Using Energy Efficiency to Help Meet Distribution System Capacity Needs

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

October 18, 2023

Breakout session: 4C: Energy Efficiency and Integrated Resource Planning

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

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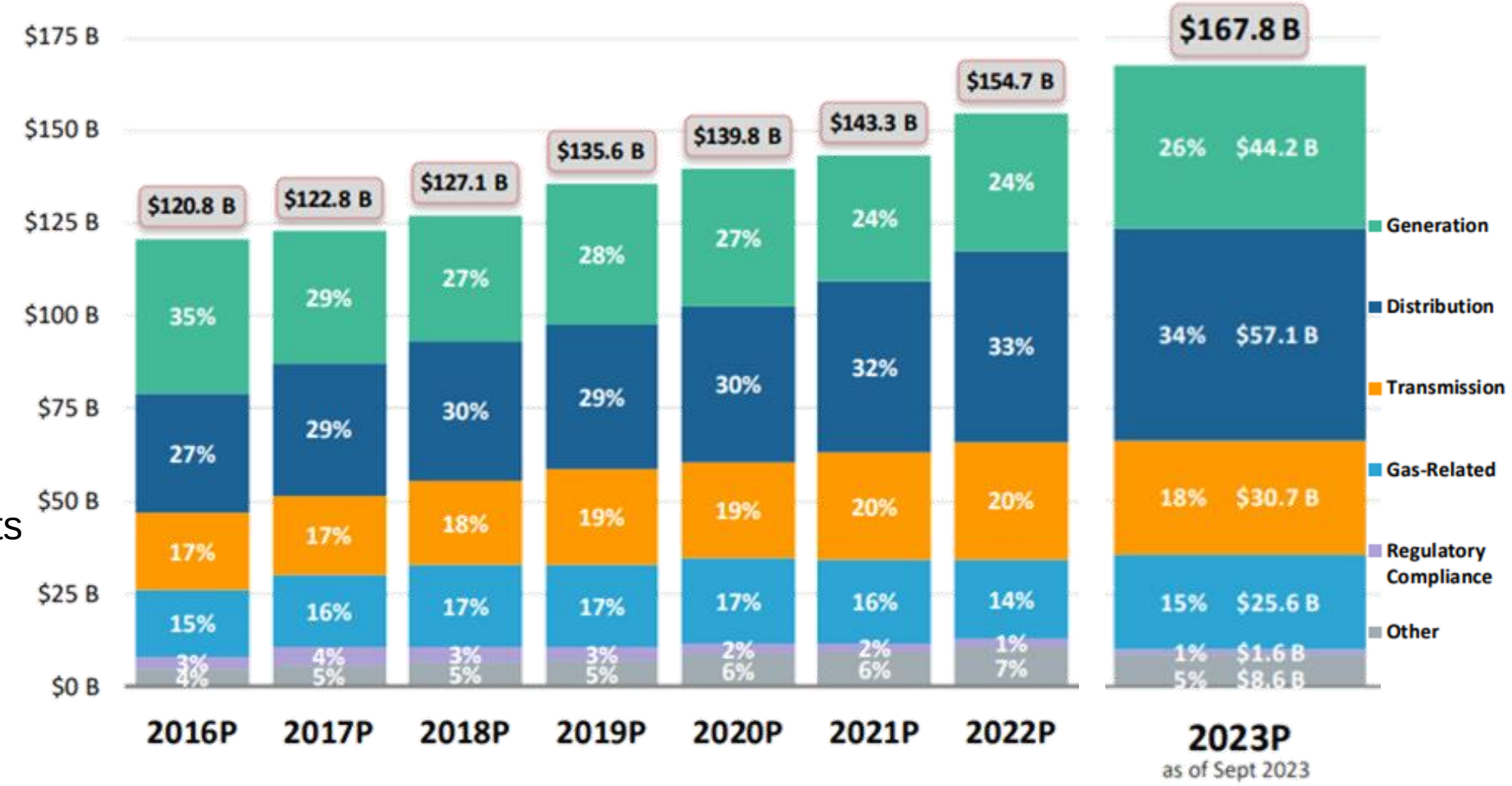
Agenda

- 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

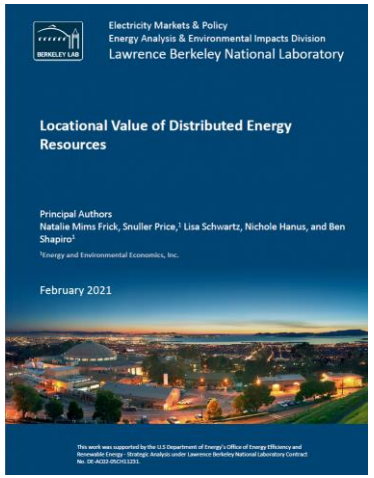
State Requirements and Objectives-based Planning

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

Michigan

- 2020 DSP order
- Model locational impacts of energy efficiency and other DERs (EVs, DR, solar DG)
- Coordination between **distribution planning**, **EE, and DR efforts can contribute to deferring and displacing distribution upgrades**

Source: MI MPSC DSP Order 2020

Colorado

- 2021 DSP order
- Conduct a grid needs assessment
  - Including existing and forecasted needs over a ten-year planning period
- Identify long-term needs that may be **mitigated or deferred via targeted energy efficiency,** demand flexibility, and demand response

Source: CO DORA DSP Requirements 2021

New York

- 2023 DSP staff guidance
- Incorporate energy efficiency resources, including:
  - Resources and capabilities to **integrate energy efficiency in planning**
  - Location and amount of energy and peak load reductions
  - Description of how utility's accomplishments and goals **align with NY climate and energy policy**

Source: NY DSP IDSP Guidance Jan 2023

Utility Practices

Utility practices – Overview

Utility	Grid need	Investment	EE measures included
PG&E	New substation	$112.3 M	• Air conditioning
Consumers Energy	Substation capacity upgrade	$1.1 M	• Residential • Air conditioning • Refrigerators • Commercial • Energy management sys. • Efficient lighting
Xcel	Transformer, feeder, and feeder configuration	$4.1 M	• Efficient lighting • Smart thermostats
Con Edison	New substation	$1 B	• Thermostats • Air conditioning
Orange and Rockland	New substation	n.a.	• n.a.
PacifiCorp	Feeder reconductoring	$220 k	• Air conditioning

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.

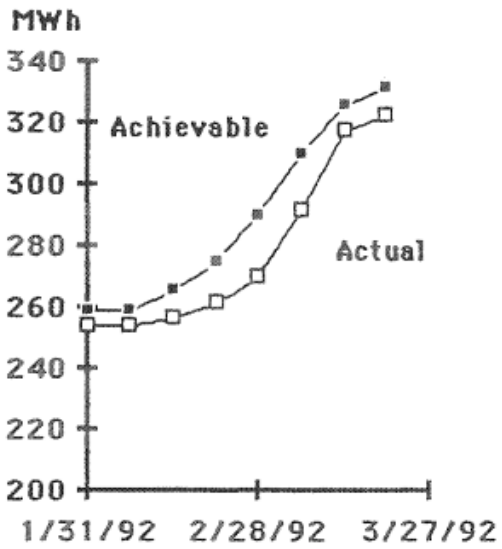


Table 2. Results

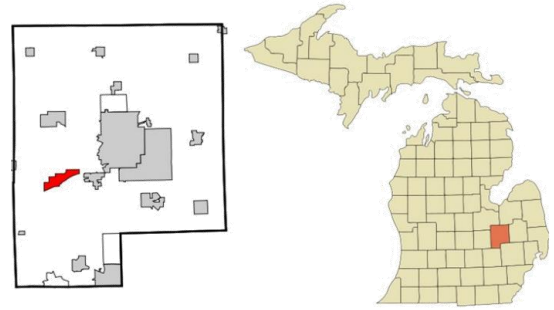
Duct and AC Statistics (initial units)	
Initial Duct Leakage	374 cfm
Final Duct Leakage	157 cfm
Low Evaporator Air Flow (<350 cfm wet)	44%
Excess Refrigerant Charge	33%
Estimated Annual Effect from Residential Direct Installation (first 1000 houses)	
Estimated MWh Savings	245
Estimated Potential kW Reduction	568
Estimated Therm Savings (heating)	58,142
Estimated CO_2 Emission Reduction	492,066 lbs.
Estimated SO_x Emission Reduction	723 lbs.
Estimated NO_x Emission Reduction	192 lbs.

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

Utility practice – Michigan
Consumers Energy – Energy Savers Club (2017 – 2018)

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

Zip Code	kW Savings
Residential Energy Efficiency	152.84
AC Peak Cycling Savings	455.3
TOU Savings	73.71
C&I Energy Efficiency	113.31
Total Savings	**795.16 kW**

Substation	kW Savings
Residential Energy Efficiency	70.04
AC Peak Cycling Savings	205.90
TOU Savings	28.35
C&I Energy Efficiency	58.96
Total Savings	**363.25 kW**

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

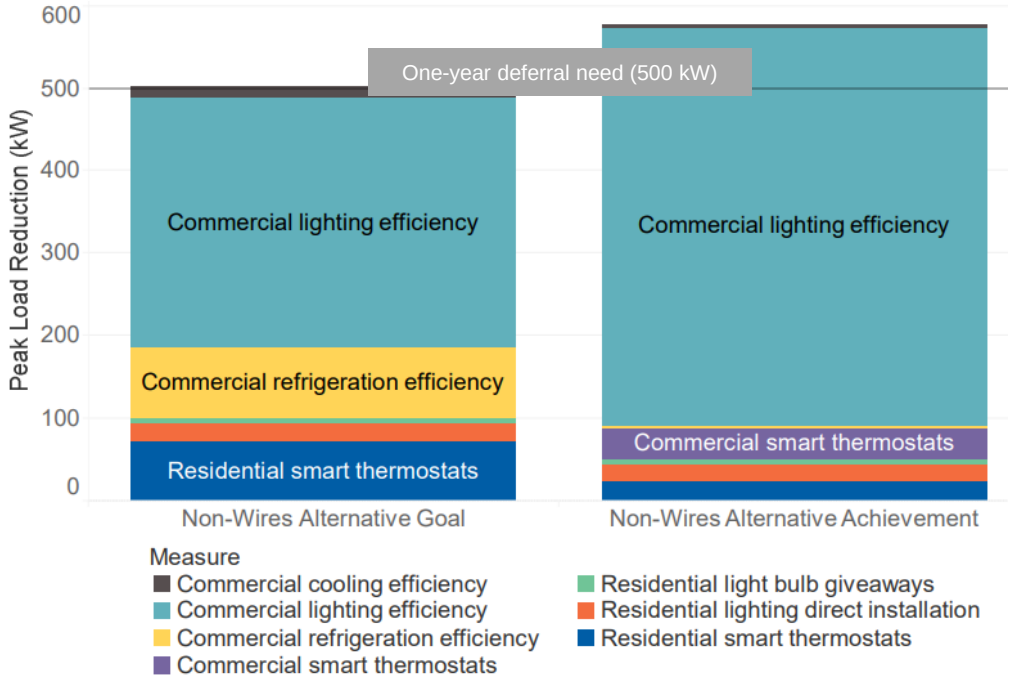
Goal: Defer $4.1M estimated distribution system capacity upgrades

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.**

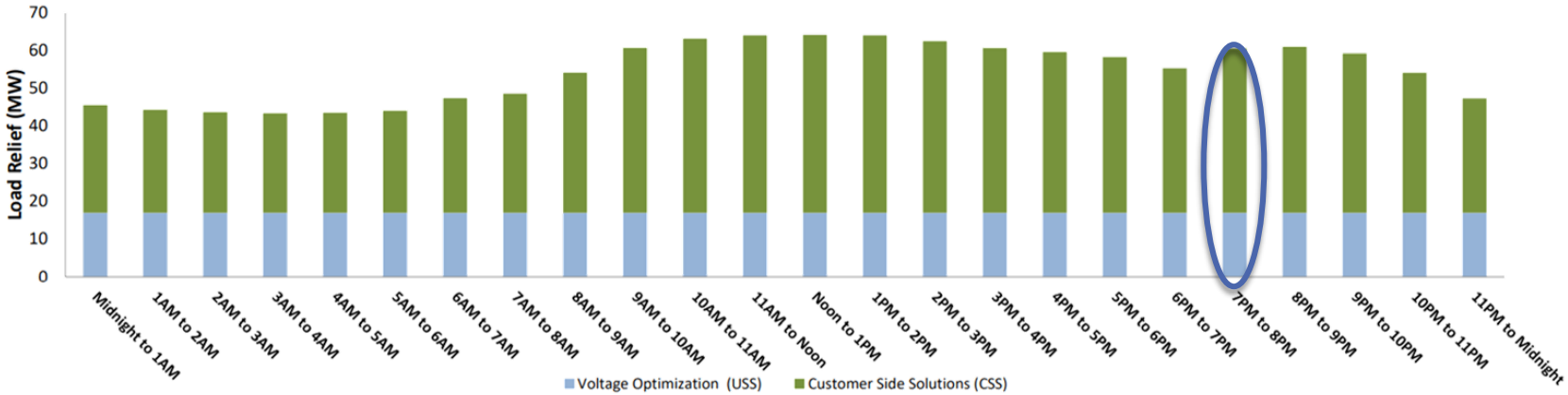


Figure 1: Hourly Load Profile of Operational BQDM Customer-Side Solutions and Non-Traditional Utility-Side Solutions. *Note: A 1.5 MW 4-hour utility-side battery energy storage system is not depicted in the load profile as its dispatch varies.*

Annual Savings	8,016 small businesses **166 GWh**	2,644 multi-family homes **45 GWh**	34,600 homes **4.6 GWh**

BQDM PORTFOLIO	2023		
	Quarter 2	Year-to-Date	Program-to-Date
FINANCIAL ACTIVITY ($ M)			
[0] Expenditures			
Customer-sided	$ 0.53	$ 1.04	$ 107.11
Utility-sided	$ -	$ -	$ 23.74
Total Expenditures	**$ 0.53**	**$ 1.04**	**$ 130.84**
Program Cost Recovery	**$ 1.15**	**$ 2.30**	**$ 76.35**
CUSTOMER-SIDED PROGRAM ACTIVITY			
Energy Efficiency			
[1] Residential Direct Install			
Peak Hour kW reduction	-	-	4,930
[2] Bring Your Own Thermostat			
Peak Hour kW reduction	-	-	391
[3] Residential AC			
Peak Hour kW reduction	-	-	9
[4] Multifamily Energy Efficiency			
Peak Hour kW reduction	12	12	5,650
[5] Small-Medium Businesses Adder			
Peak Hour kW reduction	123	191	14,677
[6] Commercial & Industrial			
Peak Hour kW reduction	-	-	985
[7] NYCHA			
Peak Hour kW reduction	-	-	2,293
[8] DCAS			
Peak Hour kW reduction	38	38	505
Distributed Generation			
[9] Fuel Cell			
Peak Hour kW reduction	-	-	6,100
[10] Combined Heat & Power			
Peak Hour kW reduction	-	-	3,079
Energy Storage			
[11] Peak Hour kW reduction	-	-	4,000
Customer-Sided Portfolio kW reduction at Peak Hour	**173**	**241**	**42,620**

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

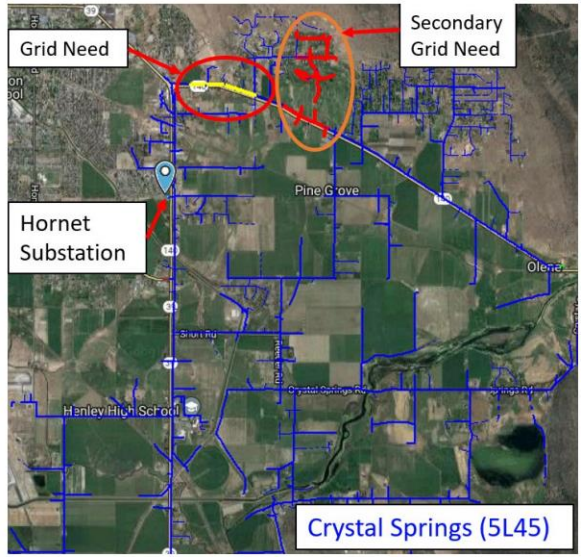
Results: Early phase of implementation.

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

Scenario	Utility Cost Test
Business-as-usual	3.1
Accelerated acquisition (typical measure mix)	2.6
Accelerated acquisition (targeted measure mix)	3.0

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, "Distribution and Grid Modernization Planning to Accelerate Deployment of Distributed Energy Resources," Presentation for NASEO-NARUC DER Integration and Compensation Initiative, April 13, 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

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

Center for Energy and Environment (CEE), Non-Wires Alternatives as a Path to Local Clean Energy: Results of a Minnesota Pilot, 2021

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