Planning for the Evolving Grid: State Distribution Planning Practices

Lisa Schwartz, Lawrence Berkeley National Laboratory
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In this presentation

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► Increasing state engagement in distribution planning
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► Examples of states advancing distribution system planning practices
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Distribution systems and distribution planning
What is the distribution system?

- Portion of electric system composed of medium voltage (up to 69 kV) lines, substations, feeders and related equipment
- Transports electricity to and from homes and businesses and links customers to high-voltage transmission system
- Physical infrastructure (transformers, wires, switches and other equipment) and cyber components (information, telecommunication and operational technologies needed to support reliable operation)

Graphic from https://www.eia.gov/energyexplained/index.cfm?page=electricity_delivery; text adapted from Modern Distribution Grid - Volume III (see “Publications”)

Emerging *integrated* distribution system planning

- Assess physical and operational changes to grid necessary for safe, reliable and affordable service *that satisfies customers’ changing expectations and use of distributed energy resources (DERs)*

- Identifies:
  1. Necessary distribution investments to enhance safety, reliability and security, *including replacement of aging infrastructure and grid modernization*
  2. Changes to interconnection processes and integration investments to support DER adoption
  3. Value of DERs and opportunities to realize net benefits for all customers through use of DER-provided services

From *Integrated Distribution Planning* (see “Publications”)
Electric grid planning activities

*Distribution planning* is focused on assessing needed physical and operational changes to local grid.

- Can support DER growth and net benefits for all

*Integrated resource planning* (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; between meshed high-voltage network & radial, lower-voltage feeders; and between federal & state regulatory jurisdiction*
Increasing state engagement in distribution planning
State drivers for improved distribution planning

► More DERs due to:
  □ Cost reductions
  □ Public policies
  □ Third-party providers
  □ Consumer interest in control over energy costs and sources

► Resiliency and reliability

► More data and better tools to analyze data

► Aging grid infrastructure and utility proposals for grid investments

► Need for greater grid flexibility with higher levels of wind and solar

► Interest in distribution efficiency improvements
  □ Conservation Voltage Reduction and Volt/VAR Optimization

► Pilots demonstrating cases where alternatives to traditional distribution solutions provide net benefits to customers
State objectives for distribution planning

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Source: *Modern Distribution Grid - Volume III* (see “Publications”)
State benefits from improved distribution planning

- Makes utility distribution system investments transparent before showing up individually in rate case or rider
- 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 third parties to propose grid solutions and participate in providing grid services

*Graph from DeMartini and Kristov, for Berkeley Lab (see “Publications”)*
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
  - $32B nationally among Edison Electric Institute members in 2016
- See “Possible places to start” in Additional Slides
Examples of states advancing distribution planning
(Juliet Homer, PNNL, assisted with NY, CA, HI slides)
States are advancing distribution system planning in a variety of ways.

- Requirements for utilities to file distribution system/grid modernization plans with stakeholder engagement (e.g., NY, CA, MA)
- Ad hoc directive to file a distribution system plan (e.g., MI, MD)
- Requirements to conduct hosting capacity analysis (e.g., MN, CA, NY)
- Consideration of cost-effective non-wires alternatives (e.g., NY, CA)
- Locational net benefits analysis for DERs (e.g., NY, CA)
- Investigations into DER procurement strategies (e.g., HI, NY, CA)
- Requirements for utilities to report regularly on poor-performing circuits and propose investments (e.g., PA)
- Storm hardening and undergrounding requirements (e.g., FL)
- Reliability codes and annual compliance reports (e.g., OH, IL)
- Smart grid reporting (e.g., OR, WA)
States advancing distribution planning

► New York – Reforming the Energy Vision

- Utilities file Distribution System Implementation Plans with stakeholder engagement
- Expansion of non-wires alternatives (NWAs)
  - Brooklyn and Queens Demand Management project ($200M) enabled $1.2B deferral of traditional upgrades (41 MW customer-side, 11 MW utility-side)
  - Focusing on NWA suitability criteria - Utilities incorporating NWA criteria into transmission and distribution capital planning – Must routinely identify projects that are candidates for NWA solutions (load relief, reliability, etc.) and post to websites with information including timing
- Value Stack tariff
  - Payments to DER projects based on demand reduction values and locational system relief value
- Hosting capacity maps for all circuits ≥12 kV by 10/1/17
States advancing distribution planning - 2

➡️ California

- **AB 327** and Public Utilities Commission (PUC) order on distribution planning
- **Distribution Resource Plans**
  - *Locational Net Benefits Analysis* - Specify net benefits DERs can provide at any given location, using E3’s Distributed Resource Avoided Cost Calculator as framework for system-level values and PUC-required, location-specific methods for avoided T&D costs
  - *Integration Capacity Analysis* – “Streamlined” hosting capacity analysis to identify how much generation can be installed on a line section w/o distribution upgrades. 9 functional requirements for demos
  - **DER Adoption and Distribution Load Forecasting methodology**
  - **Grid Modernization Investment Guidance** (staff whitepaper)
  - **Distribution Investment Deferral** to establish annual process for third party-owned DERs to defer or avoid traditional capital investments in distribution systems
- **Utility incentive mechanism pilot for DERs** – Utilities earn 4% on customer or third-party DER projects that defer distribution system investments
States advancing distribution planning - 3

► Hawaii

- **Clean Energy Initiative**
  - Achieving the state’s 100% renewable portfolio standards goal by 2045
  - Reducing electricity consumption by 4,300 GWh by 2030, enough electricity to power every home for more than two years

- High penetration of distributed solar PV and isolated island grids

- **Investigations into DERs** including procurement

- Hawaii PUC rejected piecemeal investment proposals and required HECO to file a comprehensive [Grid Modernization Plan](#) – comments due this week

► Massachusetts

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

- Must outline how the company proposes to make measurable progress toward: (1) reducing the effects of outages; (2) optimizing demand, including reducing system and customer costs; (3) integrating distributed resources; and (4) improving workforce and asset management
Minnesota

- Biennial Distribution Grid Modernization Reports (Minn. Stat. §216B.2425)
  - Utility identifies projects it considers necessary to modernize its T&D systems
  - May ask Commission to certify grid modernization projects as priority projects, a requirement for utility to recover costs through a rider (outside of a general rate case)
  - Distribution study to identify interconnection points for small-scale distributed generation (DG) and distribution system upgrades to support continued DG development; no formal Commission action required

- Xcel Energy filed 1st Biennial Distribution Grid Modernization Report in 2015
  - Commission order certified an advanced distribution management system (ADMS) and required initial hosting capacity analysis by 12/1/16 — analysis of each feeder for DG ≤1 MW and potential distribution upgrades necessary to support expected DG (based on utility’s IRP filings and Community Solar Gardens process)
  - Commission decision on Xcel hosting capacity analysis requires hosting capacity analyses Nov. 1 each year and provides guidance for next analysis
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 that continued through fall 2016
- DOE sponsored a consultant report on integrated distribution system planning for MN
- 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?

Staff Report on Grid Modernization (March 2016) tees up 3 questions

- Are we planning for and investing in the distribution system we will need in the future?
- Are planning processes aligned to ensure future reliability, efficient use of resources, maximize customer benefits and successful implementation of public policy?
- What commission actions would support improved alignment of planning and investment?
More state approaches to distribution planning

► Colorado
- PUC approved an unopposed settlement agreement on Xcel Energy’s grid modernization proposal, including Advanced Metering Infrastructure (AMI), Integrated Volt-VAr Optimization Infrastructure and associated components of an advanced communications network, including a Field Area Network and Home Area Network.

► 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).
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
More state approaches to distribution planning - 3

► Maryland

- Distribution planning is one of six topics* addressed in PC 44 - Transforming Maryland’s Electric Grid proceeding.
  - 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) require a five-year distribution investment plan within 12 months
  - BGE distribution investment plan filed; Pepco plan forthcoming

► Michigan

- PSC ordered utilities (Consumers Energy - Case No. U-17990 and DTE Electric - Case No. U-18014) to file draft 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.”
- DTE Electric and Consumers Energy filed plans; comments were due 9/6/17
- Utilities to address “electric distribution system conditions, including equipment age and useful life; system goals and related reliability metrics; local system load forecasts; and maintenance and upgrade plans”

*Other topics: rate design, EVs, competitive markets/customer choice, interconnection process and energy storage
More state approaches to distribution planning - 4

Ohio

- PUCO’s [PowerForward initiative](#) is 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”
- Duke’s [electric security plan](#) includes a rider for “new offerings designed to advance programs, services, and initiatives reflective of … PowerForward”
- AEP’s [amended electric security plan](#) includes installation of EV charging stations, microgrids and smart lighting controls
- FirstEnergy – [PUCO approved Distribution Modernization Rider](#) (3/31/16; $132.5M/yr for 3 yr); [Grid Modernization Business Plan](#) filed 2/29/16 includes 3 scenarios with full deployment of AMI and ADMS, plus Distribution Automation and Integrated Volt/VAR Control to varying degrees
- [Distribution system reliability code](#), [distribution circuit performance codes](#) and annual reliability compliance filings
More state approaches to distribution planning - 5

► Washington

- Rulemaking considering resource planning changes: DERs including energy storage; distribution system modeling; avoided costs; smart grid reporting (with sunset of current reporting requirements)
- HB 1233 (proposed) would require utilities to submit an annually updated, 10-year DER plan to the Washington Utilities and Transportation Commission for approval or rejection.

► Oregon

- Utilities must submit smart grid implementation plans biennially and annually report on projected construction budgets for transmission and distribution projects >$10 million
- Staff proposed PUC open investigation to adopt process for distribution system planning (5- to 10-year planning horizon)
Some takeaways

► Most states have not yet begun to directly engage in longer-term (5- to 10-year) utility distribution system planning. And states further down the path are still early in the process.
  • Approaches range from a cohesive set of requirements to an order in a 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 improving system efficiency, enabling greater consumer engagement, and integrating DERs.
► Common emerging distribution system planning elements include DER forecasting, DER locational value, hosting capacity analysis, and engaging stakeholders (including third-party service providers) to help identify solutions.
► Some states are taking steps toward: 1) including non-wires alternatives in distribution planning and competitive procurements to meet certain grid needs and 2) modifying utilities’ annual capital planning process to account for DER options.
► Integration of distribution planning with demand-side management planning, integrated resource planning and transmission planning is nascent.
Additional Slides
Possible places to start

- **Take early integration steps** - Consistency in inputs (e.g., assumptions, forecasts), scenarios and modeling methods — updated in time — across distribution planning, transmission planning and integrated resource planning.

- **Account for all resources** – Consider energy efficiency, demand response (e.g., direct load control, smart thermostats and time-varying pricing), distributed generation and energy storage, alongside traditional distribution solutions.

- **Specify DER attributes** – In order to meet identified 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 systems, in distribution planning and for the benefit of consumers.

- **Training and education** – See “Additional slides”

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

► Training for PUCs on distribution systems and distribution planning
  □ New England PUCs 9/2017; Midwest PUCs 12/2017; more to come

► DOE’s Solar Energy Technologies Office, in partnership with Berkeley Lab, Pacific Northwest National Laboratory and National Renewable Energy Laboratory, recently launched a three-year analytical support program for PUCs on topics related to distribution utility planning and regulatory, policy, programmatic and technology assessments of DERs.

► 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., financing, EM&V, utility programs, behavior-based approaches, cost-effectiveness, administrative options, program planning and design, cost recovery)
  □ Renewable energy resources
  □ Demand response (e.g., time-varying pricing), smart grid and grid modernization
  □ Utility regulation and business models (e.g., financial impacts to utility and utility customers)
  □ Transmission and reliability, resource planning
Publications

- U.S. Department of Energy’s (DOE) Modern Distribution Grid report (www.doe-dspx.org)
  - Volume I: Customer and State Policy Driven Functionality
  - Volume II: Advanced Technology Market Assessment
  - Volume III: Decision Guide


- *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, April 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)
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