The New Frontiers in System Planning
Today’s Speakers

• Hon. Jeff Ackermann, Colorado

• Natalie Mims Frick, Lawrence Berkeley National Lab

• Hon. Nancy Lange, Minnesota

• Hon. Andrew McAllister, California Energy Commission
The New Frontiers in System Planning
Hon. Jeff Ackermann
Colorado
NARUC – NASEO Task Force on Comprehensive Electricity Planning
Task Force Co-Chairs

Hon. Jeff Ackermann
Chairman
Colorado Utilities Commission

Dr. Laura Nelson
Director
Utah Office of Energy Development

Task Force Co-Vice-Chairs

Hon. Beth Trombold
Commissioner
Public Utilities Commission of Ohio

Dr. Andrew McAllister
Commissioner
California Energy Commission
What’s Happening in the Electricity System Right Now?
Electricity Planning and Investment Decisions are Inter-Related

Task Force will focus on aligning Resource and Distribution planning

With greater alignment of electricity planning processes, states & utilities could:

• Improve reliability and resilience
• Optimize use of distributed and existing resources
• Avoid unnecessary costs
• Support state priorities
• Increase transparency of investment decisions
NARUC-NASEO Task Force

Purpose: Develop new pathways for aligned electricity planning

• 4 workshops over 2 years (start spring 2019)
  • Two member-only workshops
  • Two member-stakeholder workshops

• 12 to 15 states
  • Commission and state energy office from each state working together
  • Participants TBA February 2019
Targeted Outcomes

1. **Innovation**: Pioneer new tools and roadmaps for aligning planning to meet your state’s needs

2. **Action**: Apply learnings to directly benefit your state

3. **Replication**: NARUC and NASEO publish templates to support all members

*Participants will be supported by each other, technical experts, and facilitators*
The New Frontiers in System Planning
Natalie Mims Frick
Berkeley Lab
The New Frontiers in System Planning

Presented by Natalie Mims Frick
Authors: Lisa Schwartz and Natalie Mims Frick

National Association of Regulatory Utility Commissioners
Annual Meeting – Nov. 14, 2018

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In this presentation

- Electric grid planning activities
- Distribution system planning and integration with other processes
- Integrated resource planning
- Alignment across planning processes: opportunities and challenges
- Resources for more information
Electric grid planning activities (1)

- **Distribution planning**
  - Assess needed physical and operational changes to local grid

- **Integrated resource planning** (in vertically integrated states)
  - Identify future investments to meet bulk power system reliability and public policy objectives at reasonable cost

- **Transmission planning**
  - Identify future transmission expansion needs and options for meeting those needs.
Electric grid planning activities (2)

- **Demand-side management (DSM) planning**
  - Identify opportunities to use energy efficiency and demand response to meet future energy and capacity needs

**Time-varying value of efficiency**

**Locational value of efficiency**
- Energy
- Capacity
- Ancillary Services
  - Planned Distribution Upgrade Replacement
  - Grid and Distribution Services
  - Location-Based T&D Losses
  - Risk Hedge
- Environmental Benefits
- Economic Development
Integrated distribution planning

- Assesses **physical** and **operational** changes to the distribution system necessary to enable safe, reliable, and affordable service **that satisfies customers’ changing expectations and use of DERs, generally in coordination with resource and transmission planning**

- Includes stakeholder-informed planning scenarios to support a reliable, efficient, and robust grid in a changing and uncertain future

Source: ICF (2016)
### Energy and grid-related services provided by DERs

<table>
<thead>
<tr>
<th>Impact</th>
<th>DER Capability/Service</th>
<th>Key Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulk Level Impact</strong></td>
<td>Energy Production/Load Reduction</td>
<td>Produce electricity</td>
</tr>
<tr>
<td></td>
<td>Generation Capacity</td>
<td>Meet extreme peak</td>
</tr>
<tr>
<td></td>
<td>Frequency Regulation/Load Following/Balancing</td>
<td>Respond rapidly to balance supply and demand</td>
</tr>
<tr>
<td></td>
<td>Spinning Reserve/Non-spinning Reserve</td>
<td>Reliability – provide ability to respond to unforeseen forces outages and/or changes in loads</td>
</tr>
<tr>
<td><strong>Locational Impact</strong></td>
<td>Locational Capacity for T&amp;D</td>
<td>Provide or defer need for additional T&amp;D peaking capacity</td>
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<tr>
<td></td>
<td>Voltage Regulation</td>
<td>Maintain power quality/reduce losses</td>
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</table>

### Foundational Elements of Distribution System Planning With DERs

#### Enabling Capabilities and Components

- Validated and calibrated feeder models
- Data and grid state
- Time-series power flow analysis (TSPFA)

#### Analysis Areas

- Multiple scenario forecasts of load and DER projections
- Hosting capacity analysis
- DER interconnection studies
- Cost-benefit analysis
- Non-wires alternatives
- Locational value analysis
- Optimization of DER type, location and sizing

#### Specific Components or System Modeling Considerations

- Smart inverters
- Energy storage
- Demand response
- Transactive energy
- Microgrids
- Grid edge control

#### Advanced Capabilities

- Cloud computing
- Advanced distribution management systems
- Distributed energy resources management systems
- Fast TSPFA
- Convergence of planning and operations
- Transmission and distribution co-simulation

#### Architecture, Communication Systems, Cybersecurity

- Architecture
- Communication systems
- Cybersecurity

#### Process and Coordination

- Coordination framework
- Connecting physical system analysis to financial models
- Prioritizing analyses

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Homer et al., *Electric Distribution System Planning with DER and Grid Modernization - Tools and Methods* (forthcoming)
Integrated planning informs grid modernization strategy

Cyclical integrated distribution planning informs initial grid modernization strategy and updates.

Grid modernization strategy and implementation plans inform subsequent long-term and near-term integrated distribution planning.

Source: USDOE
Drivers for improved distribution planning

- More DERs — cost reductions, policies, new business models, consumer interest
- Resilience and reliability
- 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 may provide net benefits to customers

Utility investments: Distribution 29% ($35.7B) of 2017 EEI member investments*

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, 2015
Examples: States advancing distribution system planning

- Requirements for utilities to file distribution system or grid modernization plans (CA, HI, IN, MA, MD, MI, MN, NV, NY)
  - Integrated distribution planning is nascent.
- Consideration of cost-effective non-wires alternatives (CA, NY, RI)
- Requirements for hosting capacity analysis (CA, HI, IL, MN, NY)
- Locational net benefits analysis for DERs (CA, HI, NV, NY)
- DER procurement strategies (CA, HI, NY)
- Storm hardening, under-grounding (MD, FL)
- Requirements for utilities to report on poor-performing circuits and improvement plans (many states)

Xcel Energy, Hosting Capacity Study, 11/1/18
Example: Hawaii’s integrated grid planning

- **Order No. 34281** (Jan. 2017) – PUC guidance for scenario-based grid modernization strategy to inform review of utility applications for grid modernization projects

- HECO filed **final Grid Modernization Strategy** on 8/29/17
  - PUC approved plan in **Order No. 35268** (2/7/18)

- HECO issued **Planning Hawai‘i’s Grid for Future Generations: Integrated Grid Planning Report** on 3/1/18 (filed 7/12/18)
  - Proposed new “Integrated Grid Planning” process integrates customer, distribution, transmission, and bulk power resource levels of the system
    - Stakeholder involvement
    - Optimized solutions for resource adequacy and grid services, based on procurement processes including NWA solutions
    - Incremental deployment of grid modernization technology

- PUC investigating plan under **Docket No. 2018-0165** (**Order No. 35569**)

- Objective: Identifying and procuring an optimal mix of distributed and grid scale resources to increase customer value and reduce risk
Seek PUC approval of Integrated Grid Plan’s 5-year plan & related applications
DERs in distribution planning: Non-wires alternatives

- Investments in energy efficiency, demand response, distributed generation and storage that provide **specific services at specific locations** to defer, mitigate or eliminate need for traditional distribution infrastructure.

- Example: New York utilities provided **suitability criteria** (project type, timeline, cost) and described **how the criteria will be applied** to projects in capital plans.

### Example: New York Utilities

- **ConEd**: Brooklyn-Queens project
- **Consumers Energy (MI)**: Energy Savers Club pilot program
DERs in distribution planning: Hosting capacity analysis

- Amount of DERs that can be interconnected without infrastructure upgrades
- Some states require regulated utilities to do it (CA, HI, MN, NY)
  - e.g., Minnesota statute requires Xcel Energy to conduct hosting capacity analysis; utility files annually - 2018 filing in Docket 18-684
- Some utilities do it on their own motion
  - e.g., Pepco
- Power system criteria to meet
  - Thermal
  - Power quality/voltage
  - Protection
  - Reliability/safety

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Capability</th>
</tr>
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<tbody>
<tr>
<td>Development Guide</td>
<td>Identify areas with potentially lower interconnection costs</td>
</tr>
<tr>
<td>Interconnection Technical Screens</td>
<td>Augment or replace rules of thumb; determine need for detailed study</td>
</tr>
<tr>
<td>Distribution Planning Tool</td>
<td>Identify potential future constraints and proactive upgrades</td>
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</tbody>
</table>

Table adapted from ICF International, 2018
Integrated resource planning is required in most states

Some regulators explicitly require utilities to consider at least one type of DER in IRP or other long-term planning.

Examples:

- Washington requires utilities to use identified DERs as inputs to IRP.
- Oregon’s order on Portland General Electric’s 2016 IRP required the utility to “work with Staff and other parties to advance distributed energy resource forecasting and distributed energy resource representation in the IRP process.”
- New Orleans requires Entergy New Orleans to consider storage and other DERs as potential supply-side resources in IRP.
- New Mexico requires energy storage to be considered with other resource options in IRP.
- Massachusetts issued an order that clarified the objective of including DERs to “facilitate the interconnection of distributed energy resources and to integrate these resources into the Companies’ planning and operations processes.”
- California, Georgia, Iowa, Indiana, Kentucky, Michigan, Nebraska, Nevada, New Mexico and Oregon require consideration of combined heat and power in IRP.

Source: Berkeley Lab (forthcoming)
Berkeley Lab’s Resource Planning Portal (1)

- Web-based tool that allows users to:
  - Input electric utility planning information in a consistent format
  - Benchmark planning assumptions across jurisdictions
  - Output results in a standardized format (e.g., maps, loads and resources tables)
- 39 western U.S. utilities (2003-17)
- 10 eastern U.S. utilities - adding now
- >117 electric resource plans and supplemental surveys
- ~1/3 U.S. installed capacity (>370 GW)

http://resourceplanning.lbl.gov/

<table>
<thead>
<tr>
<th>Resource</th>
<th>Capacity (GW)</th>
</tr>
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<tbody>
<tr>
<td>Natural Gas</td>
<td>123.7</td>
</tr>
<tr>
<td>Coal</td>
<td>73.6</td>
</tr>
<tr>
<td>Hydro</td>
<td>46.9</td>
</tr>
<tr>
<td>Unknown</td>
<td>43.7</td>
</tr>
<tr>
<td>Nuclear</td>
<td>31.4</td>
</tr>
<tr>
<td>Wind</td>
<td>18.7</td>
</tr>
<tr>
<td>Renewable</td>
<td>12.3</td>
</tr>
<tr>
<td>Solar</td>
<td>8.6</td>
</tr>
<tr>
<td>Thermal</td>
<td>4.1</td>
</tr>
<tr>
<td>Demand Response</td>
<td>8.8</td>
</tr>
</tbody>
</table>
Berkeley Lab’s Resource Planning Portal (2)

Example output: Projected installed capacity
Steps toward aligning planning processes

- **Talk across planning groups within the utility**

- **Apply consistent inputs, scenarios and modeling methods where possible**
  across distribution planning, transmission planning, integrated resource planning and DSM planning

- **Account for all resources across planning processes**
  - Use customer adoption-based DER forecasting
  - Specify DER attributes needed to meet identified distribution needs
  - Incorporate NWA analysis into distribution system planning

- **Analyze multiple possible futures** – e.g., loads, DERs

- **Plan integration of utility assets and systems**
  - Specify how proposed investments will be used with legacy and future utility systems, for planning and customer benefit
Some challenges in aligning planning processes

- Disparate statutory and regulatory requirements

- Planning dimensions (following examples from Xcel’s IDP, 11/1/18)
  - “Distribution planning is primarily concerned with location, and resource planning is primarily concerned with size, type and timing of resources – with transmission planning somewhere in the middle.”
  - “Unlike IRPs, five-year plans are considered long-term in a distribution context....”
    - Unexpected loss of power plant often covered by RTO/ISO system; loss of distribution component often causes power outage to customers
  - “[D]istribution loads and resources are evaluated for each major segment of the system – on a feeder and substation-transformer basis – rather than in aggregate, like occurs with an IRP.”

- Planning tools
  - More accurate modeling tools are time-consuming, expensive and require data on the physical and electrical characteristics of distribution systems, spread across multiple utility business units.
  - Modeling tools must be able to capture both the individual and combined characteristics of DERs.
Resources 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
  - Volume I: Customer and State Policy Driven Functionality
  - Volume II: Advanced Technology Market Assessment
  - Volume III: Decision Guide
- Several reports in Berkeley Lab’s *Future Electric Utility Regulation series*
  - *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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Click here to join the Berkeley Lab Electricity Markets and Policy Group mailing list and stay up to date on our publications, webinars and other events. Follow the Electricity Markets and Policy Group on Twitter @BerkeleyLabEMP
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Audience Questions (submit through the app)
More Information on NARUC-NASEO Task Force

Today
• See press release and charter
• Flyer

Soon
• Commissioners’ Webinar week of December 10\textsuperscript{th} – watch for announcement through Committee Lists

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B4 – The New Frontiers...

Look under the “polls” button.