Using Energy Efficiency to Help Meet Distribution System Capacity Needs

Guillermo Pereira

Contributions by Lisa Schwartz and Natalie Mims Frick, Berkeley Lab

Presentation for ACEEE 2023 National Conference on Energy Efficiency as a Resource

October 18, 2023

Breakout session: 4C: Energy Efficiency and Integrated Resource Planning
Disclaimer
This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor The Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or The Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof, or The Regents of the University of California.

Ernest Orlando Lawrence Berkeley National Laboratory is an equal opportunity employer.

Copyright Notice
This manuscript has been authored by an author at Lawrence Berkeley National Laboratory under Contract No. DE-AC02-05CH11231 with the U.S. Department of Energy. The U.S. Government retains, and the publisher, by accepting the article for publication, acknowledges, that the U.S. Government retains a non-exclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this manuscript, or allow others to do so, for U.S. Government purposes.
Agenda

- Background
  - Distribution system investment needs

- States requirements and objectives-based planning
  - Distribution grid planning and energy efficiency

- Utility practice
  - Previous, ongoing, and emerging geotargeted energy efficiency programs for grid needs
Background

- Growing need for distribution system infrastructure investments
  - Distributed generation, electric vehicles, and electrification of buildings
  - Aging infrastructure
  - Utility grid modernization

- Distribution system investments account for the largest portion (34%) of capex for U.S. investor-owned utilities: $57.1B (projected) in 2023
  - U.S. electric distribution spending increased 26% from 2016 to 2023

Source: EEI, 2023, Electric Company Industry Financial Data and Analysis
State Requirements and Objectives-based Planning
State requirements and objectives-based planning

- Several states have guidance related to the locational value of EE and other DERs, for example:

  - Colorado
  - Maine
  - Minnesota
  - DC
  - Massachusetts
  - Nevada
  - Hawaii
  - Michigan
  - New York

  Source: LBNL, 2021, Locational Value of Distributed Energy Resources

- State requirements increasingly include assessing energy efficiency as a distribution system resource through
  - NWA processes and pilots.
  - Programs geotargeting EE, DR, and DERs funded by utility customers.

- Energy efficiency can reduce utility costs by deferring or avoiding infrastructure upgrades

  Source: LBNL, 2023, Distribution and Grid Modernization Planning to Accelerate Deployment of Distributed Energy Resources
### State requirements for energy efficiency in distribution system planning

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Requirements Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Michigan</strong></td>
<td>2020</td>
<td>- 2020 DSP order</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Model locational impacts of energy efficiency and other DERs (EVs, DR, solar DG)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Coordination between distribution planning, EE, and DR efforts can contribute to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>deferring and displacing distribution upgrades</td>
</tr>
<tr>
<td><strong>Colorado</strong></td>
<td>2021</td>
<td>- 2021 DSP order</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Conduct a grid needs assessment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Including existing and forecasted needs over a ten-year planning period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Identify long-term needs that may be mitigated or deferred via targeted energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>efficiency, demand flexibility, and demand response</td>
</tr>
<tr>
<td><strong>New York</strong></td>
<td>2023</td>
<td>- 2023 DSP staff guidance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Incorporate energy efficiency resources, including:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Resources and capabilities to integrate energy efficiency in planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Location and amount of energy and peak load reductions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Description of how utility’s accomplishments and goals align with NY climate and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>energy policy</td>
</tr>
</tbody>
</table>

*Source: MI MPSC DSP Order 2020*

*Source: CO DORA DSP Requirements 2021*

*Source: NY DSP IDSP Guidance Jan 2023*
Utility Practices
## Utility practices – Overview

<table>
<thead>
<tr>
<th>Utility</th>
<th>Grid need</th>
<th>Investment</th>
<th>EE measures included</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG&amp;E</td>
<td>New substation</td>
<td>$112.3 M</td>
<td>• Air conditioning</td>
</tr>
<tr>
<td>Consumers Energy</td>
<td>Substation capacity upgrade</td>
<td>$1.1 M</td>
<td>• Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Air conditioning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Refrigerators</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Energy management sys.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Efficient lighting</td>
</tr>
<tr>
<td>Xcel</td>
<td>Transformer, feeder, and feeder configuration</td>
<td>$4.1 M</td>
<td>• Efficient lighting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Smart thermostats</td>
</tr>
<tr>
<td>Con Edison</td>
<td>New substation</td>
<td>$1 B</td>
<td>• Thermostats</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Air conditioning</td>
</tr>
<tr>
<td>Orange and Rockland</td>
<td>New substation</td>
<td>n.a.</td>
<td>• n.a.</td>
</tr>
<tr>
<td>PacifiCorp</td>
<td>Feeder reconductoring</td>
<td>$220 k</td>
<td>• Air conditioning</td>
</tr>
</tbody>
</table>
Utility practice – California
Pacific Gas and Electric (PG&E) – Delta District (1991)

Location: Delta District, Northeast San Francisco. Two substations, five feeders, 23,000 customers

Grid need: Load growth and a new substation needed in 4 years

Solution: $18M energy efficiency program, predominantly air conditioning measures

Goal: Defer $112.3 M investment by 6-7 years

Results: Estimated 2.3 MW of peak demand savings
Reduced investment needs by 32%.

Lessons:
Areas with low load growth can be a good candidate for DSM.
Selecting areas for geotargeting DSM needs to consider more than areas with high levels of planned grid investments.

Source: Kinert et al., 1992; LBNL, 2021, Locational Value of Distributed Energy Resources; Swisher and Orans, 1996;
Utility practice – Michigan

**Location:** Swartz Creek substation, 4,000 residential and 300 commercial customers

**Grid need:** Capacity upgrade needed in the medium term (2-3 years)

**Solution:** Use targeted energy efficiency and demand response programs as potential lower-cost solutions

**Goal:** Reduce peak load by 1.4 MW by 2018 and defer $1.1M infrastructure investment

**Results:** 694 residents reduced demand by 795 kW at the zip code level and 363 kW at the substation level

**Lessons:**
Providing incentives for participation is effective early on.
Including residential and C&I customers can contribute to successful outcomes.

Source: [Consumer Energy MESC Presentation](#), [Consumers Energy Presentation MPSC Meeting 2019](#)
Utility practice – Minnesota
Xcel – Geotargeted Distributed Clean Energy Initiative (2019 – 2020)

**Location:** Area surrounding St. Cloud / Sauk Rapids / Sartell.

**Grid need:** New transformer, feeder, and feeder configuration, needed in 5 years

**Solution:** Targeted energy efficiency and load management to reduce peak demand by 500 kW

**Goal:** Defer $4.1M estimated distribution system capacity upgrades

**Results:** 576 kW of peak demand savings, exceeding the goal

**Lessons:**

Email outreach was the most successful for home visit sign-ups. The initial 6-month pilot timeline was challenging for commercial customers. More lead time is helpful.

Source:
CEE 2021, Non-wires Alternatives as a Path to Local Clean Energy: Results of a Minnesota Pilot
Geotargeted Distributed Clean Energy Initiative Update Report
Utility practice – New York
Consolidated Edison Brooklyn/Queens Demand Management Program (2014 – Ongoing)

Location: Brownsville No.1 and 2 substations, 85% residential customers

Grid need: Load growth contributing to feeder overload on two substations

Solution: 52 MW customer-side demand management, 17 MW utility infrastructure

Goal: Mitigate a $1B investment need for constructing a new substation and feeders

Results: As of Q2 2023, 61 MW of load relief at the peak (9-10 pm). 29 MW from EE.

Figure 1: Hourly Load Profile of Operational BQDM Customer-Side Solutions and Non-Traditional Utility-Side Solutions. Note: A 1.5 MW 4-hour utility-side battery energy storage system is not depicted in the load profile as its dispatch varies.

Annual Savings

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,016 small businesses</td>
<td>166 GWh</td>
</tr>
<tr>
<td>2,644 multi-family homes</td>
<td>45 GWh</td>
</tr>
<tr>
<td>34,600 homes</td>
<td>4.6 GWh</td>
</tr>
</tbody>
</table>

Source: Con Edison BQDM Report Q2 2023, NY PSC Order Establishing Brooklyn/Queens Demand Management Program
Utility practice – New York  
**Orange and Rockland (O&R) (2022 – Ongoing)**

**Location:** Wisner Substation, West Warwick. The substation serves 7,624 customers.

**Grid need:** Substation transformer banks are experiencing load growth. 12 MW of load relief is needed.

**Solution:** Portfolio of energy efficiency focused on small business customers and third-party-owned batteries.

**Goal:** Defer the need to construct a new substation.

**Results:** Early phase of implementation.

Source: [O&R 2023 DSP, O&R Project Description](#)
Utility practice – Oregon
PacifiCorp – Klamath Falls – Study (2022)

Location: Crystal Springs circuit, Klamath Falls, serves 1,499 customers

Grid need: Load growth causing feeder overload and voltage issues

Solution: Targeted energy efficiency for residential and commercial customers across 3 scenarios of energy efficiency measures

Goal: Mitigate the need to invest $220k (estimate) in a new feeder

Study results: Preliminary analysis: 4,525 MWh of energy savings needed to reduce peak load by 750 kW and address the grid need

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Utility Cost Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business-as-usual</td>
<td>3.1</td>
</tr>
<tr>
<td>Accelerated acquisition (typical measure mix)</td>
<td>2.6</td>
</tr>
<tr>
<td>Accelerated acquisition (targeted measure mix)</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Source: PacifiCorp 2022 DSP
Summary

- Increasingly, states require utilities to consider energy efficiency and other DERs in distribution planning efforts
  - Typically, through procurements of non-wires alternatives
  - Upcoming Berkeley Lab/PNNL report reviews the current state of distribution system planning requirements.

- Geotargeting existing utility or third-party managed EE and DR programs can be effective
  - Target additional marketing and outreach and higher incentive levels.

- Programs across utilities and jurisdictions demonstrate that energy efficiency can successfully mitigate some types of distribution grid capital investment needs
  - Utility examples demonstrate successful deferral or mitigation of substation, transformer, and feeder investments.
Resources

Berkeley Lab’s integrated distribution system planning website

U.S. Department of Energy, *Modern Distribution Grid*

Berkeley Lab and Pacific Northwest National Lab, *Peer-Sharing Webinars* for Public Utility Commissions on Integrated Distribution System Planning with NARUC, 2023


L. Schwartz and N. M. Frick, Berkeley Lab, “*State regulatory approaches for distribution planning*,” Presentation for New England Conference of Public Utility Commissioners, June 16, 2022


Center for Energy and Environment (CEE), *Non-Wires Alternatives as a Path to Local Clean Energy: Results of a Minnesota Pilot*, 2021
Contacts
Guillermo Pereira: GPereira@lbl.gov

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