# Time and Locational Value of Efficiency and Other Distributed Energy Resources

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Midwest Energy Solutions Conference

February 16, 2021

Contributions by Lisa Schwartz

This presentation was supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Strategic Analysis, under Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231

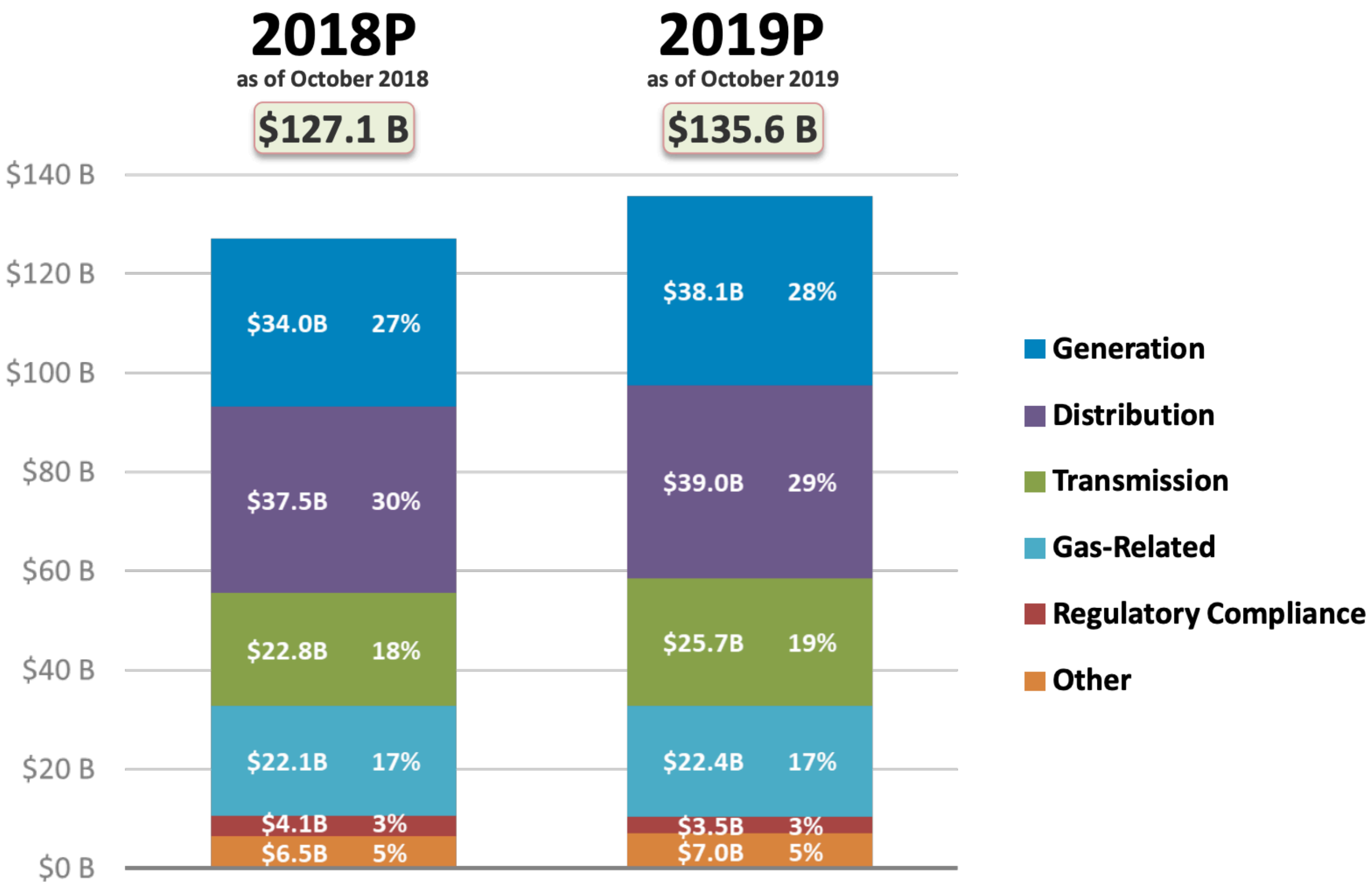
# Summary

- Distribution system investments account for the largest percentage of capital spending by investor-owned utilities.
- Utilities can consider cost-effective distributed energy resources (DERs) as non-wires alternatives (NWAs) to defer investments and reduce electricity system costs.
- The value of DERs is influenced by timing of savings or generation, and location on the grid. Electricity markets, policies and regulations affect assessment of that value.
- Several jurisdictions provide guidance to utilities for considering NWAs in transmission and distribution (T&D) planning.

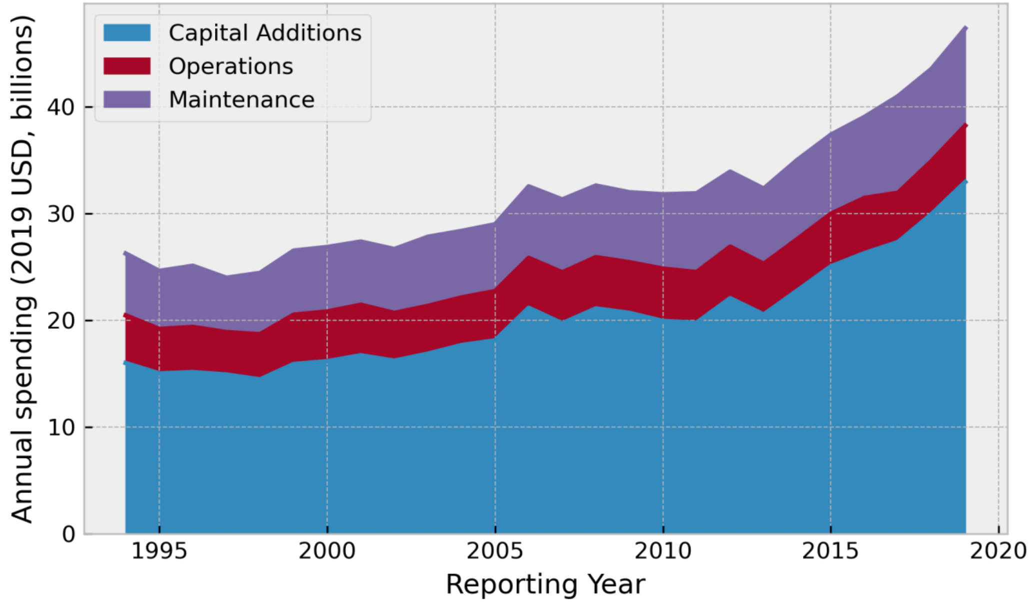
**Want to learn more?** Register for LBNL's free webinar on March 9 on our new *Locational Value of Distributed Energy Resources* report.

Principal report authors: Natalie Mims Frick, Snuller Price (Energy and Environmental Economics, Inc.), Lisa Schwartz, Nicole Hanus, and Ben Shapiro (E3)

# Distribution system investments are large and increasing.




Source: Edison Electric Institute




Source: Fowley and Duncan, UC Berkeley, based on FERC Form 1

For investor-owned utilities, distribution system investments account for the largest portion (29%) of capex: $39 billion in 2019.

EIA estimated that distribution system capital investments for major electric utilities of all types nearly doubled over the past decade.

# Quantifying locational value of DERs informs distribution system planning as well as procurement, rates and programs.

Accurately valuing all potential distribution system solutions, including consideration of the locational value of DERs, is increasingly important for reliable, least cost electricity systems.

Locational Value Use Cases

| Use Case | Objective | Capability | Challenges |
|---|---|---|---|
| **NWAs Procurement** | Enable market-based provision of DER services | Procure NWAs to defer T&D investment | Quantification of costs and benefits; risk management |
| **Tariff Design** | Provide price signals for DER locations | Link locational value analysis to tariff design | Efficient, transparent price mechanisms for benefits or costs |
| **Program Design** | Enhance system value of programs | Target program customer acquisition and/or incentives | Customer acquisition; risk management; coordination |

Source: ICF 2018

# Today we are focusing on non-wires alternatives.

Non-wires alternatives (or solutions) are investments in DERs — energy efficiency, demand response, distributed generation and storage — that provide *specific services* at *specific locations* to defer, mitigate, or eliminate the need for traditional T&D infrastructure.

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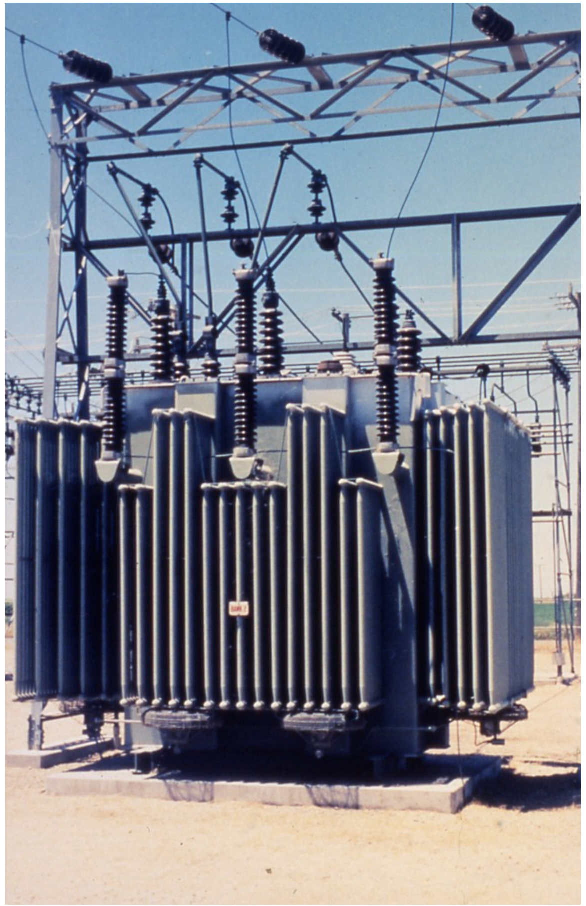
Source: ICF 2018

# How can non-wires alternatives save energy costs?

- Defer or avoid infrastructure upgrades
- Implement solutions *incrementally,* offering a flexible approach to uncertainty in load growth and potentially avoiding large upfront costs for load that may not show up
- Typically, the utility issues a **competitive solicitation** for NWAs for specific distribution system needs and compares these bids to planned traditional grid investments (e.g., distribution substation transformer) to determine the lowest reasonable cost solution, including implementation and operational risk assessment.



- ***Locational net benefits analysis*** systematically analyzes costs and benefits of DERs to determine the *net* benefits DERs can provide for a given area of the distribution system.

# Several factors affect the value of DERs.

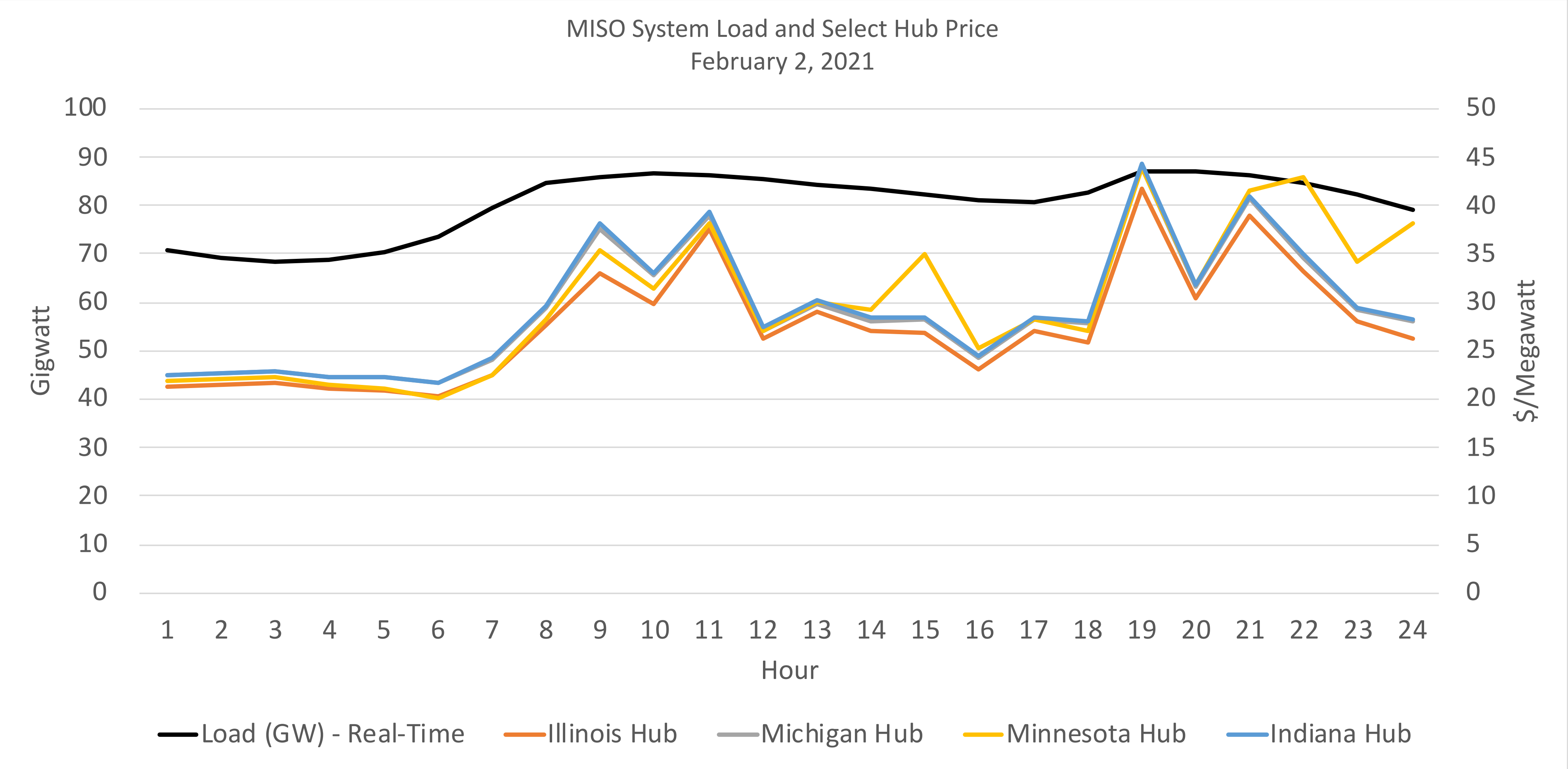
- T&D value streams depend on timing of DER savings or generation and location on grid
- Policies, regulations and market rules also affect assessment of DER locational value.

| Value Category | Value Stream | AZ | AK | CA | CO | HI | ME | MD | MA | MI | MN | MS | MT | NC | NJ | NY | NV | PA | SC | TN | TX | UT | VT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Generation | Avoided Energy | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Avoided Fuel Hedge | | ■ | | ■ | | | ■ | | ■ | ■ | ■ | | ■ | ■ | ■ | | ■ | | | ■ | ■ | |
| | Avoided Capacity & Reserves | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Avoided Ancillary Services | ■ | | ■ | ■ | ■ | ■ | | | ■ | | | | ■ | | ■ | ■ | | ■ | | | | ■ |
| | Avoided Renewable Procurement | ■ | | ■ | | | | ■ | ■ | ■ | | | | ■ | ■ | | ■ | ■ | | | ■ | | ■ |
| | Market Price Reduction | ■ | | | | | ■ | ■ | ■ | | | | | ■ | ■ | ■ | | ■ | | | | | ■ |
| Transmission | Avoided or Deferred Transmission Investment | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Avoided Transmission Losses | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Avoided Transmission O&M | | | | | | | | | | | | | | | ■ | | | | | | | |
| Distribution | Avoided or Deferred Distribution Investment | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Avoided Distribution Losses | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Avoided Distribution O&M | | | | | | | | | | | | | | | ■ | | | | | | | |
| | Avoided or Net Avoided Reliability Costs | | | ■ | | | | | | | | | | | | ■ | | | | | | | |
| | Aviоded or Net Avoided Resiliency Costs | | | ■ | | | | | | | | | | | | ■ | | | | | | | |
| Environmental/Society | Monetized Environmental/Health | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | | ■ | ■ | ■ | | ■ | ■ | | ■ | ■ | ■ | ■ | ■ |
| | Social Environmental | | ■ | | | ■ | ■ | ■ | | | ■ | | ■ | ■ | ■ | ■ | | ■ | | ■ | | | ■ |
| | Security Enhancement/Risk | ■ | | | | | | | ■ | | | | | ■ | ■ | ■ | | ■ | | | | | |
| | Societal (Economy/Jobs) | ■ | ■ | | | | | ■ | ■ | | | | | ■ | ■ | ■ | | ■ | | | | | |

■ DER value streams identified by states, utilities, consultancies, and stakeholders

Source: Adapted by E3 from Shenot et al. 2019 and DOE 2018

# The timing of DER savings or generation affects value. (1)

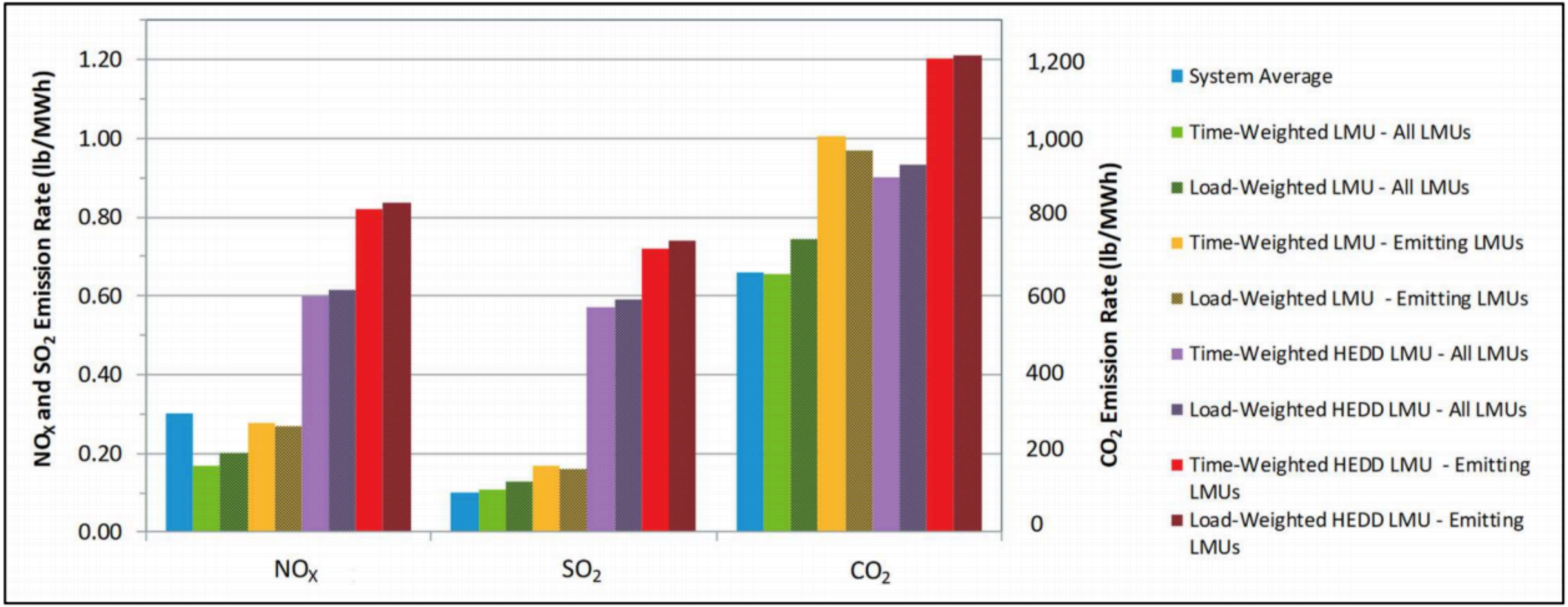



For example, the [time-sensitive value of energy efficiency ](#)(TSV-EE) considers *when* energy efficiency occurs and the *economic value* of the energy or demand savings to the electricity system at that time.

Source: MISO

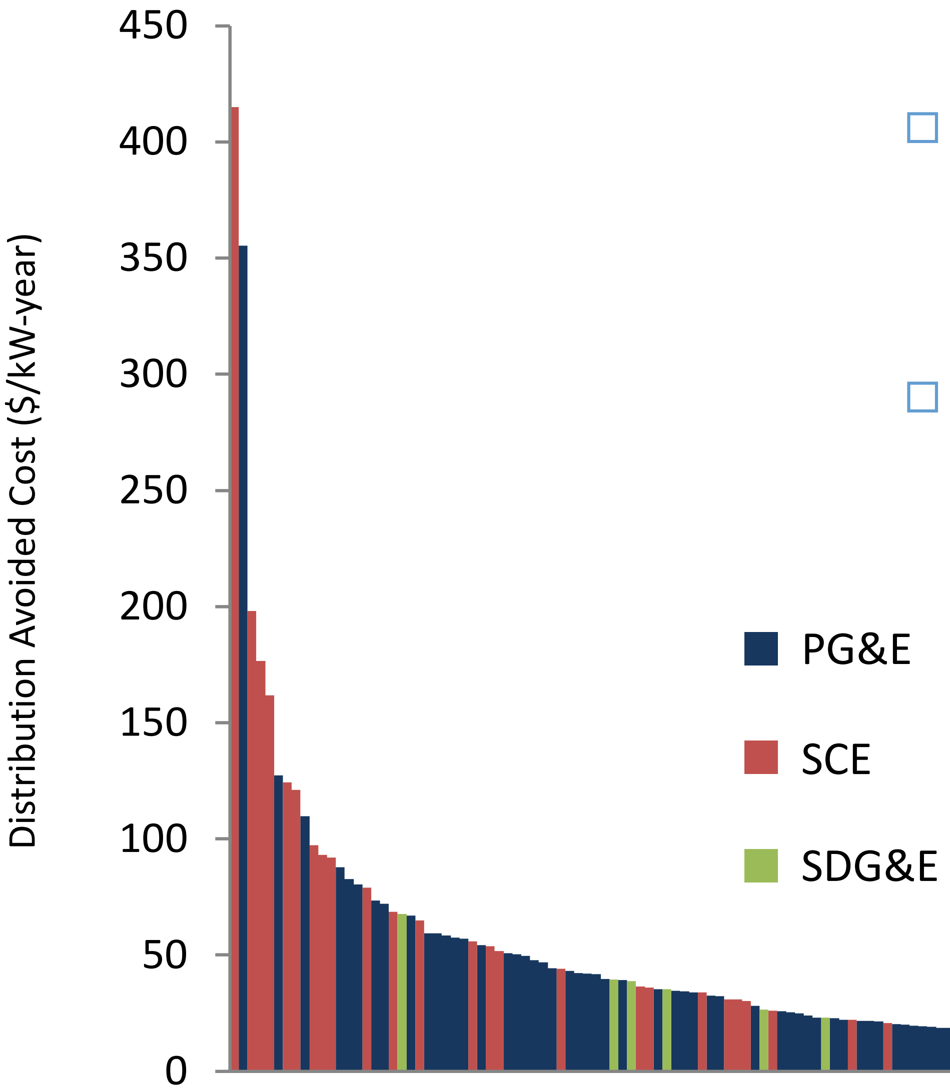
# The timing of DER savings or generation affects value. (2)

Comparison of 2018 ISO New England Emissions Rates (ISO-NE 2020)




- LMU: Locational marginal unit
- All LMUs: Includes all LMUs identified by the locational marginal price
- Emitting LMUs: Excludes all non-emitting units with no associated air emissions (e.g., hydro, nuclear, solar)
- HEDD: High electric demand day

# The location of DERs affects value.

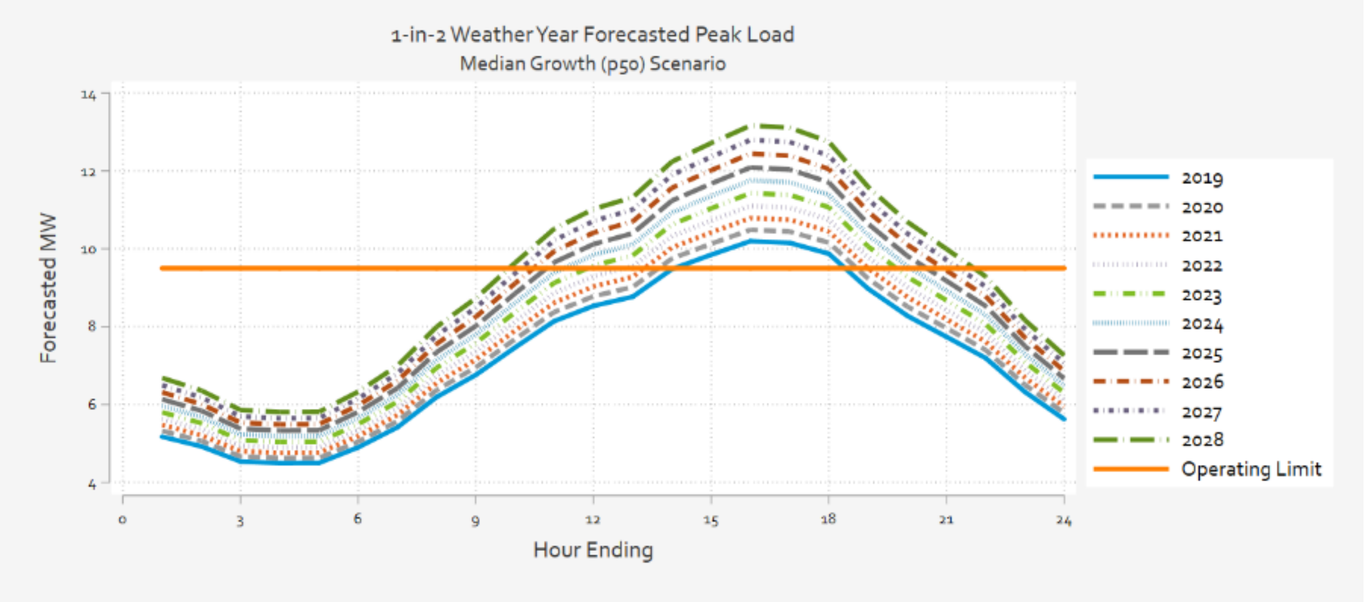



- Value may be associated with a distribution substation, individual feeder, section of feeder, or a combination of these components.
- Avoided distribution costs vary by area. DERs must be targeted to capture the highest value.

E3 study for California using utility distribution planning information

# What we’ve learned so far.

- Methods were developed in the 1990s to value DERs for deferring or avoiding distribution capacity, when utilities began to test targeting and deploying DERs as NWAs and conducted evaluations. Utilities have continued to refine these approaches. (See utility case studies in our report.)
- Lessons learned
  - ***Identify value*.** The highest value opportunities are where low load growth is driving the utility toward a large capital investment, producing significant value per kilowatt of peak load relief. (Conversely, low load growth means lower utility sales to cover the cost of utility capital investments.) Lower value opportunities occur where DERs are competing with traditional distribution solutions that have greater economies of scale, particularly to serve high growth areas with significant capacity needs.
  - ***Plan well ahead*.** Sufficient time is required to deploy NWAs, make sure they’re online before the constraint occurs, and verify reliable operation at the time needed — e.g., see New York Joint Utilities’ suitability criteria:
    - 18-24 mos. for projects $300k* to $1M
    - 36-60 mos. for projects over ≥ $1M

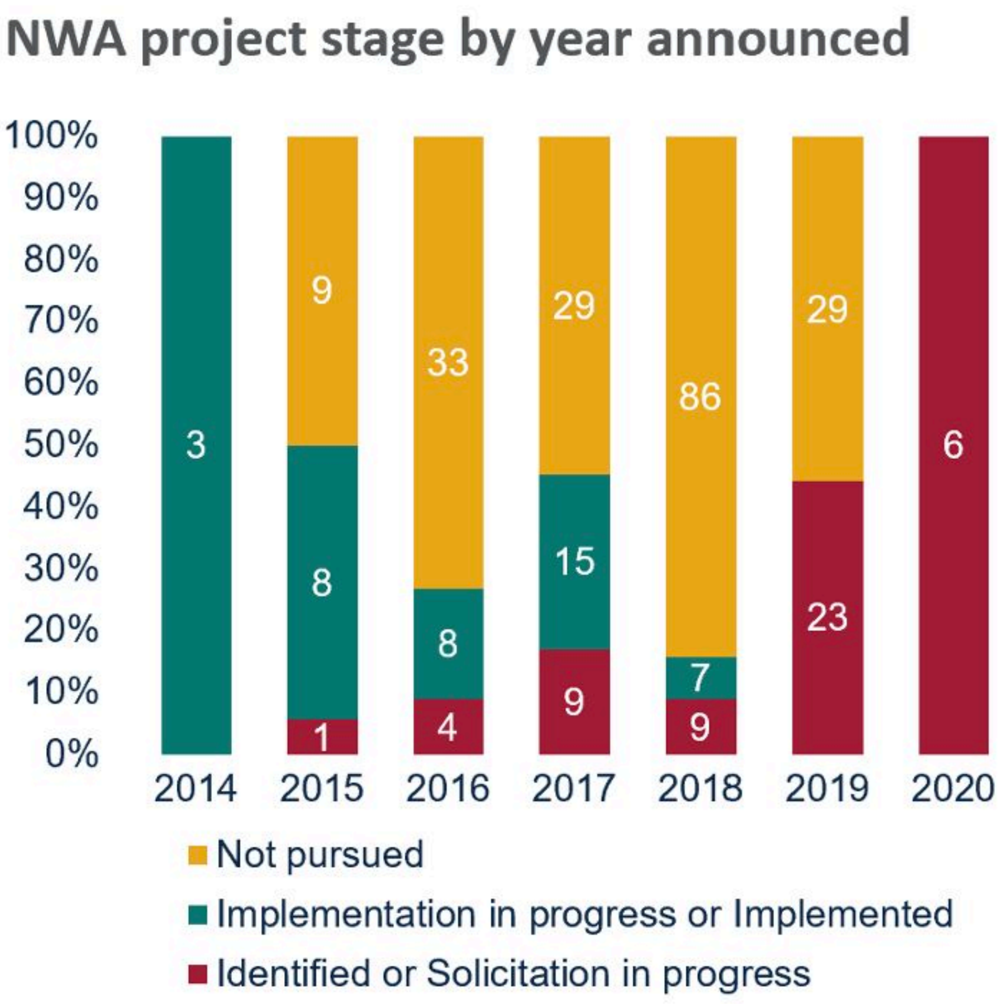



Sources: Adapted from E3, prepared for Berkeley Lab
Graphic courtesy of Demand Side Analytics

*Transaction costs may be too high for projects smaller than this threshold. DER aggregation can solve that problem.

# Procurements: NWAs are hot, but implementation is slow.

- ~850 MW of NWAs have been identified or implemented in the US
  - Projects only move forward 40% of the time and the number of identified opportunities that are implemented is shrinking
  - Front-of-the-meter batteries are most commonly implemented NWA
  - Cost and reliability are key reasons for projects not going forward
  - Broad disclosure of NWA opportunities both informs the public and also dilutes share of NWA projects implemented

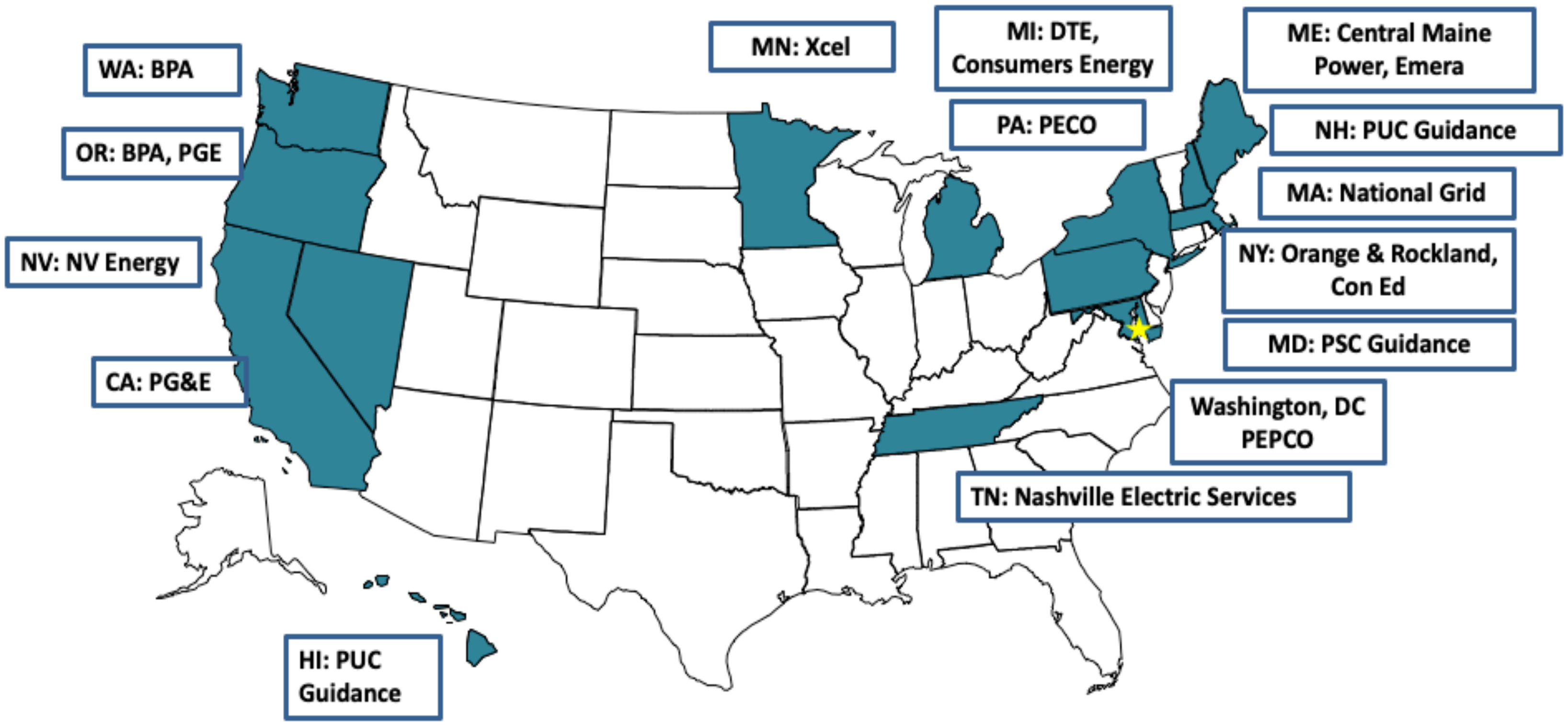



Source: Wood Mackenzie Grid Edge service, Wood Mackenzie Data Hub

Source: Debbie Lew, prepared for Berkeley Lab, based on data from Wood MacKenzie in GTM, "US non-wires alternatives H1 2020: Battery storage seizes top spot as utilities' preferred non-wires resource," 2020

# Several states require utilities to consider non-wires alternatives.

- Jurisdictions that require consideration of NWAs include CA, CO, DE, DC, HI, ME, MI, MN, NV, NH, NY, RI.
- Several additional states have related proceedings, pilots or studies underway.




Case studies featured in new LBNL report, *Locational Value of Distributed Energy Resources*

# Non-wires alternatives in California

- AB 327 (2013) requires electric utilities to submit distribution resources plans (DRPs) to "identify optimal locations for the deployment of distributed resources." PUC order on DRPs (2014) established guidance for utilities.
- PUC approved a Distribution Investment Deferral Framework (DIDF, 2018) to identify and capture opportunities for DERs to cost-effectively defer or avoid utility investments planned to mitigate forecasted distribution system deficiencies.
  - Includes annual Grid Needs Assessments and Distribution Deferral Opportunity Reports that identify distribution upgrades that could be deferred with DERs
  - The DIDF process was modified in 2020 to require data alignment among IOUs, add data requirements, expand project requirements and modify deferral prioritization metrics.
- 2021 DIDF Request for Offers for PG&E and SCE were released in January.
- At its February 11th public meeting, the PUC adopted staff's proposal to "1. Streamline and scale up DER deferral procurement, 2. Develop pilots to test the deferral tariff proposals and their elements, 3. Clarify incrementality policy for DERs sourced for deferral." Two new frameworks will encourage additional NWA projects:
  - Standard offer contract – To decrease transactional cost and risk compared to the current request for offers process (for large projects and aggregators, pilot launch August 15, 2021)
  - Clean Energy Customer Incentive – To enable dispatch by aggregators to address grid needs identified in DIDF process (for small projects, pilot launch January 15, 2022)

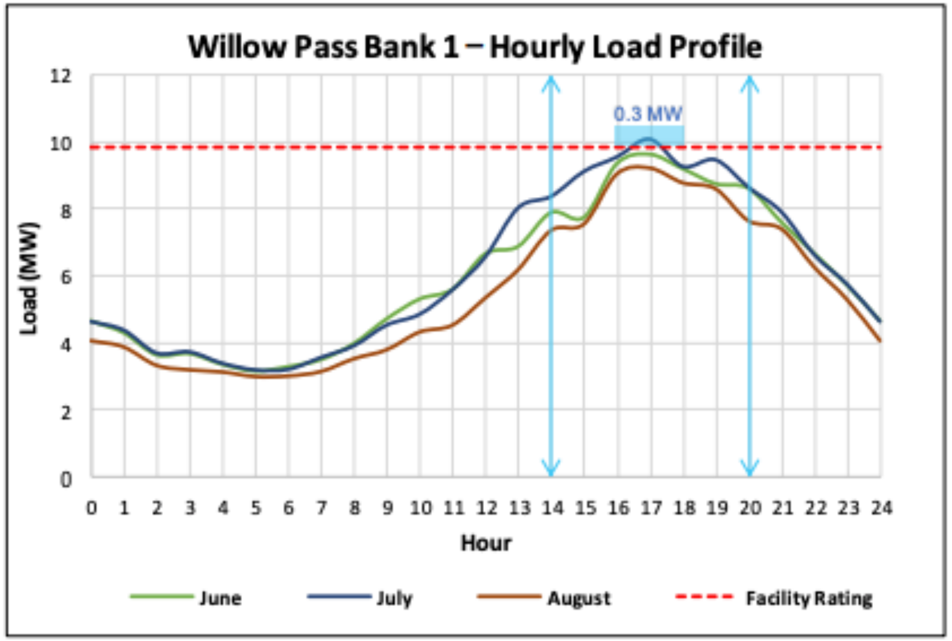
# PG&E's 2021 DIDF identified more than 19 MW of grid needs

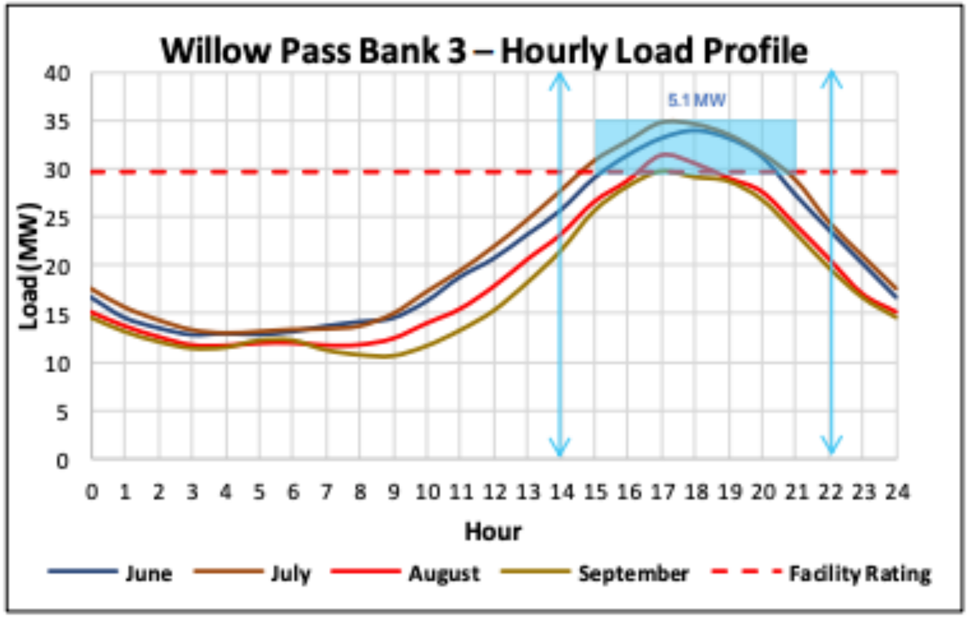

| Candidate Deferral | GNA Facility Name | In-Service Date |
|---|---|---|
| WILLOW PASS BANK 1 | WILLOW PASS BANK 1 | 2023 |
| | WILLOW PASS BANK 3 | 2023 |
| SAN MIGUEL BANK 2 | SAN MIGUEL BANK 1 | 2023 |
| | SAN MIGUEL 1104 | 2023 |
| | PASO ROBLES 1107 | 2023 |
| CALISTOGA BANK 1 | CALISTOGA BANK 1 | 2023 |
| | CALISTOGA 1102 | 2023 |
| RIPON 1705 | VIERRA 1707 | 2024 |
| ZAMORA BANK 1 | ZAMORA BANK 1 | 2023 |
| GREENBRAE BANK 2* | GREENBRAE BANK 2 | 2023 |
| BLACKWELL BANK 1 * | BLACKWELL BANK 1 | 2023 |

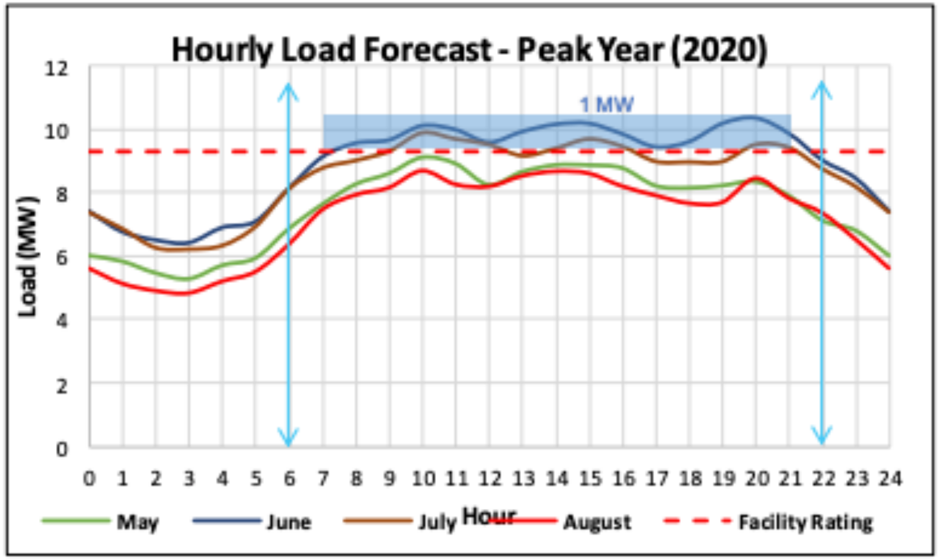
* CUSTOMER CONFIDENTIAL due to their peak loads violating the 15-15 customer privacy rule

Source: PG&E presentation on 2021 RFO for more than 19.6 MW support of local distribution capacity relief in seven areas in central California

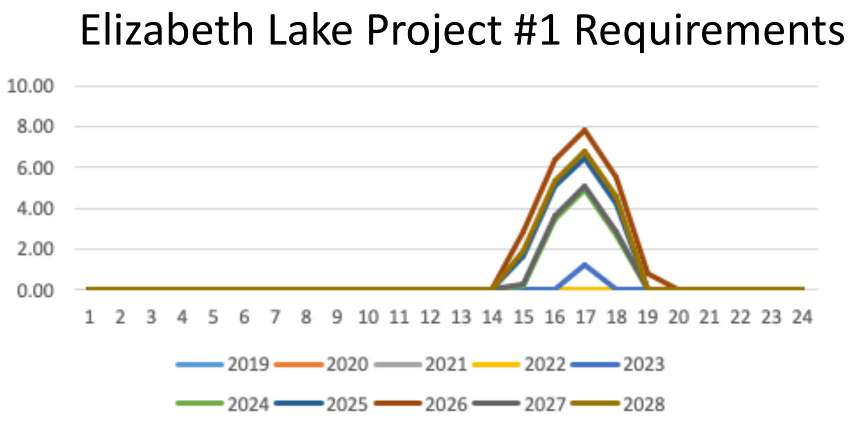
# PG&E's 2021 DIDF identified many different grid size and duration needs.

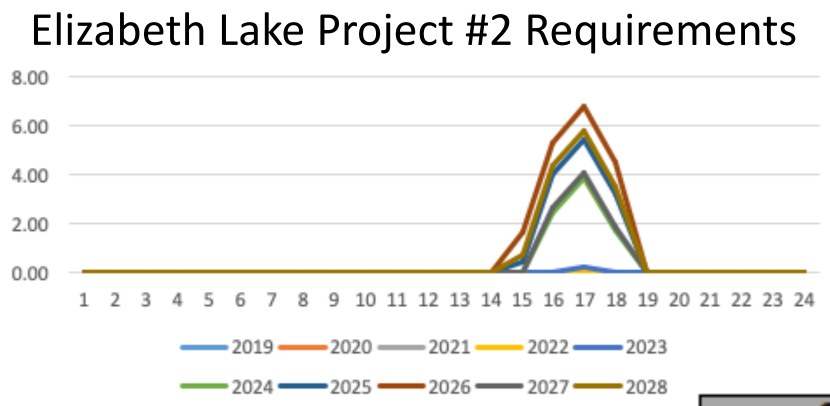


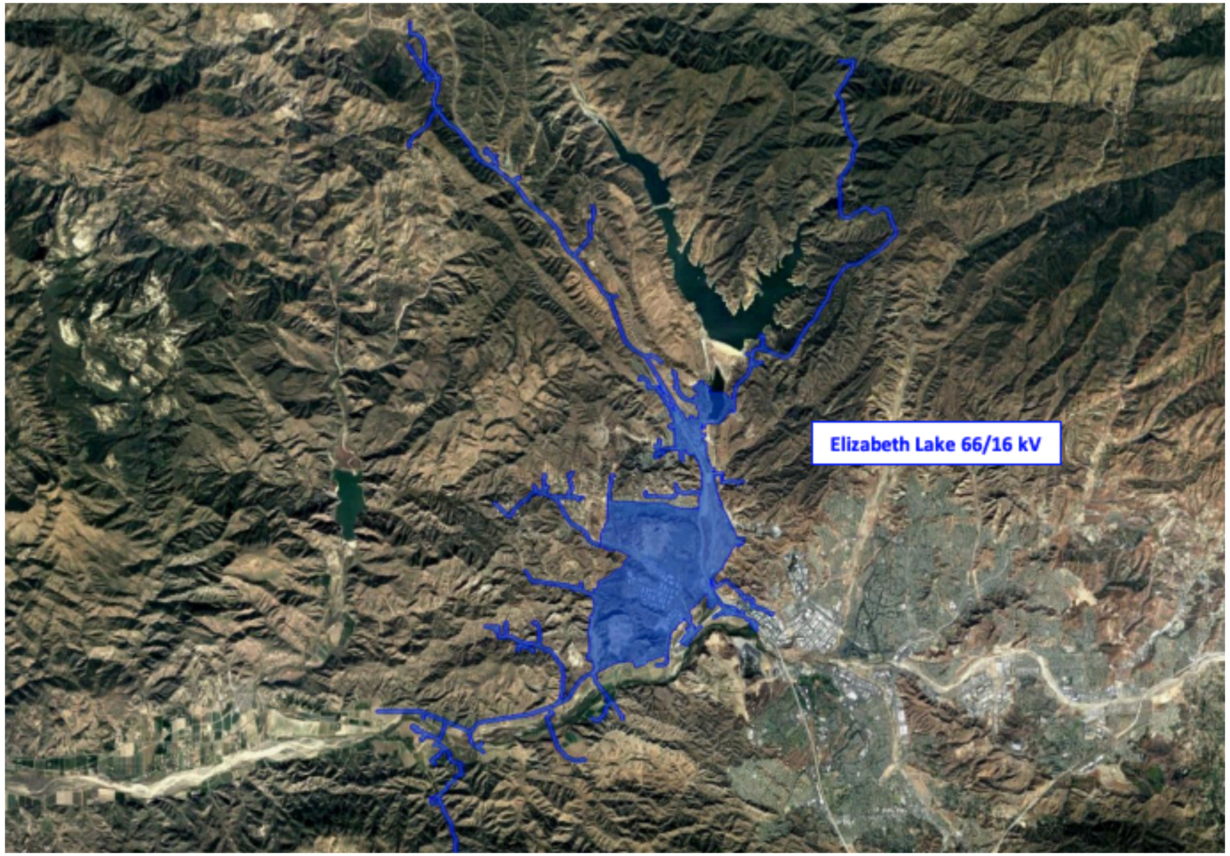



# Southern California Edison is implementing two NWA projects.



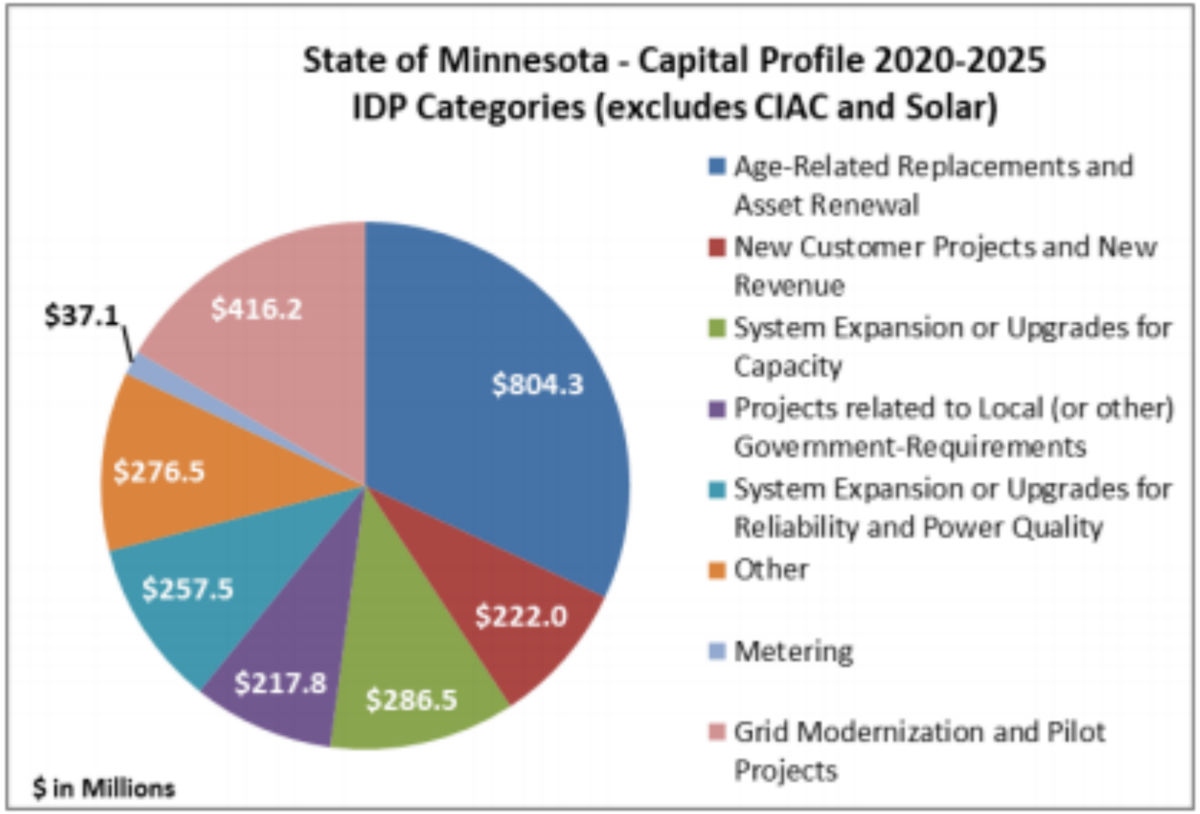




| Seller | Deferral Projects | Interconnection (Circuit and/or Substation) | Technology Type | Size (MW)[2] | Initial Delivery Date | Term of Agreement (Years) |
|---|---|---|---|---|---|---|
| Homestead Energy Storage, LLC | Elizabeth Lake #1 and Elizabeth Lake #2 | Elizabeth Lake 66/16 kV Substation | ES (Lithium Ion) | 14 | 3/1/2023 | 10 |

Source SCE

# Non-wires solutions in Minnesota

- Minn. Stat. §216B.2425 requires utilities to submit biennial T&D plans to the PUC.
- PUC established Integrated Distribution Planning requirements for Xcel Energy in Docket No. 18-251 and for smaller regulated utilities including:
  - For projects >$2M, analyze how non-wires solutions compare with traditional grid solutions in terms of viability, price and long-term value.
  - Specify distribution system project types (e.g., load relief or reliability) as well as timelines, cost thresholds and screening process for NWAs.
- Xcel Energy filed its 2020 Integrated Grid Planning report in October in Docket M-19-666, including analysis of NWAs.



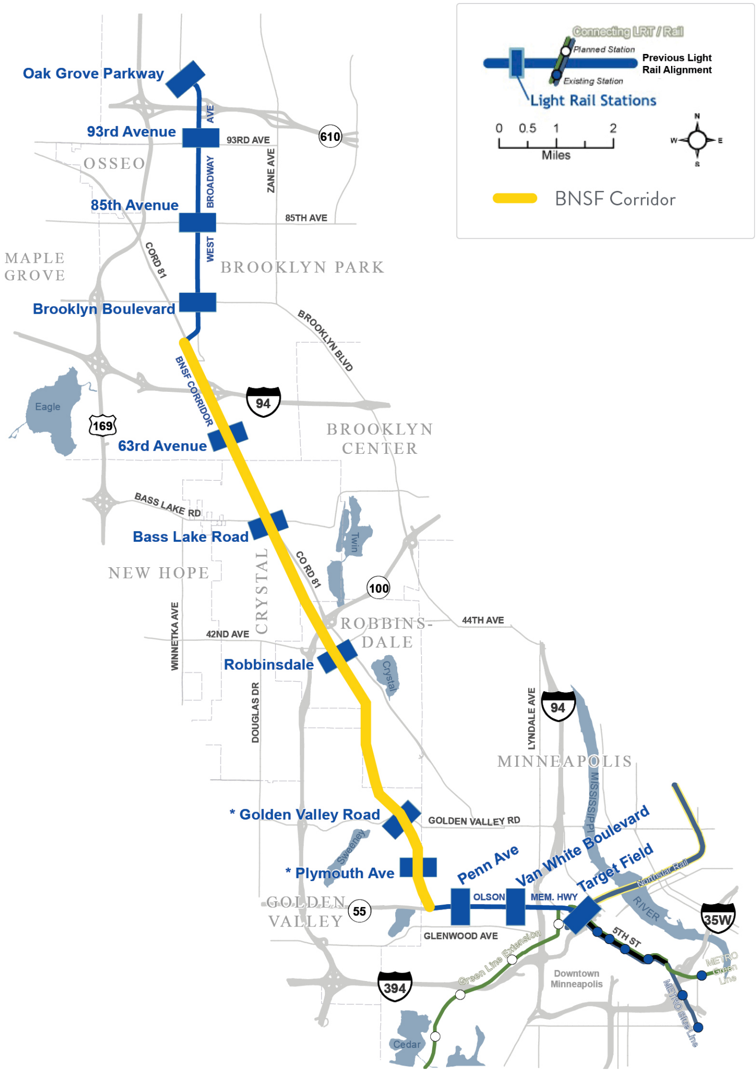
# Xcel Energy 2020 Integrated Distribution Plan NWA analysis results (MN)

| Project Title | # of Risks | Aggregate Project Peak Demand (MW Overload) | Aggregate Project Energy Demand (MWh Overload) | Cost of NWA | Cost of Traditional Project |
|---|---|---|---|---|---|
| Install Kohlman Lake KOL Feeder | 8 | 10.28 | 40.21 | $15.75M | $4.52M |
| Install Birch Area Sub | 4 | 17.9 | 57.51 | $18.08M | $7.70M |
| Install Viking VKG Feeder | 3 | 9.18 | 55.14 | $22.2M | $4.10M |
| Install Goose Lake GLK TR3 & Feeders | 8 | 23.19 | 116.94 | $46.78M | $5.26M |
| Reinforce Burnside BUR TR2 | 3 | 12.8 | 111.45 | $59.4M | $2.7M |
| Install Stockyards STY083 and STY084 | 3 | 13.93 | 77.94 | $68.1M | $3.96M |
| Install Orono ORO TR2 & Feeder | 3 | 10.27 | 186.61 | $76.65M | $4.10M |
| Reinforce Veseli VES TR1 & Feeder | 3 | 3.73 | 32.05 | $76.8M | $2.75M |
| Install Cannon Falls Trans CTF TR02 & Fdr | 4 | 5.6 | 248.73 | $88.0M | $1.99M |
| Install TR2 at First Lake | 1 | 15.12 | 259.07 | $91.01M | $3.2M |
| Install West Coon Rapids WCR TR | 4 | 28.09 | 269.19 | $94.64M | $2.18M |
| Reinforce Faribault FAB TR1 | 5 | 31.6 | 415.79 | $165.4M | $2.02M |

# Piloting NWAs in central Minnesota

- Focused on existing energy efficiency and demand response programs
- Partnership between Xcel Energy and Center for Energy and the Environment
- Targeted outreach in cities of Sartell and Sauk Rapids using community-based marketing strategies to increase program participation — e.g., for residential:
  - Community ambassador initiative
  - Coordination with city on promotions
  - Direct mail
  - Email campaign
  - Event tabling
  - Manufactured home outreach
  - Social media
- Sought to defer or avoid a new transformer and feeder reconfiguration
- Pilot achieved its goals for both EE and DR to meet the stated project needs
- Completed in summer 2020

# Xcel Energy’s proposed Minneapolis NWA




Source: [Metropolitan Council]

- Xcel included a preliminary proposal for a NWA that would provide resilience in their Relief and Recovery proposal.
- Xcel is considering a NWA along the METRO Blue Line Extension (Bottineau) light rail corridor using variety of NWA technologies in the ~2022-2024 timeframe.
- Hennepin County and the Metropolitan Council are exploring opportunities to advance the line extension without using BNSF Railway right of way.
- Xcel may identify a NWA pilot or demonstration elsewhere in Minneapolis.

# Resources

Natalie Mims Frick, Snuller Price, Lisa Schwartz, Nichole Hanus, and Ben Shapiro. *Locational Value of Distributed Energy Resources* – Register for the March webinar here.

Berkeley Lab's research on time- and locational-sensitive value of DERs

U.S. Department of Energy's (DOE) Modern Distribution Grid guides

Regional distribution system planning trainings for PUCs and state energy offices: Southeast, New England, MISO footprint, West, Mid-Atlantic

*Integrated Distribution Planning: Utility Practices in Hosting Capacity Analysis and Locational Value Assessment*, by ICF for DOE, 2018

Alan Cooke, Juliet Homer, Lisa Schwartz, *Distribution System Planning – State Examples by Topic*, Pacific Northwest National Laboratory and Berkeley Lab, 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, 2017

Berkeley Lab's Future Electric Utility Regulation reports

Berkeley Lab and NREL's End Use Load Profiles for the U.S. Building Stock project

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