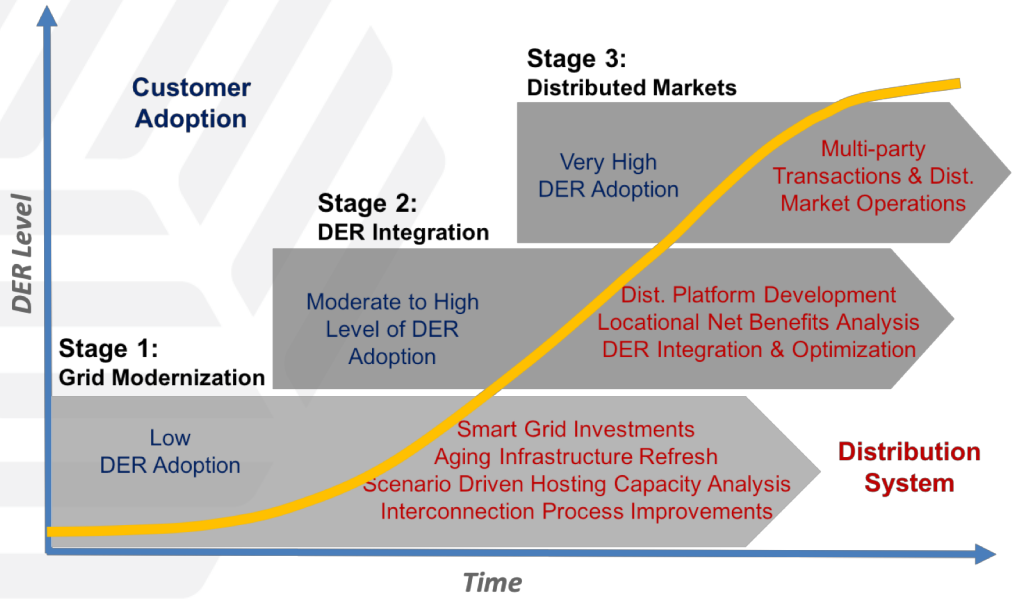
- More DERs — cost reductions, policies, new business models, consumer interest
- Resilience and reliability
- More data and better tools to analyze data
- Aging grid infrastructure and utility proposals for grid investments
- Need for greater grid flexibility in areas with high levels of wind and solar
- Interest in conservation voltage reduction and volt/VAR optimization
- Non-wires alternatives to traditional solutions that may provide net benefits to customers

State benefits from improved distribution planning

- Makes transparent utility plans for distribution system investments before showing up individually in rider or rate case
- Provides opportunities for meaningful PUC and stakeholder engagement
  - Can improve outcomes
- Considers uncertainties under a range of possible futures
- Considers all solutions for least cost/risk
- Motivates utility to choose least cost/risk solutions
- Enables consumers and service providers to propose grid solutions and participate in providing grid services



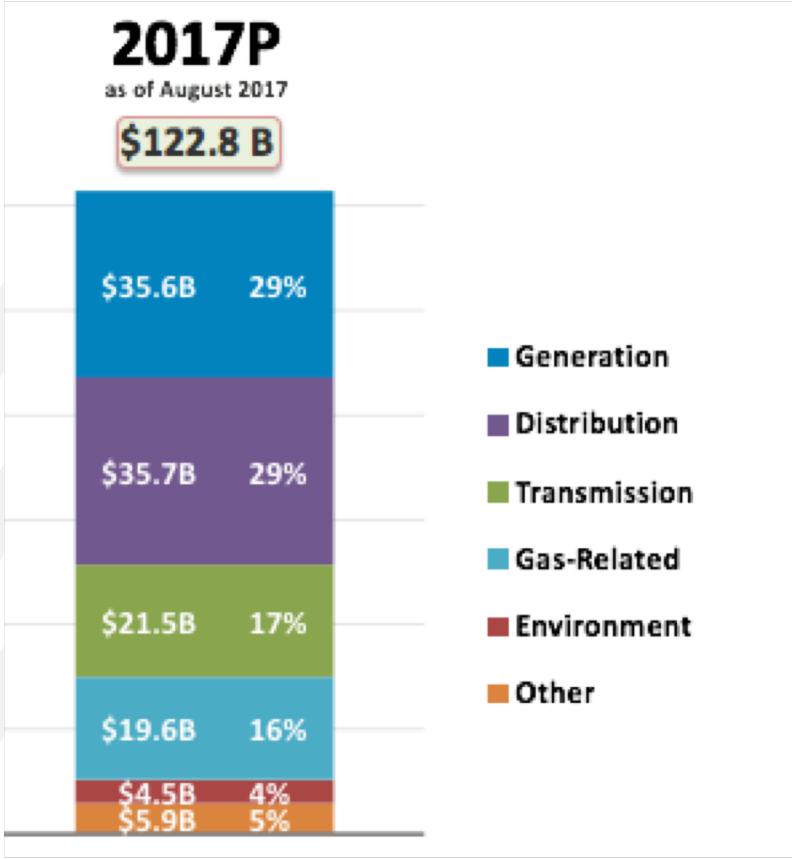
Graph from De Martini and Kristov, for Berkeley Lab

Barriers to state engagement in distribution system planning — and potential solutions

- Asymmetry of resources and technical expertise
  - *Can leverage stakeholder input, and train and educate staff*
- Data availability and sharing
  - *Can identify data gaps, begin building on information available through other filings (e.g., reliability, DSM, IRP) and increase transparency*
- Time consuming
  - *Can take incremental steps and reap early benefits*
- Major storm or event can derail planning activities
  - *Can build in regular activities to keep distribution planning updates on track*
- Uncertainty with fast-changing technologies, consumer behavior
  - *Can plan for multiple possible futures (probabilistic models)*
- Granularity – Many disparate distribution system components
  - *Can focus on "hot spots"*
- Novel processes — e.g., non-wires alternatives
  - *Can get started through pilots*

Some considerations for establishing a regulatory process for distribution planning

- Statutory requirements, regulatory precedents
- Priorities, phasing, related proceedings
- What's worked elsewhere, tailored to your state
- Recognize differences across utilities
- Regulatory clarity with flexibility built-in
- Quick wins, early benefits for consumers
- Long-term, cohesive view to achieve goals
- Pilots vs. full-scale approaches (including economy of scale, rate impacts)
- Utility distribution investments are large



[$35.7B nationally among Edison Electric Institute members in 2017]

State Engagement in Distribution System Planning

Homer, Cooke, Schwartz, Leventis, Flores-Espino, Coddington, *State Engagement in Electric Distribution Planning*, PNNL, Berkeley Lab, and NREL, December 2017

	States with advanced practices					Other state approaches										
	California	Hawaii	Massachusetts	Minnesota	New York	D.C.	Florida	Illinois	Indiana	Maryland	Michigan	Ohio	Oregon	Pennsylvania	Rhode Island	Washington
Statutory requirement for long-term distribution plans or grid modernization plans[a]	✓			✓					✓							
Commission requirement for long-term distribution plans or grid modernization plans[a]		✓	✓		✓					✓	✓					
No planning requirements yet, but proceeding underway or planned						✓							✓		✓	✓
Voluntary filing of grid modernization plans								✓				✓		✓		
Non-wires alternatives analysis and procurement requirements	✓				✓										✓	
Hosting capacity analysis requirements	✓	✓		✓	✓											
Locational net benefits analysis required	✓				✓											
Smart grid plans required													✓			
Required reporting on poor-performing circuits and improvement plans							✓	✓				✓		✓	✓	
Storm hardening requirements							✓			✓						
Investigation into DER markets		✓														

(a) For one or more utilities.

For a summary by topic with some updates, see Cooke and Homer (PNNL) and Schwartz (LBNL), *Distribution System Planning – State Examples by Topic*, May 2018

States are advancing distribution system planning in a variety of ways. Here are some *examples*.

- Requirements for utilities to file distribution system or grid modernization plans (CA, HI, IN, MA, MD, MI, MN, NV, NY)
- Requirements to conduct hosting capacity analysis (CA, HI, MN, NY)
- Consideration of cost-effective non-wires alternatives (CA, NY, RI)
- Locational net benefits analysis for DERs (CA, NY, HI, NV)
- Investigations into DER procurement strategies (CA, HI, NY)
- Storm hardening and undergrounding requirements (MD, FL)
- Requirements for utilities to report on poor-performing circuits and improvement plans (many states — e.g., FL, IL, OH, PA, RI)
- Develop explicit benefit-cost analysis methodology or cost-effectiveness guidance (NY, CA, RI, MD, NV)

Covering some examples next. See "Extra Slides" for information on additional states and more on some states covered in main slide deck.

Example state approaches* - 1

Minnesota

Biennial Distribution Grid Modernization Reports (Minn. Stat. §216B.2425)

- Utility identifies projects it considers necessary to modernize T&D systems
  - May ask Commission to certify priority grid modernization projects in order to recover costs through a rider (outside general rate case) — e.g., see Docket No. E-002/M-15-962
- Utility identifies interconnection points for small-scale DG and distribution system upgrades to support continued DG development — no formal Commission action required
  - Commission decision requires annual hosting capacity analyses (Docket No. E-002/M-15-962)
  - Commission issued latest guidance in Docket 17-777
  - Commission is considering Xcel's 11/1/18 hosting capacity analysis filing in Docket 18-251

PUC initiated inquiry in May 2015 on Electric Utility Grid Modernization with a focus on distribution planning (Docket No. CI-15-556)

- Series of stakeholder meetings continued through fall 2016
- DOE sponsored a consultant report on integrated distribution system planning for MN
- Staff PUC Report on Grid Modernization (March 2016)
- Questionnaire on utility planning practices with stakeholder comments and responses
  - How do Minnesota utilities currently plan their distribution systems?
  - What is the status of each utility's current plan?
  - Are there ways to improve or augment utility planning processes?

Example state approaches

- Commission set Integrated Distribution Planning requirements for Xcel Energy in Docket No. 18-251 and also set requirements for smaller regulated utilities

  Docket Nos. 18-253 (Otter Tail), 18-254 (Minnesota Power), 18-252 (Dakota Electric)
- Most requirements are the same across utilities. Diverge in 2 key ways:
  - Filing cycle – Annual vs. biennial
  - Simpler hosting capacity analysis requirements – For smaller utilities, Excel spreadsheet for analysis by feeder with daytime minimum load data
- Fundamental provisions
  - 10-year Distribution System Modernization and Infrastructure Investment Plan
    - Including a 5-year action plan, based on internal business plans and DER future scenarios
      - Base case, medium and high — specifying methods and assumptions
  - Coordination with Integrated Resource Planning (except Dakota Electric, a distribution coop)
  - Utility holds at least one “timely” meeting prior to filing; PUC staff can convene a stakeholder meeting during public comment period
  - Data specified for filing - Baseline distribution system, financial data, DER deployment
  - For projects >$2M, analyze how NWAs compare in viability, price and long-term value
    - Specify project types (e.g., for load relief or reliability), timelines and cost thresholds

Example state approaches - 2

▶ Washington

On 4/17/18, WUTC staff proposed rules on IRP and distribution system planning for electric utilities and requested comments and posed questions for both electric and natural gas utilities

- "…it is imperative that the IRP principle of comparing disparate resources on even terms is applied to distribution system planning"
- "…adopt changes to the current [IRP] rule, or create a new rule, that will increase transparency of utility planning to meet distribution system needs that ensures that utilities make investments on a least-cost, least-risk basis."
- Each electric utility must develop an IRP "that cohesively plans for meeting resource needs through investments in … generation, transmission, and distribution systems."
- Stakeholder engagement via advisory group*
- DSP consists of 1) 10-year capital investment plan; 2) long-term plan on how utility is improving distribution system operations and transparency; 3) report on tools and practices to facilitate integration of DERs – **All an input to IRP**
  - Facilitate DER integration through probabilistic forecasts of customer-owned DERs, identifying potential tariffs and rate designs to compensate customers for value and provide accurate price signals, and identifying pilot programs

Example state approaches

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- Washington's overarching principles for DER planning for distribution systems

  Transparency: DER planning should *fairly consider both wire-based and non-wires resource alternatives* for meeting distribution system needs. Planning should *optimize the investment decisions of customers and third parties by identifying points on the grid where distributed resources have greatest value*.

  Coordination: Distribution plans should *inform and interact with other utility planning processes*, including integrated resource plans & capital budget plans.

  Flexibility: The planning *process needs to improve over time and adapt* to changing grid conditions, new technologies, and improved modeling capabilities.

  Reliability and Security: DER planning should *ensure that reliability, physical security, and cybersecurity are maintained* as the distribution grid changes.

  Inclusion: *All customers should have opportunities to participate in grid modernization* through tariffs and programs that compensate customers for the value of their distributed resources, with particular consideration given to low-income customers.

From Washington Utilities and Transportation Commission, *Report on Current Practices in Distributed Energy Resource Planning*, report to Washington Legislature, Dec. 31, 2017 [emphasis added].
See "Extra Slides" for WUTC best practices report, based on survey of state practices.

Example state approaches - 3

Michigan

Distribution Planning Framework - PSC Staff Report for achieving an "open, transparent, and integrated electric distribution system planning process in Michigan" (September 2018)

- PSC Order on staff recommendations: "*framework at this time is not to be treated as a one-size-fits-all approach but is to be used as a guide for the next iterations of distribution plans…." "Unconventional solutions, including targeted EE, DR, energy storage, and/or customer-owned generation, that could displace or defer investments in a cost-effective, reliable, and timely manner should be considered and evaluated."*

PSC ordered 3 utilities to file 5-yr distribution investment & maintenance plans

- *"to increase visibility into the needs of maintaining the state's system and to obtain a more thorough understanding of anticipated needs, priorities, and spending."*
- Commission consolidated all 3 utility filings into Case No. U-20147 (April 2018)

DTE Electric , Consumers Energy and Indiana Michigan Power Co. filed draft plans and parties commented

DTE Electric final plan 1/31/18; Consumers Energy final plan 3/1/18

Example state approaches - 4

Indiana

Commission required 3 IOUs to establish stakeholder collaboratives to develop performance metrics, including for distribution planning & operations

- First raised in IURC Order in Cause 44602 for Indiana Michigan Power Co. (3/16/16), then in IURC order in Cause 44967 and utility compliance filing
- Also see NIPSCO (Cause 44688) and I&M (Cause 44967)

IRP rule requires utilities to consider effects of distributed generation on distribution system planning (and other types of planning)

Transmission, Distribution, and Storage System Improvement Charge (2013 legislation) to encourage T&D investments for safety, reliability, modernization

- 7-year plans for approval by Indiana URC
- Detailed project descriptions required for all years
- For capital projects only (e.g., *not* for vegetation management)
- Charge limited to 80% of "approved capital expenditures and TDSIC costs"; remaining 20% addressed in general rate case

Example state approaches - 5

New York

Reforming the Energy Vision – Utilities file Distributed System Implementation Plans with stakeholder engagement

- Guidance for 2018 DSIP Updates

Value Stack tariff

- Location-specific relief zones
- Payments to DER (including storage) projects based on energy, capacity, environmental, demand reduction and locational system relief value;
  - NY PSC staff proposing changes to this methodology (proposed 12/18) — e.g., using NWA in lieu of locational relief zones, changing calculation of demand relief value
  - **"Staff believes that the current DRV and LSRV rules may represent an attempt to achieve greater granularity and precision than is reasonable under VDER Phase One and possible in an open, administratively-determined tariff mechanism."**

Hosting capacity maps for all circuits ≥12 kV

NWA – Utilities must routinely identify candidate projects for NWA solutions (load relief, reliability), post information to websites and issue RFPs

New York Joint Utilities NWA criteria

- Incorporating NWA criteria into T&D capital planning – The Joint Utilities (ConEd, O&R Utilities and Central Hudson) provided suitability criteria for NWA projects in March 2017 and described how criteria will be applied to projects in their capital plans in a supplemental filing on 5/8/17.

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

*Reliability projects entail projects for remote single source regions or customer-requested enhanced reliability projects. Source: Central Hudson NWA Opportunity website

Example state approaches

- New York Joint Utilities NWA procurement

  The Joint Utilities' May 8, 2017, supplemental filing stated they would use their own procurement process to award contracts for NWAs. Information on the Joint Utilities NWA process is here and on the REV Connect website.

  - RFP response requirements include:
  - Proposed solution description
  - Project schedule and acquisition plan
  - Detailed costs associated with proposed solution
  - Risks, challenges and community impacts
  - Professional background and experience with the proposed solutions

- Example underperformance requirement: "Failure to deliver load relief committed as part of any solution may result in liquidated damages to ConEd as provided by the contract."
- Example NWA: Rochester Gas & Electric plans to use targeted efficiency near Station 51 to reduce peak demand that would otherwise be met with traditional upgrades

Example state approaches - 6

California

AB 327 (2013), PUC proceeding on distribution resource plans

2014 PUC order on DRPs

Locational Net Benefits Analysis – Net benefits DERs can provide at a given location, using avoided cost calculator for system-level values plus PUC-required, location-specific methods for avoided T&D costs

- Locational benefits demonstration projects to test analytical tools
- LNBA working group

Integration Capacity Analysis – Hosting capacity analysis to identify how much generation can be installed on a line section w/o distribution upgrades

Utility incentive mechanism pilot for DERs – Utilities earn 4% on customer or 3rd party-owned DER projects cost-effectively deferring distribution investments

- Includes cost-effectiveness framework

DER Adoption & Distribution Load Forecasting

Example state approaches

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- **California, cont.**

  CA Grid Modernization Investment Guidance – Answering the question: *What grid modernization investments are appropriate given the need to integrate the growing number of DERs?*

  March 2018 CPUC decision in R-14-08-013

  - Defines grid modernization and establishes classification framework to serve as a common vocabulary (informed by DOE's DSPx work)
  - Establishes structure and timing of grid modernization planning process - Grid modernization plans to be submitted as part of general rate cases
  - Provides guidance on how the CPUC will evaluate cost-effectiveness

  Cost-reasonableness rather than *cost-effectiveness* to be the basis for consideration, similar to other items proposed in a general rate case:

  - "Benefits of grid modernization investments cannot be isolated from benefits provided by other grid investments or benefits of DERs enabled"
  - "IOUs shall propose the lowest cost approach to meeting grid needs"
  - "We find that current GRC approaches are effective and appropriate, and should continue to be used."

Example state approaches

- **California, cont.**
  - Feb. 2018 order on Distribution Investment Deferral Framework (DIDF)
    - Annual process for third party-owned DERs to defer or avoid traditional capital investments in distribution systems
    - "The central objective of the DIDF is to identify and capture opportunities for DERs to cost-effectively defer or avoid traditional IOU investments that are planned to mitigate forecasted deficiencies of the distribution system."
    - IOUs implement DER growth scenarios and Integration Capacity Analysis (hosting capacity analysis).
    - IOUs file annually detailed Grid Needs Assessment and Distribution Deferral Opportunity Report. 2018 GNAs filed June 1st.
    - Distribution Planning Advisory Group – Stakeholder feedback on IOU reports
    - Annually by Dec. 1, each IOU recommends distribution deferral projects for solicitations via the Competitive Solicitation Framework Request for Offers.
    - On Feb. 5, 2019, the CPUC approved first RFOs for SCE, PG&E and SDG&E

CAISO-launched initiative looking at storage as a transmission asset; developed three strawman proposals

Example state approaches - 7

Hawaii

HPUC rejected piecemeal investment proposals and required Hawaiian Electric Companies (HECO) to file a comprehensive Grid Modernization Plan

Order No. 34281 provided guidance for a holistic, scenario-based grid modernization strategy to inform review of discrete projects submitted by utility

HECO's Grid Modernization Strategy (8/2017) approved in Order No. 35268

Distributed generation interconnection plans (DGIPs) in Docket 2014-0192 analyzed distribution investments that could enable greater level of DERs

Power Supply Improvement Plans (PSIPs) in Docket 2014-0183 expanded on DGIPs with system and circuit level DER integration analyses

HECO filed an ambitious and holistic new approach to power system planning called Integrated Grid Planning that merges planning processes for G, T & D

- Integrates solution procurement into this merged process
- Goal of identifying gross system needs, coordinating solutions, and developing an optimized, cost-effective portfolio of assets
- Allows a variety of distributed and grid scale resources to provide power generation and ancillary services
- Stakeholder council, technical advisory panel, ad-hoc working groups

Example state approaches

- Hawaii Integrated Grid Planning (Order 35569)

  First step – Working group assists in developing **forecasts & assumptions** that will drive planning

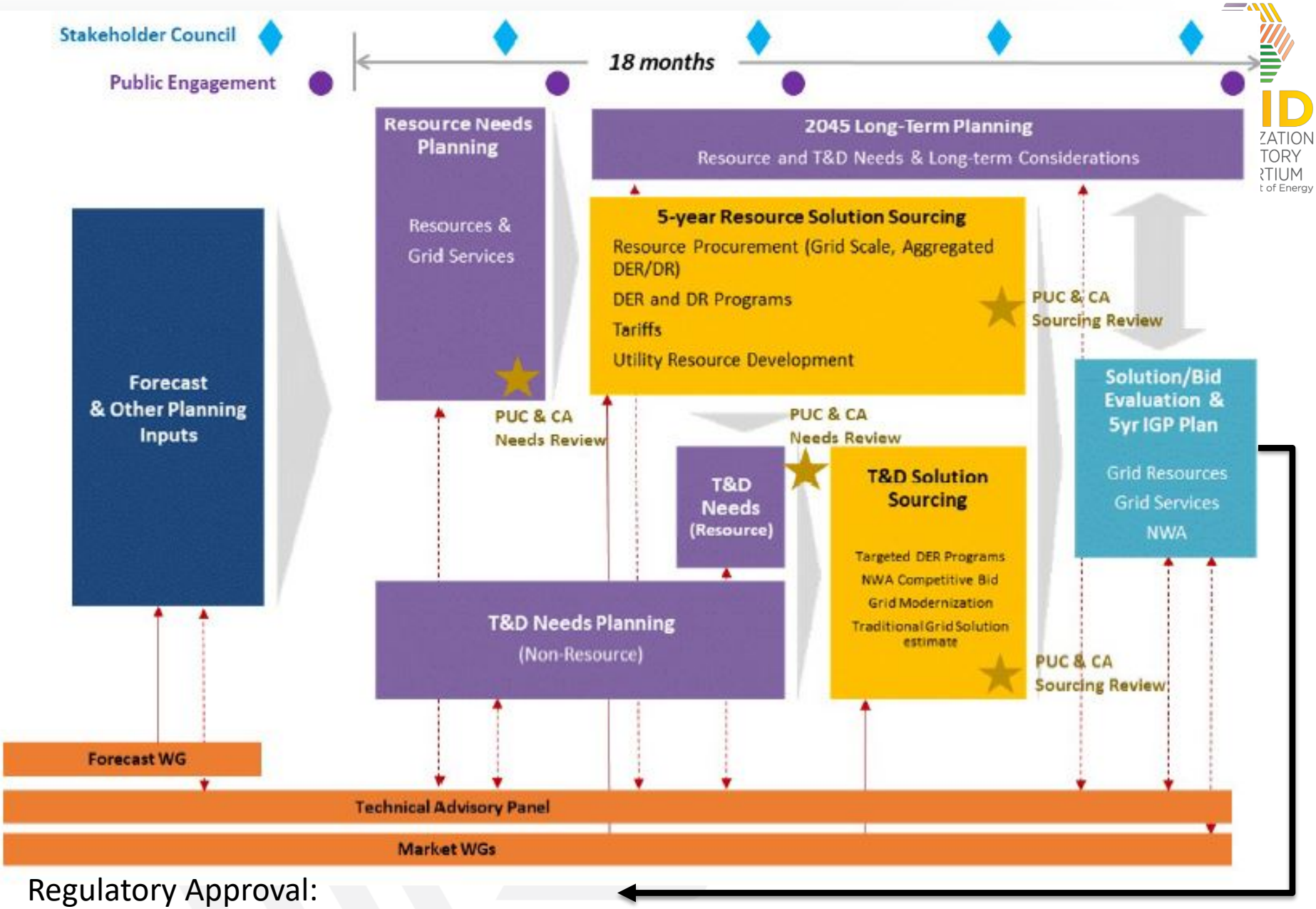
  Step two – **Collectively identify needs** - resource, transmission and distribution. Use advanced modeling tools to identify portfolio of solutions that meet system needs, policy goals and reliability standards.

  Step three – **Identify solutions** - resource, transmission & distribution that can be achieved through **procurement,* pricing and program** options.

  Step four – **Evaluate and optimize** resource, transmission, and distribution solutions. Screen potential solutions through modeling tools and optimize based on cost and policy objectives.

  At the end of step four – Submit **five-year plan** with discrete investments, programs, and pricing proposals to the commission for review.

**Market working group will address structural changes for streamlining RFP process, including defining unbundled grid services and standardizing contracting methods and agreements*



Regulatory Approval:
Seek PUC approval of Integrated Grid Plan's 5-year plan & related applications

Example state approaches - 8

Massachusetts

Requirements for each electric distribution company to develop and implement a 10-year grid modernization plan (2014)

DPU ruled on Grid Modernization Plans in May 2018 Order

- Denied AMI requests due to low benefit to cost ratio and uncertainty about impacts of Municipal Aggregation (aka Community Choice Aggregation)
- Approved reliability/resilience-related requests for ADMS, automation and Volt/var optimization – mentioned recent frequency of large storms
- Refined DPU's grid modernization focus to improving access to distribution system planning process and facilitating a robust market
- Required utilities to file performance metrics, a joint proposed evaluation plan, a model Grid Modernization Factor tariff
- Required utilities to file Annual Grid Modernization Reports with updated projections, and metrics (feeder and substation, system level infrastructure, performance)

House Bill 4857 (August 2018) – country's first Clean Peak Standard

- Requirements for *Annual Resiliency Reports* for distribution systems with heat maps of areas that are congested/constrained and most vulnerable (demand & weather)
- Utilities "may" competitively solicit NWAs in areas needing T&D upgrades

Example state approaches - 9

Nevada

SB 146 (2017) requires distributed resource plans

Distribution Planning Guidelines approved by the PUCN in October 2018 in Docket 17-08022 – result of informal and formal workshops

- DRP filed *with IRP* and covers 3-year action plan of utility
- Must include forecast of net distribution system load (system, substation and feeder level) and distributed resources for a forecast period of 6 years, updated annually
- Hosting Capacity analysis required with scenario analysis and online maps
- Grid Needs Assessment must be included — comparing traditional and distributed resource solutions to forecasted T&D system constraints
- Recommendations will be based on LNBA of resource options to utility customers
- How distributed resources have affected need for supply-side resources (G&T)

When PUCN approves IRP, it will determine prudence of DRP elements.

- Prudence implies analyses have been "prudently performed" and selections of new distributed resources set forth in the DRP "are reasonable."
- "A utility may recover all costs it prudently and reasonably incurs in carrying out an approved DRP, in the appropriate separate rate proceeding."

NV Energy to file 1st DRP April 2019 as amendment to 2018 IRP

Example state approaches - 10

District of Columbia

Modernizing the Energy Delivery System staff report issued in January 2017 included two draft NOPRs for Commission to consider

August 2018 Order established working groups on:

- Data and Information Access and Alignment
- Non-wires Alternatives to Grid Investments
- Future Rate Design
- Microgrids
- Customer Impact
- Pilot Projects

October 2018 final rulemaking – added definitions to multiple rule chapters

January 2019 Notice of final rulemaking – amended interconnection rules

PEPCO filed transportation electrification plan September 2018; reply comment deadline was Jan. 14, 2019

Example state approaches - 11

▶ Maryland

Distribution planning is one of six topics* addressed in PC 44 - Transforming Maryland's Electric Grid proceeding.

- PC-44 working group progress: proposing a statewide EV program, refining interconnection rules and processes, developing and proposing retail supplier regulations, and designing both time varying rates and storage ownership pilots
- Benefits and Costs of Utility Scale and Behind the Meter Solar Resources in Maryland - Final report November 2018:
  - Presents benefits and costs as they accrue to (1) the bulk power system, (2) local power distribution systems, and (3) society and the economy
  - Considers benefits that accrue in two timeframes (1) value of production over life of installation, and (2) value of installation in first year of use
  - Desire to translate results of benefit cost analysis into time-varying rate pilots
  - Original RFP for consultant to study benefits & costs of distributed solar in IOUs' service areas

Orders in Case No. 9406 (BGE rate case) and Case No. 9418 (Pepco rate case) required a five-year distribution investment plan within 12 months

- BGE distribution investment plan and Pepco plan filed

*Other topics: rate design, EVs, competitive markets/customer choice, interconnection process and energy storage

Example state approaches - 12

Ohio

PUCO's PowerForward initiative - reviewing technological and regulatory innovation that could enhance the consumer electricity experience.

- Workshops with industry experts "to chart a path forward for future grid modernization projects, innovative regulations and forward-thinking policies"

PowerForward Roadmap released August 2018 - vision for the modernization of Ohio's grid with a series of recommended next steps

- Distribution utilities to file grid architecture status reports & current state planning assessments in April 2019, followed by applications for grid arch investments
- October 2018 - two separate working groups/dockets: Distribution System Planning and Data and the Modern Grid

OH Commission approves Duke PowerForward rider in Dec 2018 to recover capital and O&M costs for new PowerForward related initiatives

- *Note: Duke Carolina's Power Forward Rider rejected in North Carolina*

Distribution system reliability code, distribution circuit performance codes and annual reliability compliance filings

Example state approaches - 13

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Pennsylvania

Utilities can propose a Distribution System Improvement Charge to recover reasonable and prudent costs to repair, improve or replace certain eligible distribution property by filing Long Term Infrastructure Improvement Plans

- e.g., see FirstEnergy LTIIP

Distribution reliability code directs PSC to regulate distribution inspection & maintenance plans, requires utilities to report quarterly on worst-performing circuits and make annual compliance filings (see 2016 PA reliability report)

May 2018 - Commission issued Proposed Policy Statement Order with factors it will use to determine just and reasonable rates and to invite utilities to propose rate designs that achieve multiple objectives in their rate case filings

In November 2018 a statewide partnership led by Dept of Environmental Protection issued Pennsylvania's Solar Future report with 15 strategies to reach 11 GW of solar by 2030

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Possible places to start

Haven't yet begun? Possible places to start

- *Take early integration steps* - Consistency in inputs (e.g., assumptions, forecasts) and scenarios — updated in time — across distribution planning, capital planning, transmission planning and, in vertically integrated states, integrated resource planning
- *Account for all resources* – Consider energy efficiency, demand response (including direct load control, smart thermostats and time-varying pricing), distributed generation and storage alongside traditional distribution solutions where applicable
- *Specify DER attributes* – In order to meet identified distribution system needs
- *Test new sourcing and pricing methods* – e.g., competitive solicitations, tariffs, programs
- *Analyze multiple possible futures* – e.g., loads, DERs, markets

Possible places to start - 2

- *Phase in hosting capacity analysis* – To facilitate distributed generation integration and indicate better or more difficult locations
- *Pilot evaluation of locational impacts* – Identify where DERs might offer greatest benefits
- *Plan integration of utility systems in advance* – Specify how any proposed investments (e.g., advanced metering infrastructure, automated distribution management systems) will be used with other utility assets and systems, as well as providing data for distribution planning, for the benefit of consumers.
- *Education and training – You're doing that right now!*

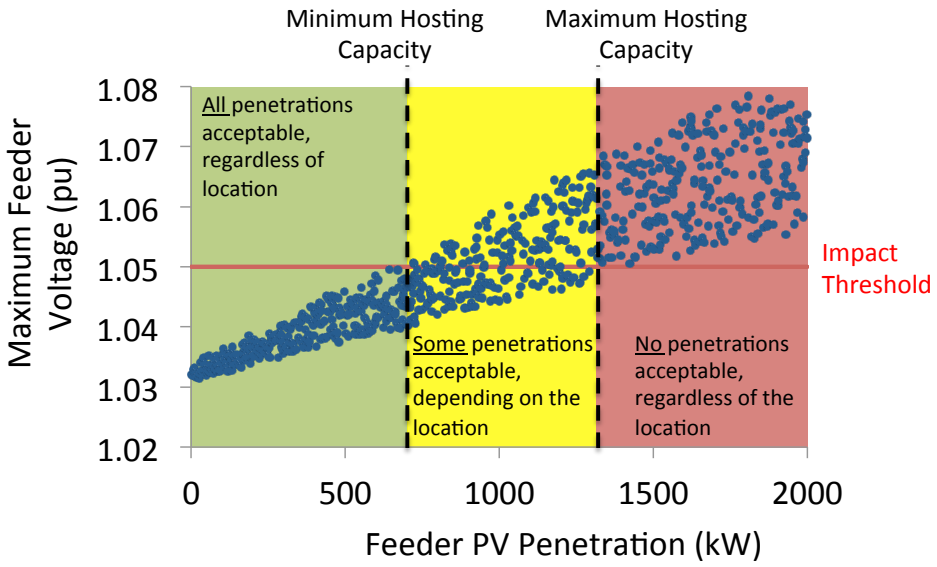

Figure adapted by Berkeley Lab from EPRI (2015), *Distribution Feeder Hosting Capacity: What Matters When Planning for DER?*

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Some takeaways

Some takeaways

- Getting distribution system models correct and validated is an important first step.
- Most states have not begun to directly engage in longer-term utility distribution planning. States further down the path are still early in the process.
  - Approaches range from a cohesive set of requirements to ad hoc order in utility rate case
- Some PUC distribution planning processes are tied to greater utility assurance of cost recovery for distribution investments that are included in approved plans.
- Beyond universal interest in affordability and reliability, common state drivers for a state distribution system planning process include facilitating higher levels of DERs, harnessing them to provide grid services for customers, enabling greater consumer engagement, and improving review of utility distribution investments.
- Common *emerging* elements of distribution system planning include DER forecasting, hosting capacity analysis, DER locational value, guidance or standards on cost-effectiveness, and engaging stakeholders to help identify least-cost solutions.
- Some states are taking steps toward including non-wires alternatives in distribution planning and competitive procurements to meet certain grid needs.
- Integration of distribution planning with other types of planning is nascent – different time frames and separate models are challenging.

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Resources

Technical assistance for states

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- **Berkeley Lab's Electricity Markets and Policy Group** provides independent and unbiased technical assistance to state utility regulatory commissions, state energy offices, tribes and regional entities in these areas:
  - Energy efficiency (e.g., policy frameworks, implementation strategies, resource planning approaches, utility cost recovery, and evaluation)
  - Demand response (e.g., time-varying pricing)
  - Renewable energy resources
  - Utility regulation (e.g., rate design and ratemaking, utility incentives and disincentives, financial impacts of distributed energy resources)
  - Distribution and transmission planning
  - Grid modernization and broader issues on electricity system decision-making

- **Pacific Northwest National Laboratory** provides policy support analysis to states on topics including distribution system planning, valuation and markets, and DER rate design issues.

Publications for more information

- Alan Cooke, Juliet Homer, Lisa Schwartz, *Distribution System Planning – State Examples by Topic*. Pacific Northwest National Laboratory and Berkeley Lab, May 2018
- Juliet Homer, Alan Cooke, Lisa Schwartz, Greg Leventis, Francisco Flores-Espino and Michael Coddington, *State Engagement in Electric Distribution Planning*, Pacific Northwest National Laboratory, Berkeley Lab and National Renewable Energy Laboratory, December 2017
- U.S. Department of Energy's (DOE) Modern Distribution Grid initiative and report (www.doe-dspx.org)
- Paul De Martini (ICF) for Minnesota Public Utilities Commission, *Integrated Distribution Planning*, 2016
- *Summary of Electric Distribution System Analyses with a Focus on DERs*, by Y. Tang, J.S. Homer, T.E. McDermott, M. Coddington, B. Sigrin, B. Mather, Pacific Northwest National Laboratory 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 DER and Grid Modernization - Tools and Methods* (forthcoming)
- Natalie Mims Frick, Lisa Schwartz, Alyse Taylor-Anyikire, *A Framework for Integrated Analysis of Distributed Energy Resources: Guide for States*, Berkeley Lab, 2018
- Natalie Mims Frick, Tom Eckman, Charles Goldman, *Time-varying value of electric energy efficiency*, Berkeley Lab, 2017
- Berkeley Lab's Future Electric Utility Regulation report series — in particular:

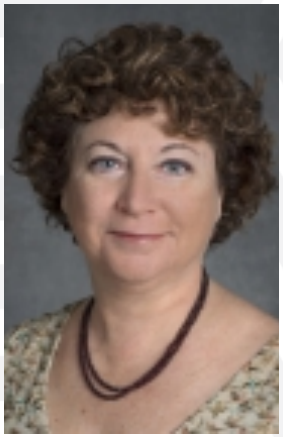
  Distribution Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation and Oversight, by Paul De Martini (Cal Tech) and Lorenzo Kristov (CAISO)

  The Future of Electricity Resource Planning, by E3 and Andrew Mills, Berkeley Lab)

  Value-Added Electricity Services: New Roles for Utilities and Third-Party Providers, by Institute for Electric Innovation, Advanced Energy Economy and National Association of State Utility Consumer Advocates

  The Future of Transportation Electrification: Utility, Industry and Consumer Perspectives, by Alliance for Transportation Electrification, EVgo and National Consumer Law Center

Contact



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Click here to stay up to date on our publications, webinars and other events and follow us @BerkeleyLabEMP

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Extra Slides

More state approaches to distribution planning

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Delaware

Senate Bill 80 (June 2018) instituted a Distribution System Improvement Charge (DCIS) for electric utilities (previously only available to water utilities) for the automatic adjustment of rates to provide recovery of eligible costs on a semiannual basis.

- Includes replace new distribution facilities serving customers, extend or modify distribution facilities to eliminate negative conditions

MOU between Delmarva Power, the Public Advocate, and Public Service Commission Staff (April 2018) to develop a proposal for enhanced distribution system planning rules for electric, natural gas, and water utilities by September 1, 2019, with a progress report by March 31, 2019

- New distribution planning docket (Docket No. 18-0935) will provide information in support implementation of the DSIC

More state approaches to distribution planning

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Illinois

Utilities file annual reliability reports, ICC assesses utility report ≤3 years

Energy Infrastructure Modernization Act authorized investment plans for grid hardening and smart meters

- Utilities file annual Grid Modernization Action Plans with formula rates for ICC approval — e.g., see ICC order on 2016 Ameren plan

ICC kicked off NextGrid initiative in March 2017, a consumer-focused study on topics such as leveraging Illinois' restructured energy market, investment in smart grid technology, and recent law expanding renewables and efficiency

- ICC resolution invited stakeholders to comment on an independent facilitator and topics to be considered as part of the initiative
- Series of workshops to kick off 18-month process; 7 working groups
- Draft Final Report issued 12/14/18; comment period closed 1/10/19

Distributed Generation Valuation and Compensation workshops held and whitepapers developed with DOE support to inform future proceeding to establish rebate value for distributed generation, a requirement of the Future Energy Jobs Act (Illinois Public Act 99-0906)

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New Jersey

Clean Energy Law signed May 2018 – creates new RPS, increases solar renewable energy credit obligations for utilities, establishes community solar program and energy storage target, and launches new regulatory dockets

In May 2018, the Governor directed the Board of Public Utilities to develop the 2019 Energy Master Plan.

- Building a Modern Grid stakeholder group is addressing:
  - Steps and barriers to grid modernization, resource planning, integrated distribution planning, reliability and resilience, performance metrics, rate design and tariff structures to support grid modernization
- Final plan is expected in June 2019.

In September 2018 PSE&G filed its proposed Clean Energy Future plan, which includes $4 billion in investments in energy storage, electric vehicles, advanced metering infrastructure, non-wires alternatives, volt-VAR optimization, energy efficiency and smart homes. Utility is requesting recovery charges, automatic rate adjustments, and riders to recover costs.

Atlantic City Electric and Jersey Central Power & Light also filed significant infrastructure investment plans with requests for cost recovery through riders.

More state approaches to distribution planning

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▶ Oregon

Utilities must submit smart grid implementation plans biennially and annually report on projected construction budgets for T&D projects >$10 million; staff proposed Commission open investigation to adopt process for distribution system planning (5- to 10-year planning horizon); staff white paper underway

Pacific Power and Energy Trust of Oregon (ETO)* are using targeted energy efficiency to possibly defer a substation upgrade.

2-year pilot (Q3 2017 to Q2 2019) targets efficiency measures for 3,000 customers to reduce substation load. Goals of the pilot:

- Measure peak demand savings
- Evaluate ability to replicate strategies in other regions served by utility
- Develop processes for coordinated implementation with ETO
- Determine needed changes to improve targeted efficiency deployment to defer system upgrades

Commercial	Industrial	Residential
• Lighting direct installation for commercial, multifamily • Standard incentives	• Lighting • Operations & maintenance • Standard incentives	• Energy Saver Kits • Smart thermostats • Online Home Energy Reviews

*ETO is the third-party administrator for energy efficiency programs.

More state approaches to distribution planning

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▶ Rhode Island

A benefit-cost framework adopted by the PUC – originally proposed in a stakeholder report — is the culmination of a stakeholder engagement process

Framework includes identifying:

- Mixed cost-benefit, cost or benefit category
- System attribute benefit/cost driver
- Candidate methodologies
- Potential visibility requirement

Power System Level	Mixed Cost-Benefit, Cost, or Benefit Category	System Attribute Benefit/Cost Driver	Candidate Methodologies (Includes options with increasing specificity where multiple methods per driver)	Potential Visibility Requirements
	Energy Supply & Transmission Operating Value of Energy Provided or Saved (Time- & Location-specific LMP)	Bids, Offers, Marginal Losses, Constraints, & Scarcity in Time & Location specific LMP (+ Reactive Power requirements & Impacts on Distribution Assets in DLMP)	AESC Seasonal On- & Off-Peak Energy Price Forecasts	
			Expected Time- & Location-specific Bulk Power LMP for forecast period of resource operation	Requires interval or advanced metering functionality & Tracking of ISO Nodal Prices
			Expected Time-, Location-, & Product-specific Distribution LMP for forecast period of resource operation	Requires interval or advanced metering functionality & analysis of actual power flows
	Renewable Energy Credit Cost / Value	Cost of REC Obligation or REC Revenue Received	AESC Forecast of REC prices	
	Retail Supplier Risk Premium	Differential between retail prices and ISO market prices * retail purchases	Absent AMI + dynamic retail pricing, AESC estimate or risk adjusted observed differentials	Quantitative estimation requires detailed economic modeling
	Forward Commitment: Capacity Value	Whether an FCM Qualified Resource &, if so, FCA bid and Provision of Qualified Capacity	Estimate of likely FCA Auction bid capacity from FCM Qualified Resources	Quantitative estimation requires detailed economic modeling
		Change in Demand reflected (~4 yr. later) in a Revision of FCM forecast Capacity Requirements	Review of FCM capacity requirements & estimate of likely future impacts (Same as Capacity DRIPE below)	Quantitative estimation requires detailed economic modeling
	Forward Commitment: Avoided Ancillary Services Value	Whether it is a Qualified Ancillary Service Resource &, if so, Qualified Capacity	Forecasts of AS requirements / Provision of AS net of Energy supplied * Forecast AS prices	
	Utility / Third Party Developer Renewable Energy, Efficiency, or DER costs	Direct Cost of New Non-customer Resources (Capital & Operating costs of resources) + Customer Program costs (Participant recruitment, administrative, incentive and EM&V costs)	Cost Estimates	

More state approaches to distribution planning

- Rhode Island, cont.

  Investigation Into the Changing Electric Distribution System (Docket 4600) produced a Guidance Document in October 2017 on how the PUC will consider distribution system investments in National Grid regulatory proceedings.

  PUC created Least Cost Procurement Standards in July 2017 (Docket 4684) with guidelines for incorporating NWAs into utility System Reliability Procurement (SRP) plans. NWA implementation costs are recovered in SRP. (SRP also includes other types of expenditures.)

  In August 2017, National Grid filed its Efficiency and System Reliability Procurement Plan. The SRP plan highlighted the use of NWAs for:

  - Highly utilized distribution systems
  - Areas where construction is physically constrained
  - Areas where the utility anticipates demand growth

- RI System Data Portal includes a Heat Map to identify opportunities where NWAs can be used to reduce or manage load for these use cases
- Power Sector Transformation Initiative Phase I report, November 2017

More state approaches to distribution planning

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▶ Virginia

Grid Transformation and Security Act (Senate Bill 966, March 2018)

- Specifies Dominion Energy will be subject to triennial rate reviews and calls for:
  - An increase to 5,000 MW of utility-owned wind and solar and 500 MW of rooftop solar less than 1 MW in size that are "in the public interest";
  - $1.1 billion investment in energy efficiency programs by IOUs; and
  - Cost recovery structures

Dominion Virginia Power filed for approval of Phase 1 Grid Transformation Plan ($816M CapEx + $101M O&M) in July 2018.

- Commission approved costs for cyber security and some telecommunications but did not approve costs for AMI, intelligent grid devices and grid hardening

Virginia Energy Plan 2018 developed by Office of the Secretary of Commerce and Trade; and Department of Mines, Minerals and Energy

- Includes recommendations related to: (1) Solar and Onshore Wind, (2) Offshore Wind, (3) Energy Efficiency, (4) Energy Storage, and (5) Electric Vehicles and Advanced Transportation

More state approaches to distribution planning

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▶ Vermont

Annual solicitations for distributed renewable projects with standard-offer contracts to "plants that have sufficient benefit to the…electric grid"

- Screening Framework identifies areas where distributed generation may provide benefits or reduce grid constraints, implemented by a stakeholder group — Vermont System Planning Committee

PUC can approve alternative regulation plan if it will "offer incentives for innovations and improved performance that advance State energy policy" (30 V.S.A. § 218d). July 2018 order on principles and considerations for plans

More on states covered in main slide deck

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More on California

SB 1339 enacted in September 2018 requires CPUC and CEC actions to facilitate microgrids by December 2020, including:

- Develop service standards to meet state and local permitting requirements,
- Develop guidelines that determine what impact studies are required for microgrids to connect to the grid,
- Develop separate rates and tariffs, as necessary, to support microgrids, while ensuring that system, public, and worker safety are given the highest priority,
- Form a working group to codify standards and protocols to meet California utility and ISO microgrid requirements, and
- Develop a standard for direct current metering in Electric Rule 21 to streamline the interconnection process and lower interconnection costs for direct current microgrid applications.

Southern California Edison rate case (A-16-09-001) includes $2.1 billion in CapEx for Grid Modernization, including automation for real-time monitoring and control, new telecommunications capabilities, and new software for system management. Statutory deadline for the proceeding is June 3, 2019.

More on states covered in main slide deck

- More on California, cont.
  - Integrated Resource Planning rulemaking to set greenhouse gas targets for load serving entities; CPUC staff to do initial modeling
  - SCE Grid Modernization Plan – As part of 2018 rate case SCE proposed $1.9 billion to modernize grid for DERs; Commission decision Jan 2018
  - Report on improving T&D coordination for high DERs from More Than Smart, CAISO, PG&E, SCE, SDG&E
  - Energy storage mandate (AB 2514) - target of 1,350 MW of energy storage by 2020

More on states covered in main slide deck

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- **More on Hawaii**

  Investigations into DERs including procurement. 3 tariff options:
  - Customer self-supply
  - Customer grid-supply (Smart Export tariff)
  - Time-of-use tariff

  PUC inclinations on future of utilities

  Study on alternative utility and regulatory models – not yet available

More on states covered in main slide deck

More on Minnesota

Staff Report on Grid Modernization (March 2016) included principles

- Maintain and enhance the safety, security, reliability, and resilience of the electricity grid, at fair and reasonable costs, consistent with the state's energy policies
- Enable greater customer engagement, empowerment, and options for energy services
- Move toward the creation of efficient, cost-effective, accessible grid platforms for new products, new services, and opportunities for adoption of new distributed technologies
- Ensure optimized utilization of electricity grid assets and resources to minimize total system costs
- Facilitate comprehensive, coordinated, transparent, integrated distribution system planning

More on states covered in main slide deck

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More on New York

Updated NY PSC Guidance on Distributed System Implementation Plans – DSIPs must include sections on:

- Integrated Planning, Advanced forecasting, Grid operations, Energy storage integration, Electric Vehicle Integration, Energy efficiency integration and innovation, Distribution system data, Customer data, Cyber Security, DER Interconnections, Advanced Metering Infrastructure, Hosting capacity, Beneficial locations for DERs and Non-wires Alternatives, Procuring Non-wires Alternatives

DSIP must also address DSIP governance, links to marginal cost of service studies and links to the utility's most recent Benefit-Cost Analysis Handbook

Each utility must maintain a Benefit-Cost Analysis Handbook (BCA Order)

- Common handbook template 1.0 developed in 2016, 2.0 in 2018
- Handbook templates provides parties a consistent and transparent methodology and presents general BCA considerations and notable issues regarding data collection required for project and investment benefits assessments.
- Definitions and equations for each benefit and cost are provided along with key parameters and sources. Where applicable, utilities customize the handbook to account for utility specific assumptions and information.

Energy Storage Mandate – 3,000 MW by 2030, established 12/18

Best practices for DER planning for distribution systems – Washington UTC report

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1. Identify *data gaps* that impede planning process and any *upgrades needed* to obtain data
2. Propose *monitoring and metering upgrades w/biz case* identifying net benefits
3. Identify programs and tariffs to *compensate customers* for DER value and optimal usage
4. Use *probabilistic models to forecast DER growth* on the utility's system
5. Identify all major, planned investments for next 10 years and *analyze non-wires alternatives*
6. *Competitively procure DERs* identified in plan through detailed requests for proposals, specifying locations
7. Use identified *DERs as inputs to integrated resource plans*
8. Discuss how utility is *adapting cybersecurity and data privacy practices* to changing distribution grid
9. Discuss lessons learned from current planning cycle plus *process and data improvements for next cycle*
10. Use transparent approach for *stakeholder input and feedback*