# Locational Value of Distributed Energy Resources

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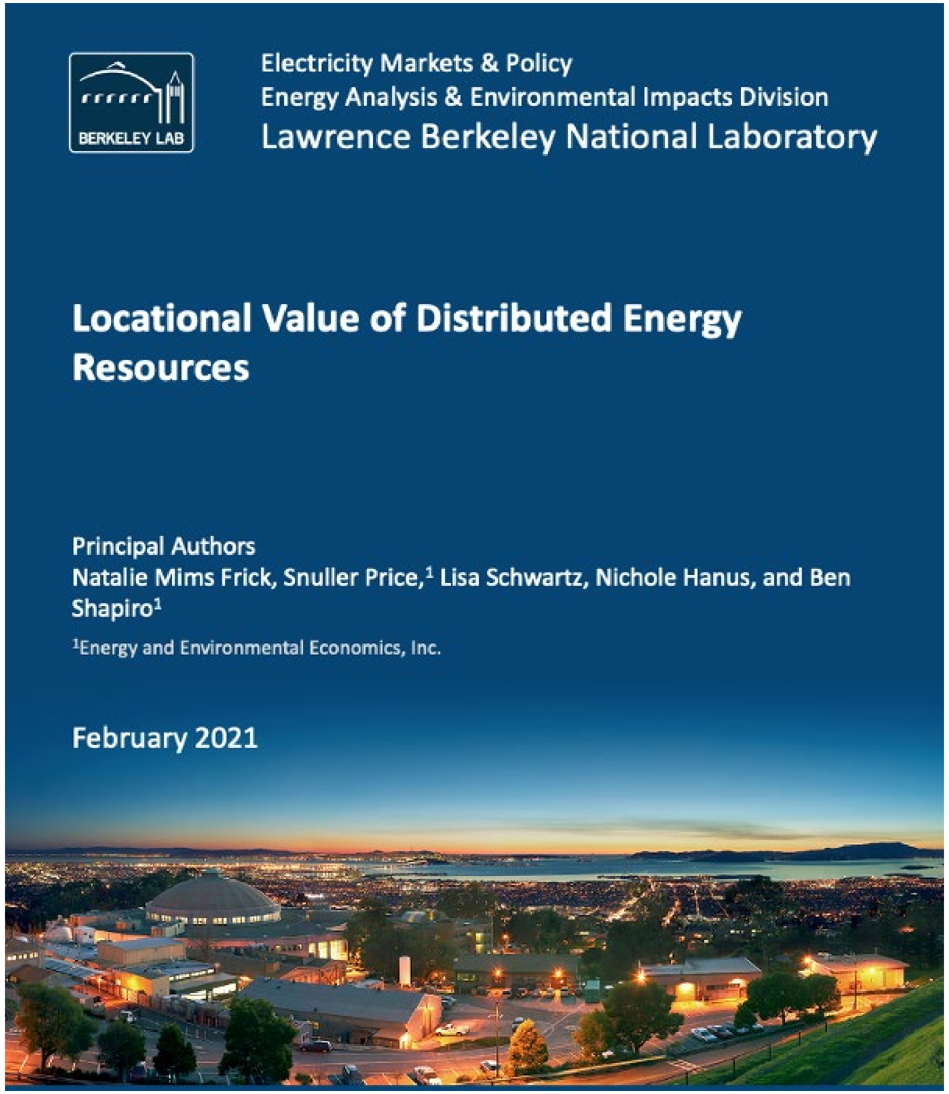
# Today's speakers

- **Natalie Mims Frick** is an Energy Efficiency Program Manager in the Electricity Markets and Policy Department at Berkeley Lab. She manages projects on energy efficiency and other distributed energy resources (DERs), including technical assistance to states and research on DER policies and programs. Before joining the lab, Natalie was the principal at Mims Consulting, LLC, where she served as an expert witness in demand-side management regulatory proceedings across the country. She also was an Energy Efficiency Director at the Southern Alliance for Clean Energy and a Senior Consultant at Rocky Mountain Institute.
- **Snuller Price** leads E3's work on energy and climate policy, energy efficiency, demand response and other DERs, and renewable energy and emerging technologies. He has helped state and federal government agencies, utilities and technology companies support a clean energy transition for more than 25 years. His work in regulatory analysis focuses on evaluation of DER cost-effectiveness, and he has contributed to assessments of the largest and most sophisticated DER programs in the U.S., including in California and New York. He also built several tools to support utility distribution planning and assessment of DERs.
- **Lisa Schwartz** is a Deputy Leader of Berkeley Lab's Electricity Markets and Policy Department. She manages work spanning utility regulation, electricity system planning, energy efficiency and other DERs, and grid-interactive efficient buildings and leads training for states on integrated distribution system planning. Previously, she was Director of the Oregon Department of Energy. At the Oregon Public Utility Commission, she was staff lead on resource planning and procurement, demand response, and distributed and renewable energy resources. She also served as a senior associate at the Regulatory Assistance Project.

# Summary

- As solar panels cover more rooftops, and buildings with load controls and storage provide more grid services, understanding the value of DERs is increasingly important. Yet few utilities and states consider their *value at specific points on the electric system* in planning, procurement, and design of DER programs and rates.
- DERs can provide significant utility system benefits by generating electricity or controlling or reducing electricity consumption, avoiding some types of electricity system costs.
- The potential value of a DER at a specific location on the grid depends on its capability and potential costs it can avoid at that location.
- Electricity markets, policies and regulations affect assessment of DER value. Several jurisdictions provide guidance to utilities for considering DERs as non-wires alternatives (NWAs) in transmission and distribution (T&D) planning.


BERKELEY LAB

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**Locational Value of Distributed Energy Resources**

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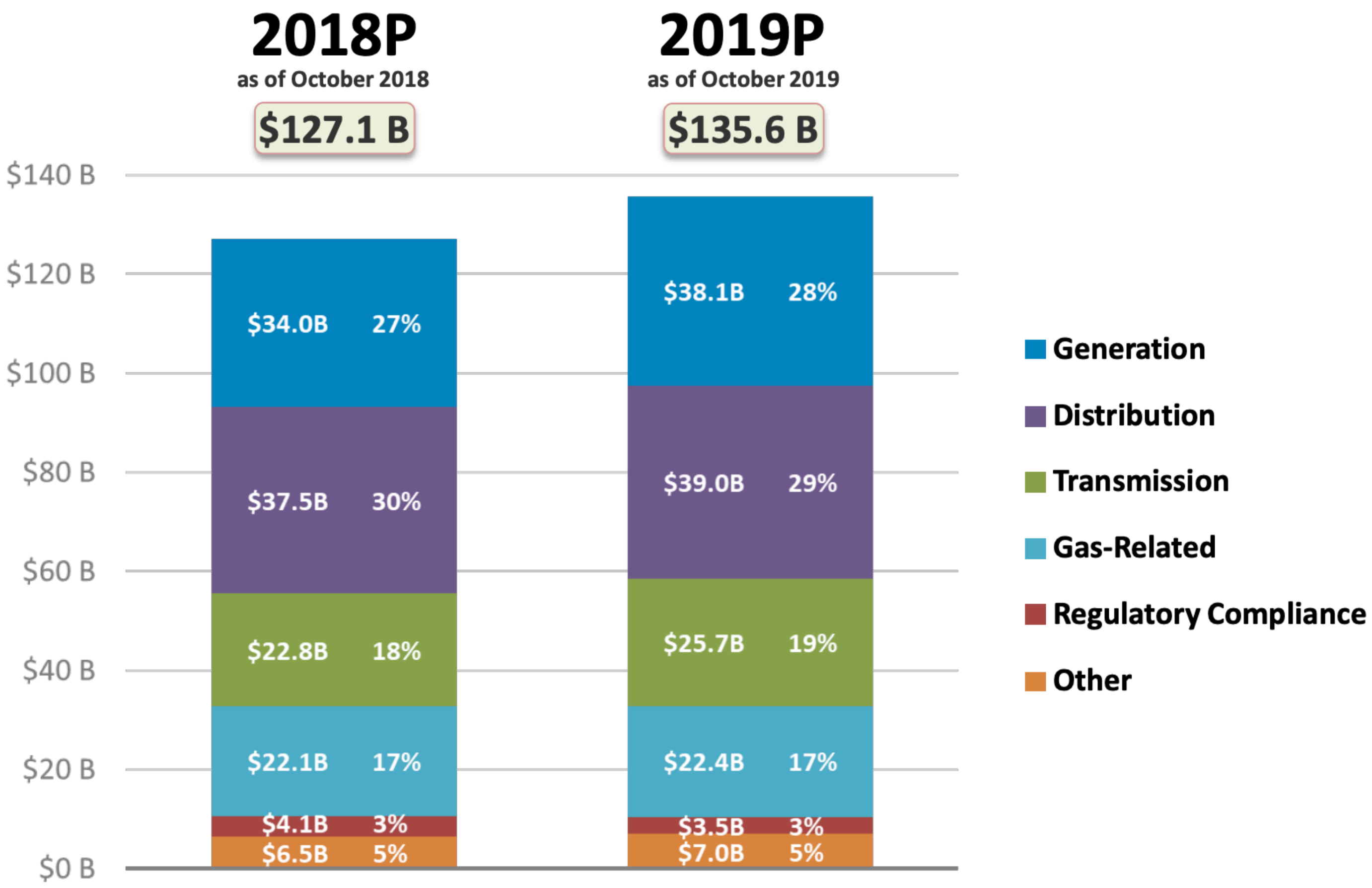
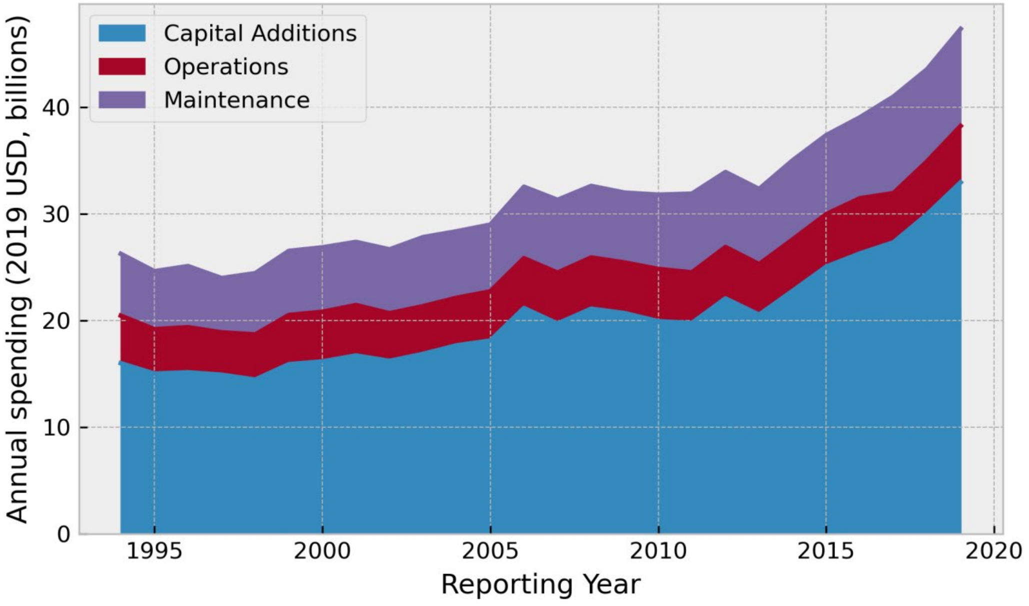
**Report and these slides at** [https://emp.lbl.gov/publications/locational-value-distributed-energy](https://emp.lbl.gov/publications/locational-value-distributed-energy)

# 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

# DERs can provide grid services

DERs can provide grid services to support the generation and delivery of electricity from the utility to the consumer and provide value through avoided electricity system costs (including consumers who provide electricity to the grid)—the cost of acquiring the next least expensive alternative resource that provides comparable services.

| Grid Service | Potential Value (Avoided Cost) |
|---|---|
| **Generation Services** | |
| Generation: Energy | Power plant fuel, operation, maintenance, and startup and shutdown costs |
| Generation: Capacity | Capital costs for new generating facilities and associated fixed operation and maintenance costs |
| **Ancillary Services** | |
| Contingency Reserves | Power plant fuel, operation & maintenance, and associated opportunity costs |
| Frequency Regulation | Power plant fuel, operation & maintenance |
| Ramping | Power plant fuel, operation, maintenance, and startup and shutdown costs |
| **Delivery Services** | |
| Non-wires alternatives | Capital costs for transmission and distribution equipment upgrades |
| Voltage Support | Capital costs for voltage control equipment (e.g., capacitor banks, transformers, smart inverters) |

# DER value across the power delivery supply chain comes from avoided costs

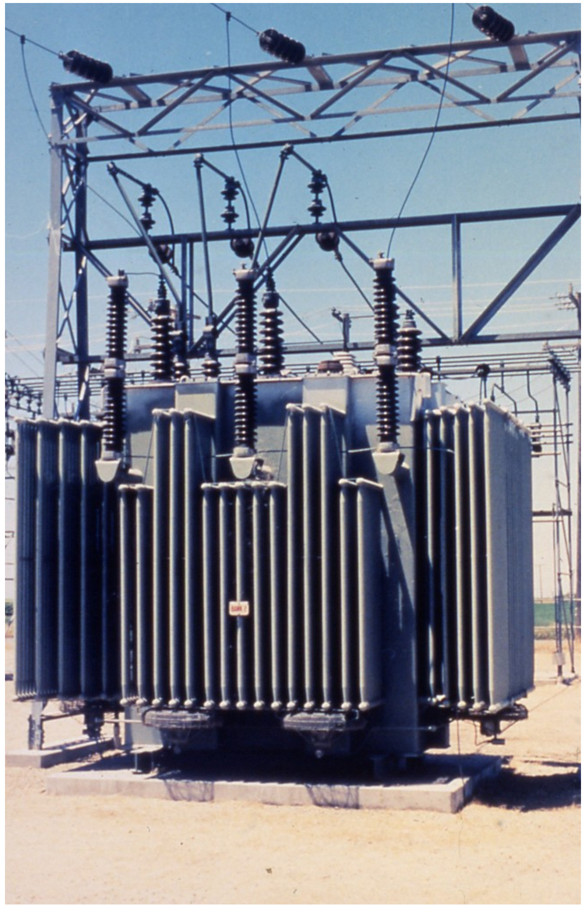
Power Delivery Impacts →

← DER Value Creation

| Value Category | Generation (System Values) | Transmission | Distribution (Locational Values) |
|---|---|---|---|
| Energy | Fuel combustion, Power purchase agreement costs | Transmission losses | Distribution losses |
| Capacity | New power plants & storage resources | New transmission facilities | New distribution facilities |
| Operations | Ancillary services | Ancillary services, Volt-var control | Voltage and var control |
| Environment | Air emissions, land use, water, waste | Land and right-of-way procurement | Land and right-of-way procurement |

# How can non-wires alternatives save energy costs?

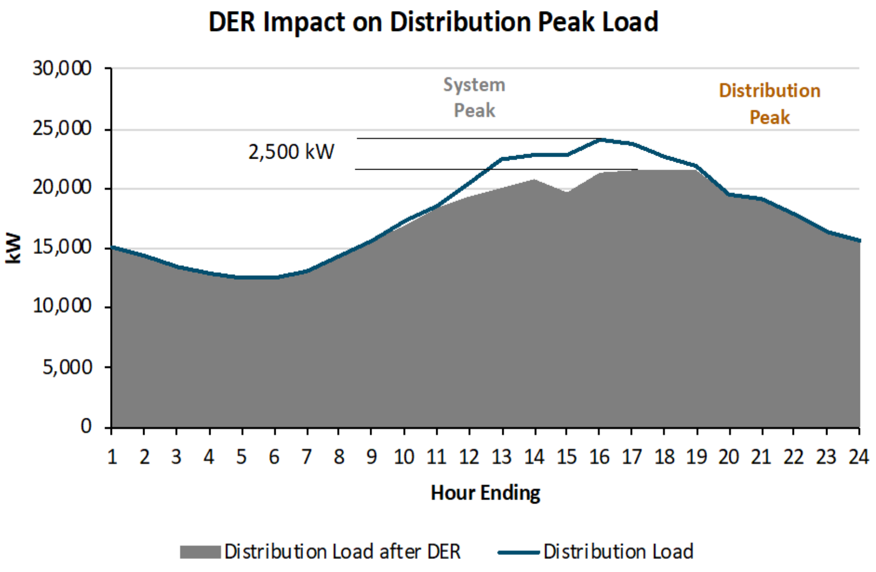
- Defer or avoid infrastructure upgrades
- Implement solutions *incrementally,* offering a flexible approach to uncertainty in load growth and potentially avoiding large upfront costs for load that may not show up
- Typically, the utility issues a **competitive solicitation** for NWAs for specific distribution 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.

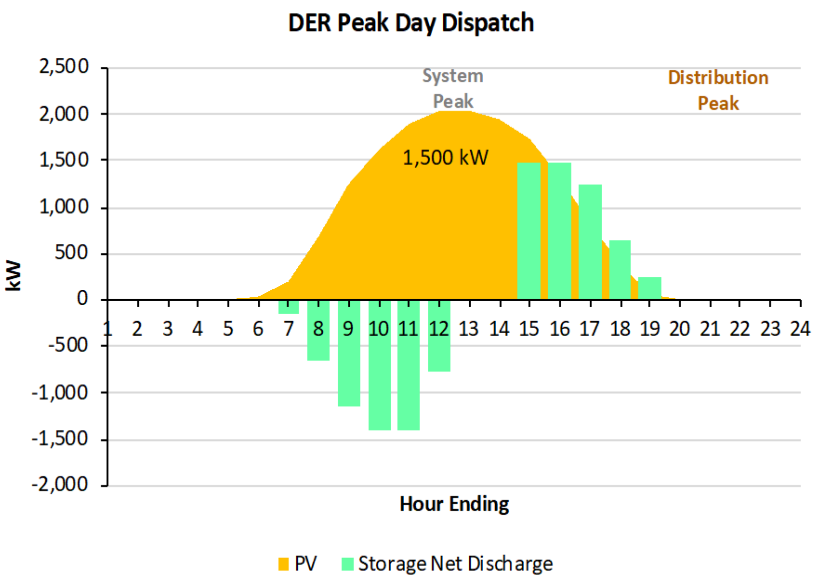


- ***Locational net benefits analysis*** systematically analyzes costs and benefits of DERs to determine the *net* benefits DERs can provide for a given area of the distribution system.

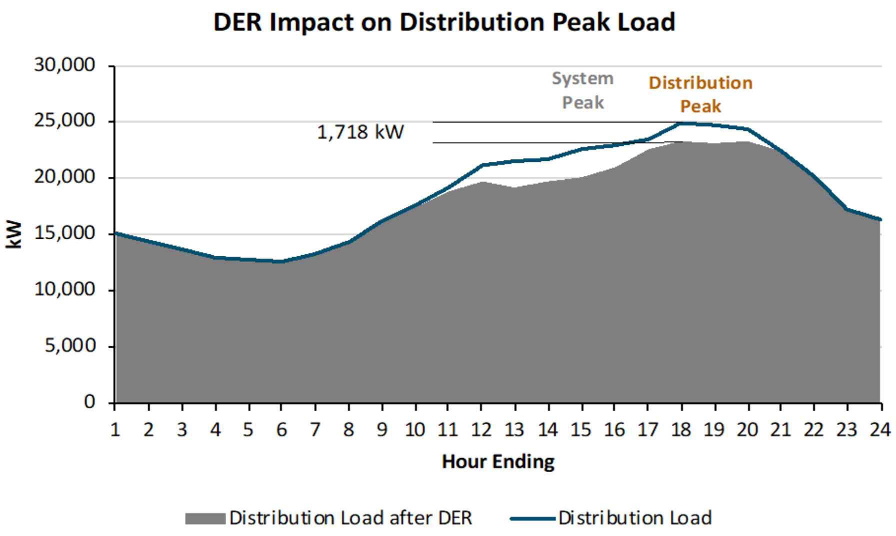
# DERs that reduce demand during distribution system peak produce the most value

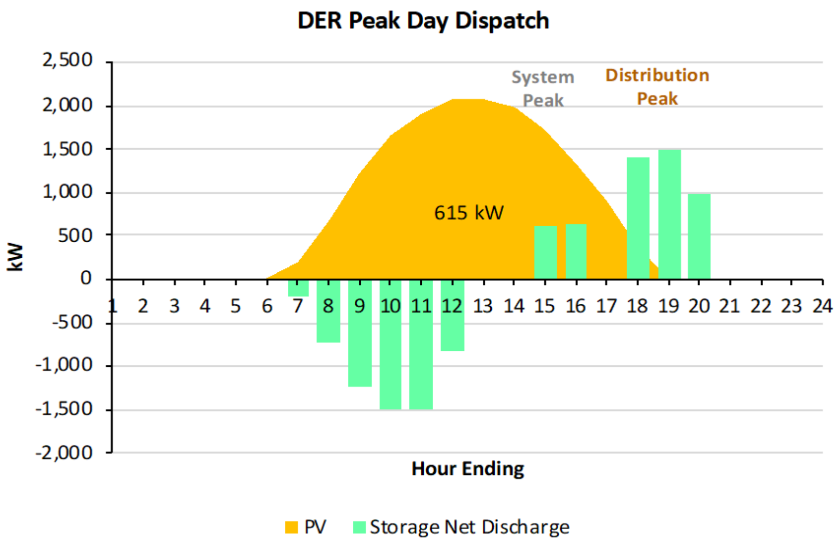
Peak load reductions from PV + storage when distribution and bulk power system peaks are coincident



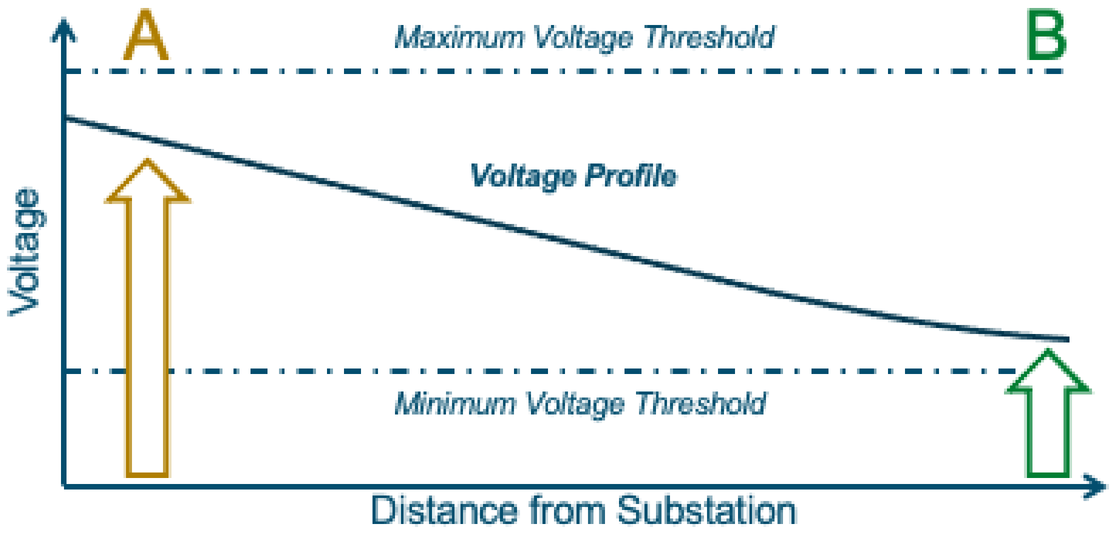

Peak load reductions from PV + storage when bulk power system and distribution systems peaks are *not* coincident



# DERs located further from substations have a larger impact on voltage

The two significant constraints for feeder designs are voltage and current. Voltage must be kept within a range, while current must be lower than the rating of the equipment available.




DERs located near the substation have a smaller impact on voltage because the amount of connected load is high relative to the size of the installed DER.

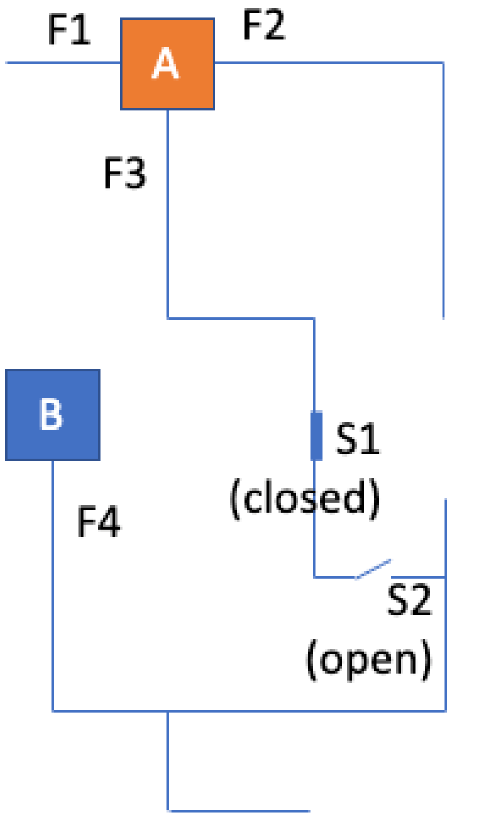
**Interconnecting DER at Point A**

- Voltage effects are more easily managed for DER near the substation.
- Current along the feeder is not affected, as the DER installation is not changing loads downstream.
- DER does not materially reduce feeder losses.

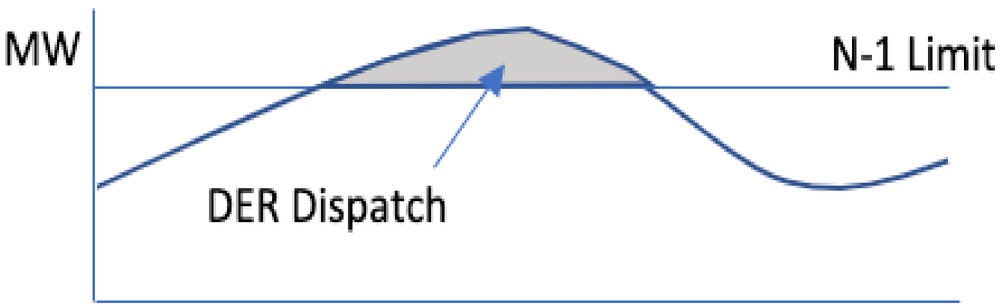
**Interconnecting DER at Point B**

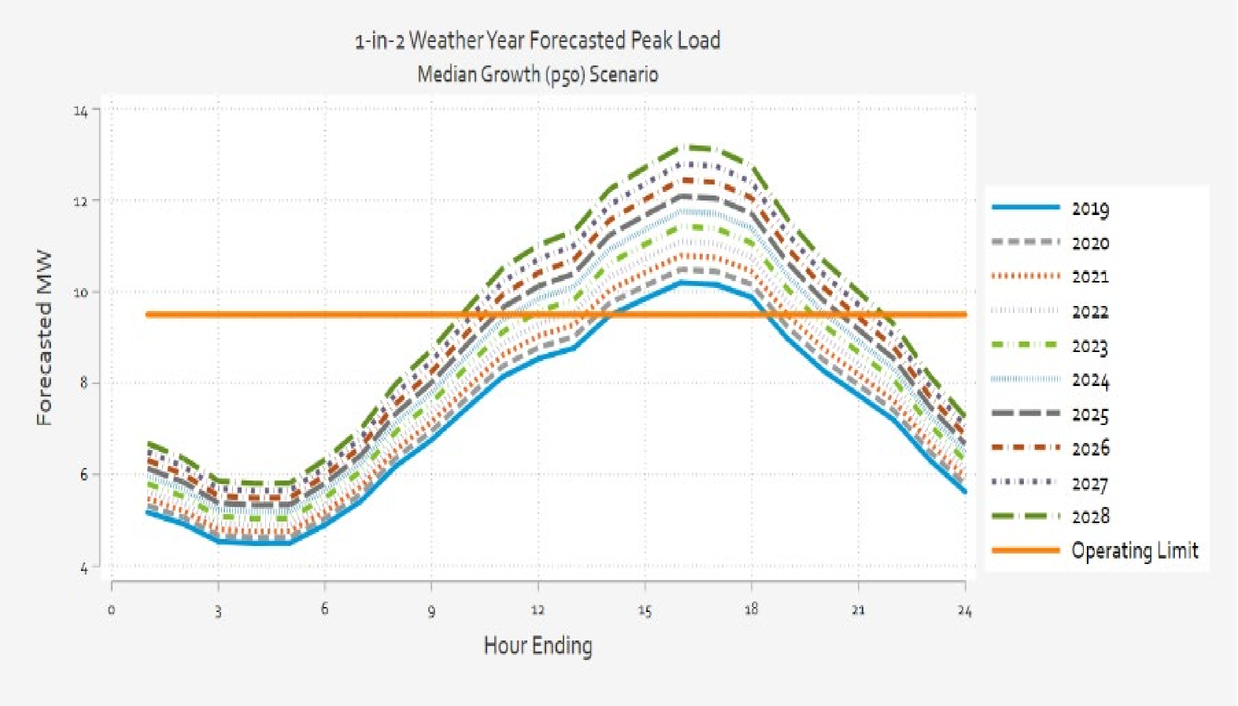
- Voltage effects are more pronounced at the end of the feeder, which may be problematic if left unmanaged, or can present an opportunity to optimize DER deployment for voltage support.
- Current along the feeder is reduced as loads downstream are affected by the DER.
- DER has the opportunity to reduce feeder losses as it is reducing load further downstream.

# Engineering considerations for estimating the locational value of DERs



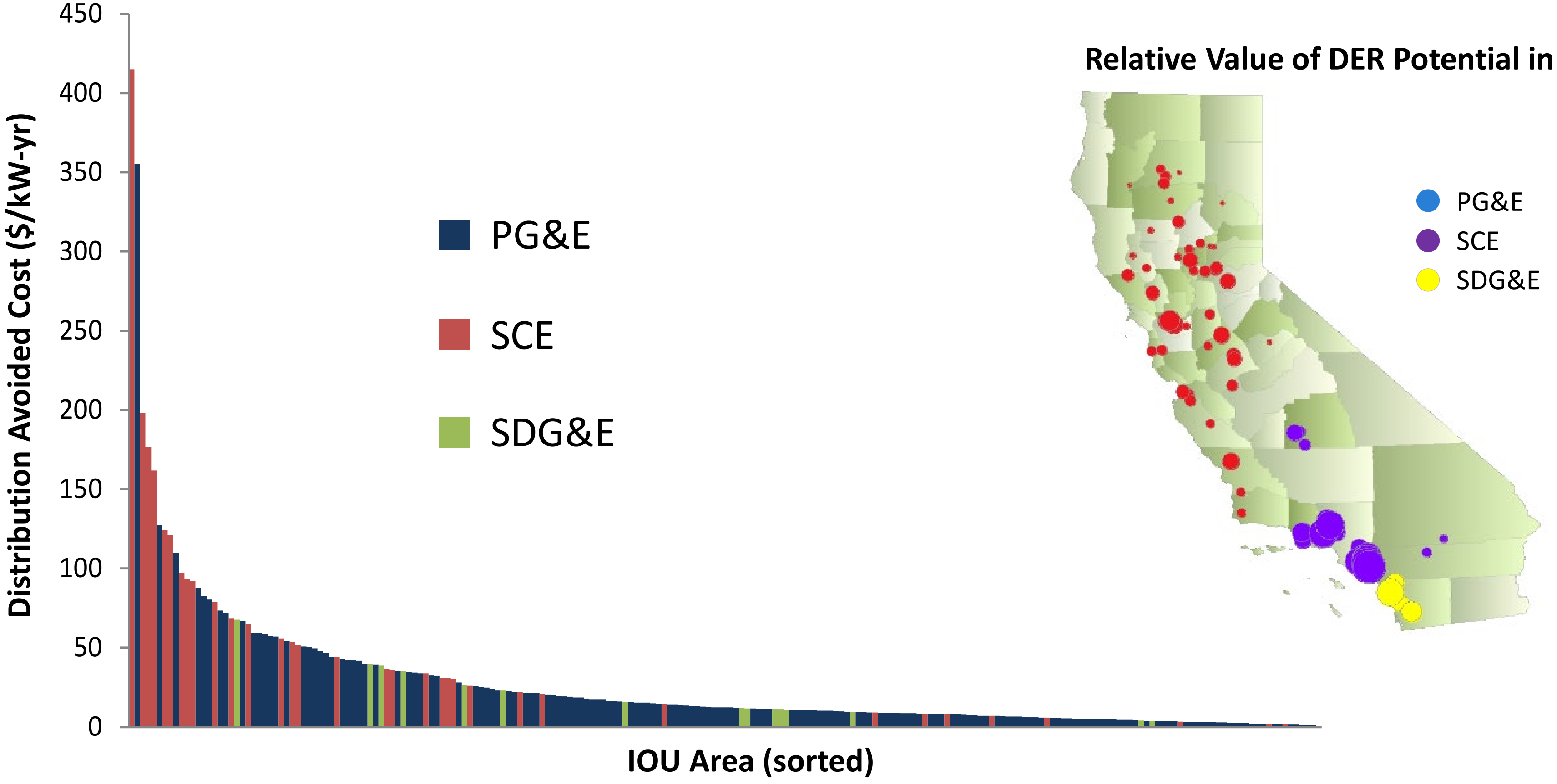

**Legend**
Substations A and B
F1, F2, F3, and F4 are feeders
S1 and S2 are switches



# Right Place

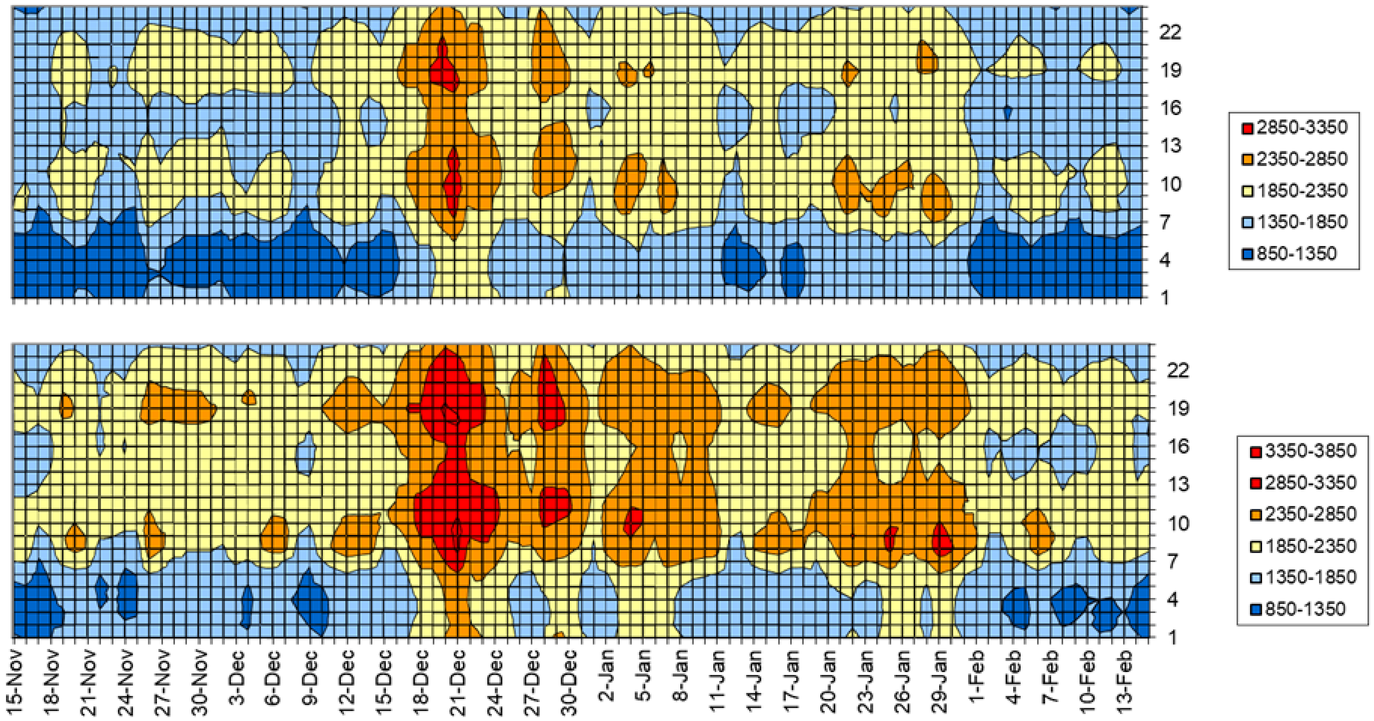
- The graph shows the range of local distribution avoided costs by area from an E3 study for California using utility distribution planning information.
- There are high value locations across the state, but DERs must be targeted to capture the highest value.



# Right Time

- Within each of those areas, load reduction must be delivered at the right time.

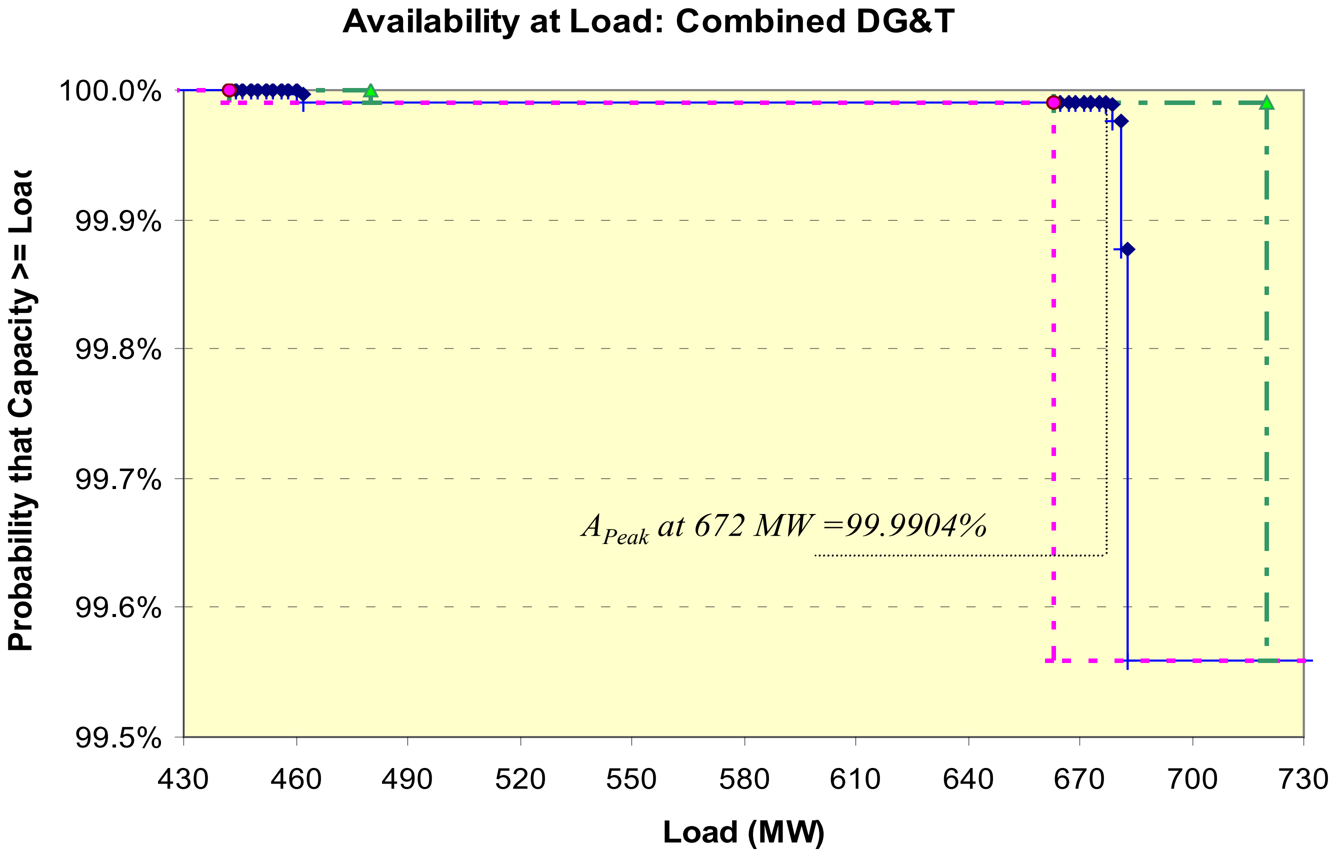
## 2004 and 2010 Load Projections for Region




Note: 2,850MVA is the emergency limit

# Right Certainty

- Finally, DER must provide sufficiently reliable load reduction in order to provide sufficient certainty so that the distribution engineer who is responsible for the local area reliability is able to defer the investment.



# Two approaches to assessing the locational value of DERs

| | How Value Is Assessed | Typical Use Case |
|---|---|---|
| **Area-specific Avoided Distribution Costs** | Forward-looking value of local capacity deferral using the present worth method | Evaluation of hourly distribution value of specific DERs at specific locations |
| **Distribution Marginal Cost of Service Studies** | Long-run system average marginal distribution cost based on the historical relationship between distribution investment and peak load | Evaluation of costs and benefits of systemwide deployment of DERs |

# Present Worth (PW) Method: local distribution expansion planning

The essence of the PW method for area-specific avoided distribution costs is the value of deferring a local distribution expansion plan for a specific period of time. A one-year deferral value equals the difference between the present value of the distribution expansion plan and the present value of the same plan deferred by one year, adjusted for inflation and technological progress. The value of deferring capacity in year 1 for $\Delta t$ years is:

$$PW\ Deferral\ Value = \sum_{t=1}^{n} \frac{K_t}{(1+r)^t}\left[1 - \left(\frac{1+i}{1+r}\right)^{\Delta t}\right]$$

where:
$n$ = finite planning horizon in years,
$K_t$ = distribution investment in year $t$,
$i$ = inflation rate net of technological progress,
$r$ = a utility's cost of capital (discount rate),
$\Delta t$ = deferral time = peak load reduction divided by annual load growth.

The PW deferral value can be divided by the associated incremental load change that produced the deferral to obtain a $/kW estimate of the marginal distribution capacity cost (MDCC):

$$\$/kW\ Marginal\ Cost = \frac{PW\ Deferral\ Value}{Deferral\ kW}$$

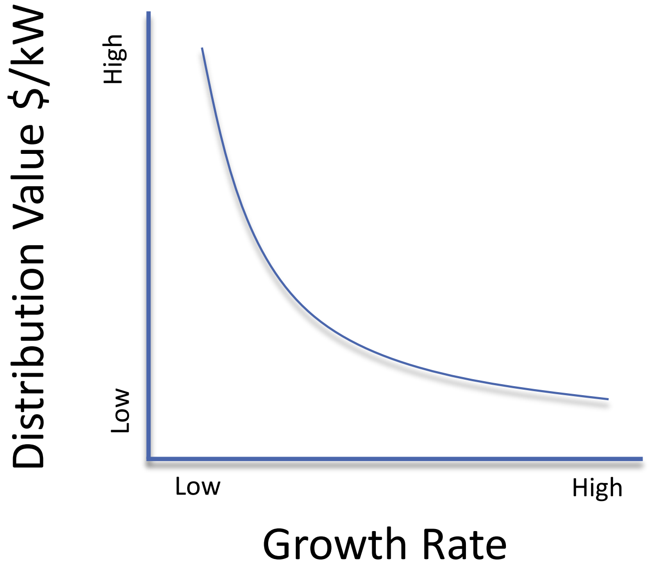
The MDCCs are allocated to hours in proportion to the likelihood that the hour will contain the peak load, using peak allocation factors (PCAFs):

$$PCAF_h = \frac{(Load_h - Threshold)}{\sum_{h=1}^{8760}(Load_h - Threshold)}$$

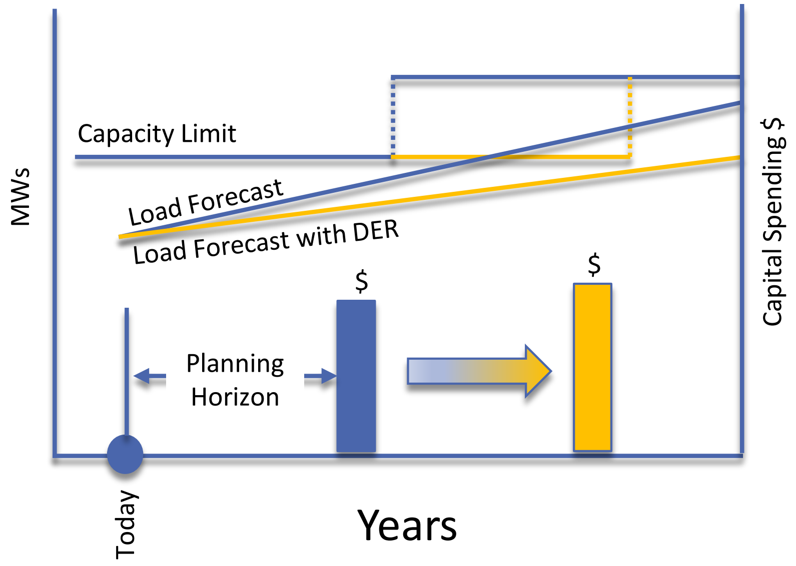
where:
$Threshold$ = the peak period cut-off value

# Implications of the Present Worth Method formula

Slow Growth Areas Have Higher Marginal Value



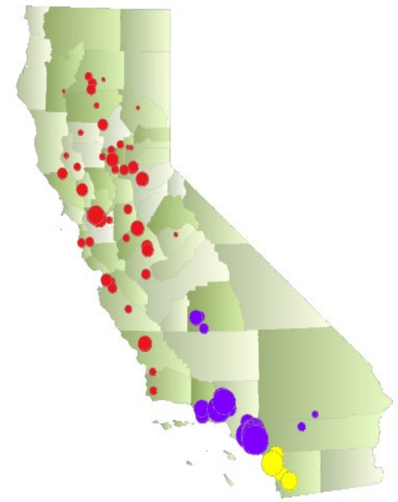

Planning Horizon is Important to Capture Opportunities




**Strategies**

Use system capacity value to deploy dispatchable DER system wide (“anchor tenant”)

Use local value to increase ratepayer value and prioritize capital spending



# Tools for calculating the locational value of DERs

| | Utility/Developer | Publicly Available? |
|---|---|---|
| **Single DER Solutions** | | |
| Brooklyn-Queens Demand Management Program Cost-Benefit Model | Consolidated Edison | Y |
| Avoided Cost Calculator | E3 | Y |
| Long Island's Public Service Enterprise Group Value of Distributed Energy Resources Value Stack Calculator | PSEG | Y |
| New York Solar Value Stack Calculator | NYSERDA | Y |
| **Portfolio of DER Solutions** | | |
| Locational Net Benefit Analysis Tool | E3 | Y |
| Integrated Demand Side Management Model | E3 | N |
| Solar + Storage Optimization Tool | E3 | Y |
| Distributed Energy Resources-Customer Adoption Model (building/microgrid level) | Berkeley Lab | Y |
| Integrated Modeling Tool | Berkeley Lab | Y |
| REOpt: Renewable Energy Integration & Optimization | NREL | Y (REOpt Lite only) |
| Load Relief Needs and T&D Deferral Value Tool | Demand Side Analytics | N |
| DER Micro-potential and Non-Wires Optimization Tool | Demand Side Analytics | N |
| **Battery Storage** | | |
| bSTORE | Brattle | N |
| RESTORE Model | E3 | N |
| Storage Value Estimation Tool (StorageVET®) | EPRI | Y |
| Electricity Storage Valuation Tool | Navigant/TenneT | Y |
| QuESt | Sandia National Lab | Y |

# Market structure influences value of DERs

## Organized Markets

- Value established by market
- Only values "products" traded in market:
  - Capacity
  - Energy
  - Reserves (spinning and balancing)
  - Volt/Var support
- Gaps/Challenges
  - Locational value of avoided/deferred T&D capacity not captured
  - Value of resilience
  - Value of increased hosting capacity
  - Recognition of "long-term" resource value in some markets

## Vertically Integrated Utilities

- Value established through regulatory/planning processes (e.g., PURPA filings, IRPs)
- Value depends on scope of state "cost-effectiveness" test
- Gaps/Challenges
  - Not all states include all utility system benefits of demand flexibility or quantify them in a consistent manner (e.g., not all states use time-dependent valuation).
  - Methods to quantify and monetize the locational value of demand flexibility are "under construction."
  - Integrated analysis of the impacts of demand flexibility is complex, and thus rarely done.

Adapted from Tom Eckman and Lisa Schwartz, "Determining Utility System Value of Demand Flexibility," 2020

# Two market issues for DERs

- Dual market participation
  - FERC Order 2222 enables participation of DERs in centrally organized markets through aggregation.
  - Dual market participation requires alignment of different markets to capture multiple, or stacked, value streams.
  - Utilities and RTOs/ISOs must specify which grid services can be provided simultaneously and which require a choice by the resource operator.
  - How markets will work together to assess value of local capacity resources and, in case of conflicting operational needs, to prioritize DER participation must be worked out.
- DERs in nested areas — a constrained distribution system that also is located in a constrained local transmission zone
  - Design of NWA procurement or utility program should encourage DER operations to relieve both constraints when possible.
  - But if timing of distribution and bulk power system peaks does not align, dispatching the DER to support one constraint may preclude operating the DER for the other constraint, requiring the establishment of dispatch priorities.

# State policies affect the value of DERs.

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

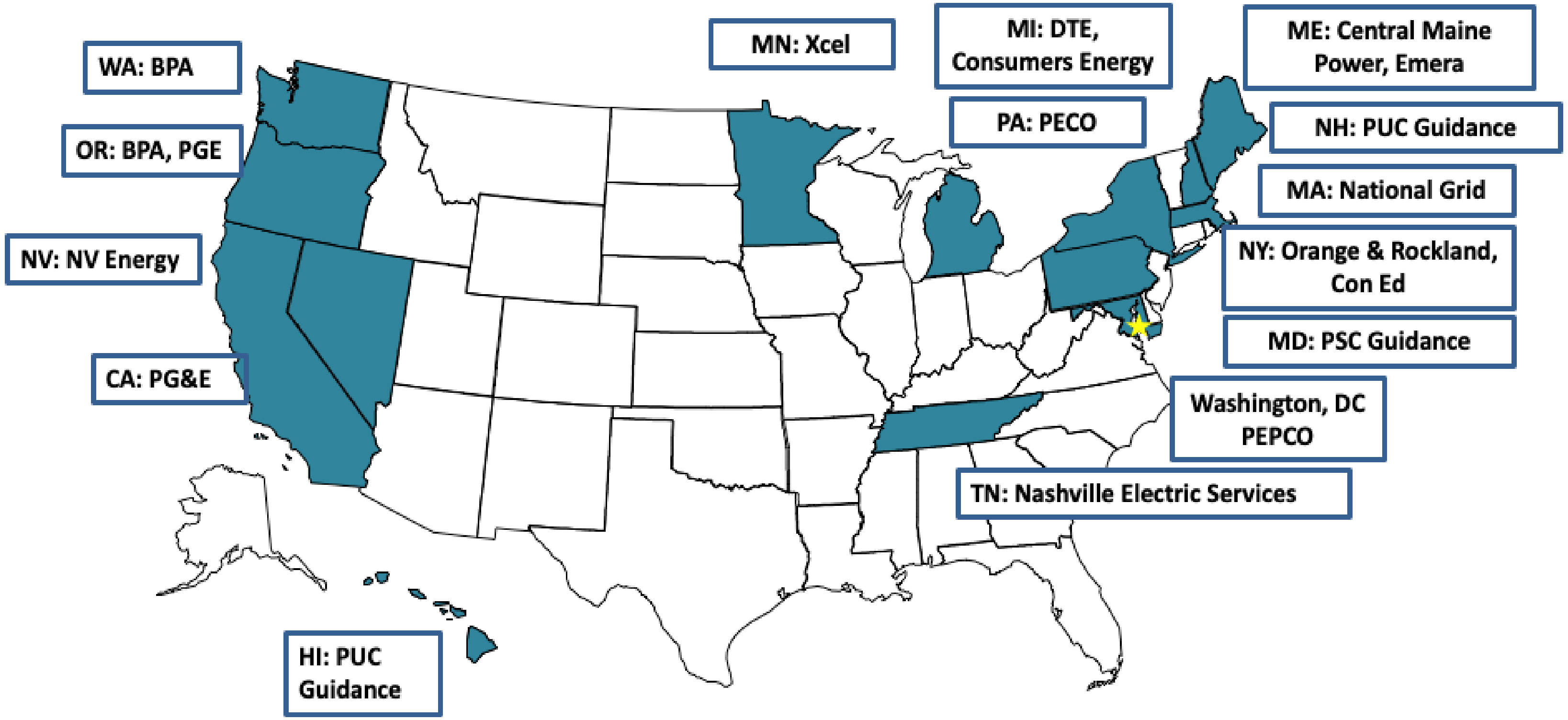
| Value Category | Value Stream | AZ | AK | CA | CO | HI | ME | MD | MA | MI | MN | MS | MT | NC | NJ | NY | NV | PA | SC | TN | TX | UT | VT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Generation | Avoided Energy | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | 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 | | | ■ | | | | | | | | | | | | ■ | | | | | | | |
| | Aviođed 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

# 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 Berkeley Lab 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.” The PUC’s order on DRPs (2014) established guidance for utilities.
- The 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)

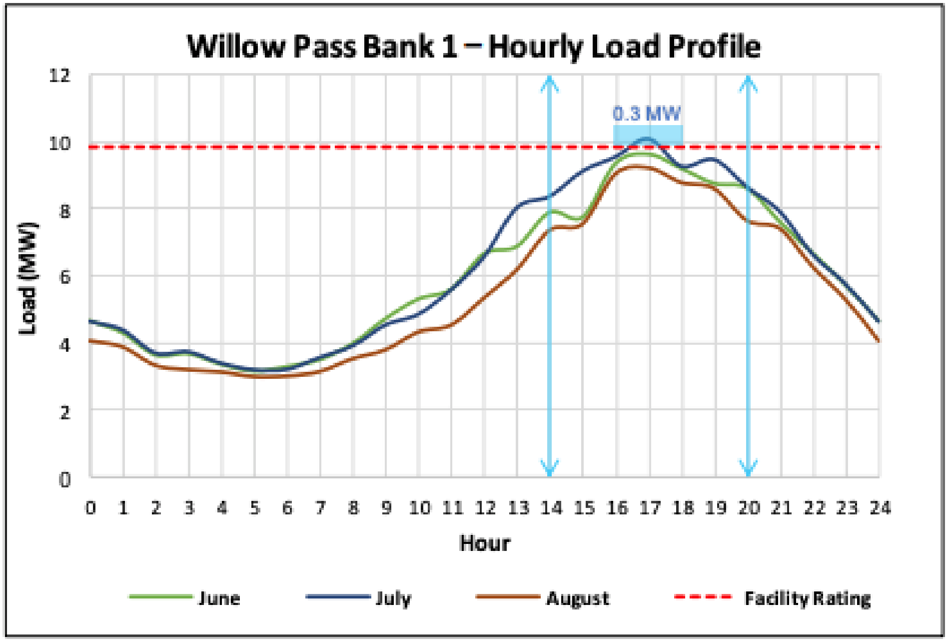
# PG&E's 2021 DIDF identified more than 19 MW of grid needs

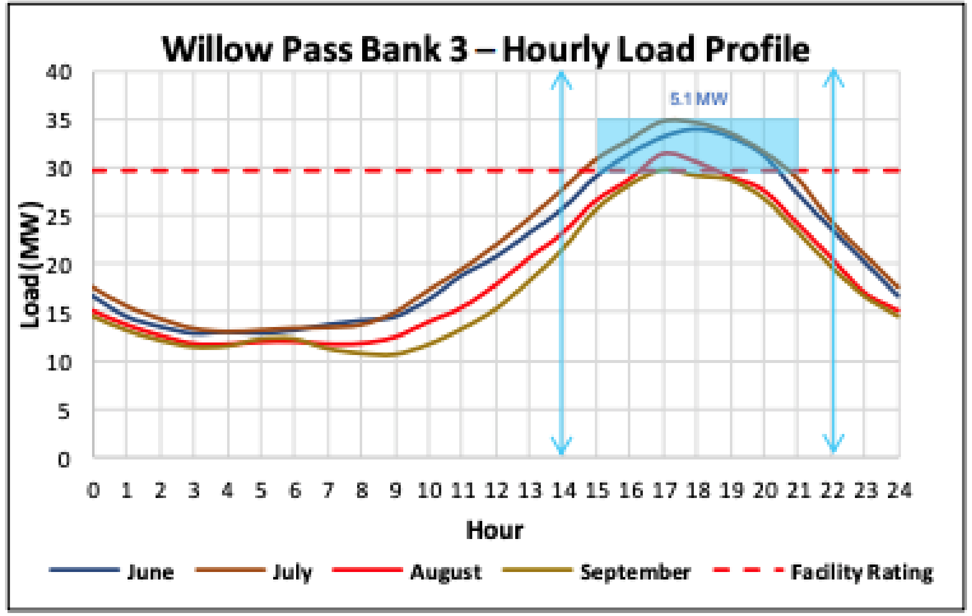

| Candidate Deferral | GNA Facility Name | In-Service Date |
|---|---|---|
| WILLOW PASS BANK 1 | WILLOW PASS BANK 1 | 2023 |
| | WILLOW PASS BANK 3 | 2023 |
| SAN MIGUEL BANK 2 | SAN MIGUEL BANK 1 | 2023 |
| | SAN MIGUEL 1104 | 2023 |
| | PASO ROBLES 1107 | 2023 |
| CALISTOGA BANK 1 | CALISTOGA BANK 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 |

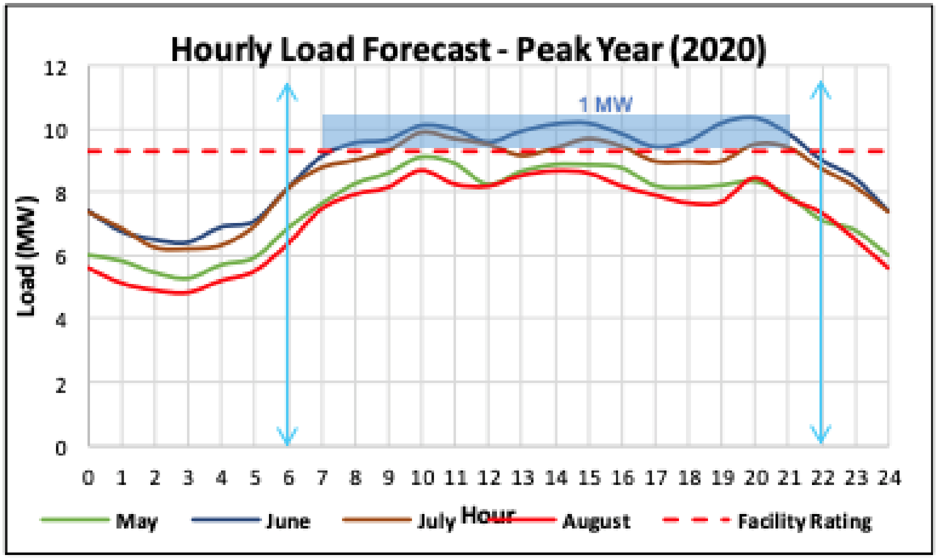
* CUSTOMER CONFIDENTIAL due to their peak loads violating the 15-15 customer privacy rule

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.

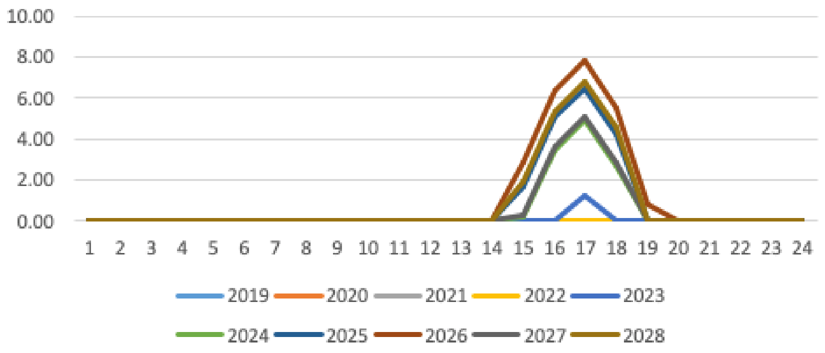


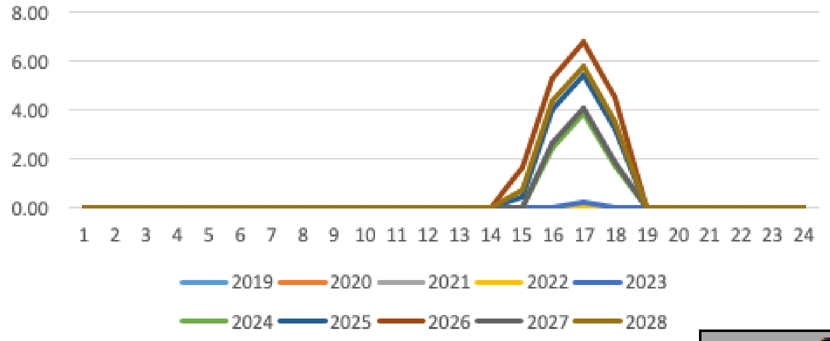



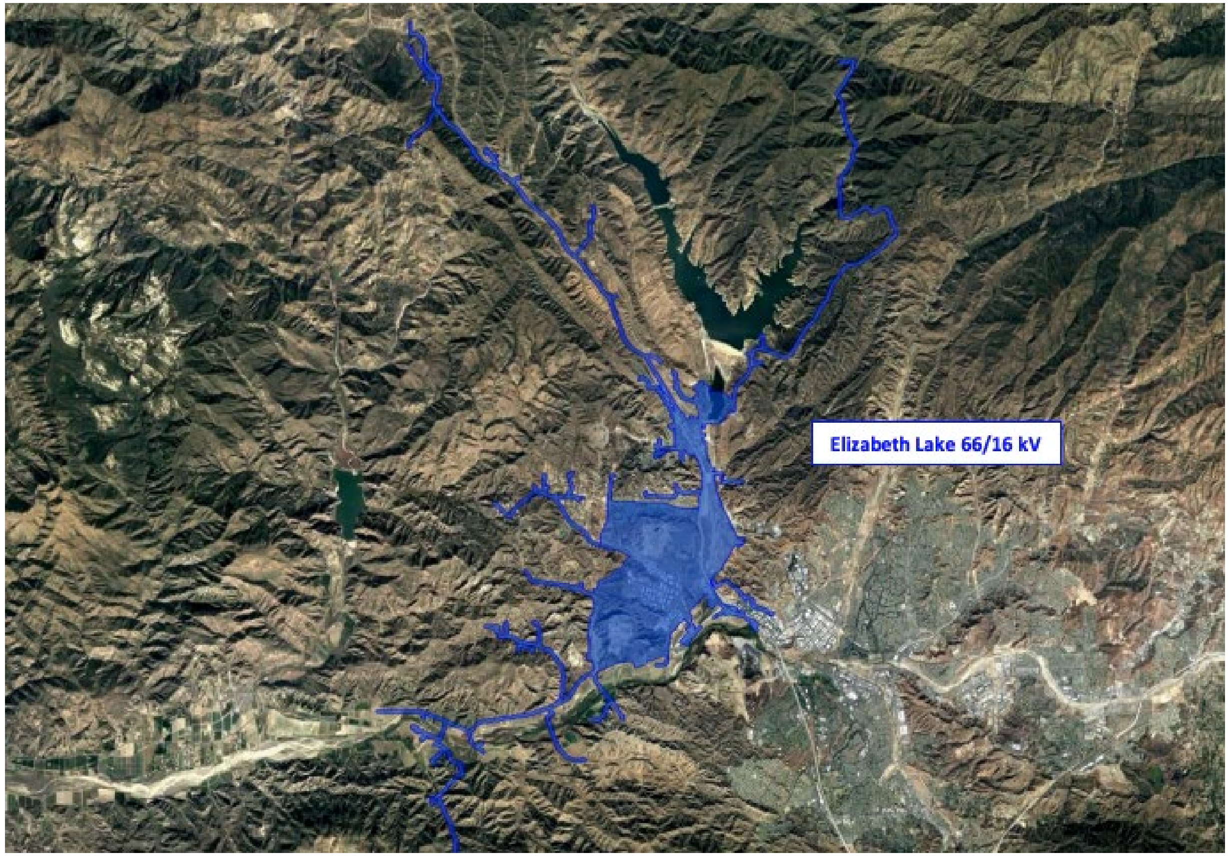
# Southern California Edison is implementing two NWA projects.

Elizabeth Lake Project #1 Requirements




Elizabeth Lake Project #2 Requirements



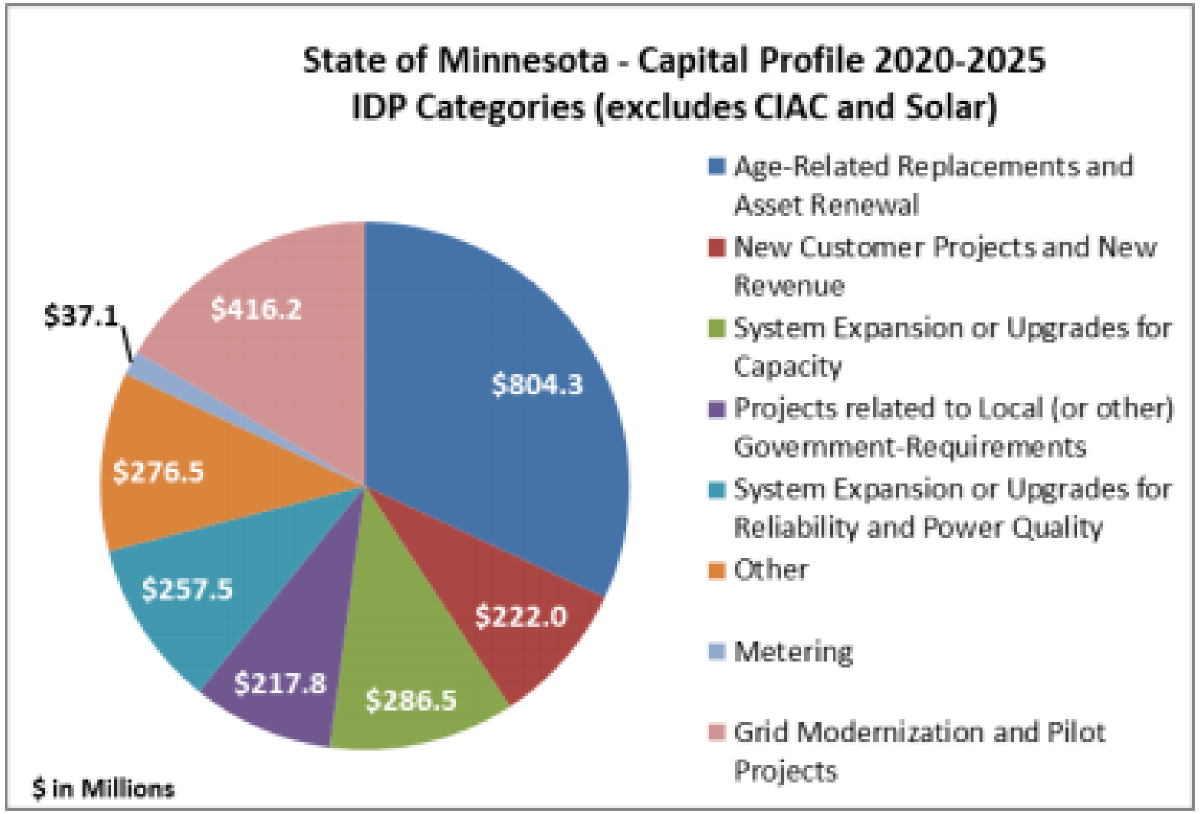




| Seller | Deferral Projects | Interconnection (Circuit and/or Substation) | Technology Type | Size (MW)2 | Initial Delivery Date | Term of Agreement (Years) |
|---|---|---|---|---|---|---|
| Homestead Energy Storage, LLC | Elizabeth Lake #1 and Elizabeth Lake #2 | Elizabeth Lake 66/16 kV Substation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

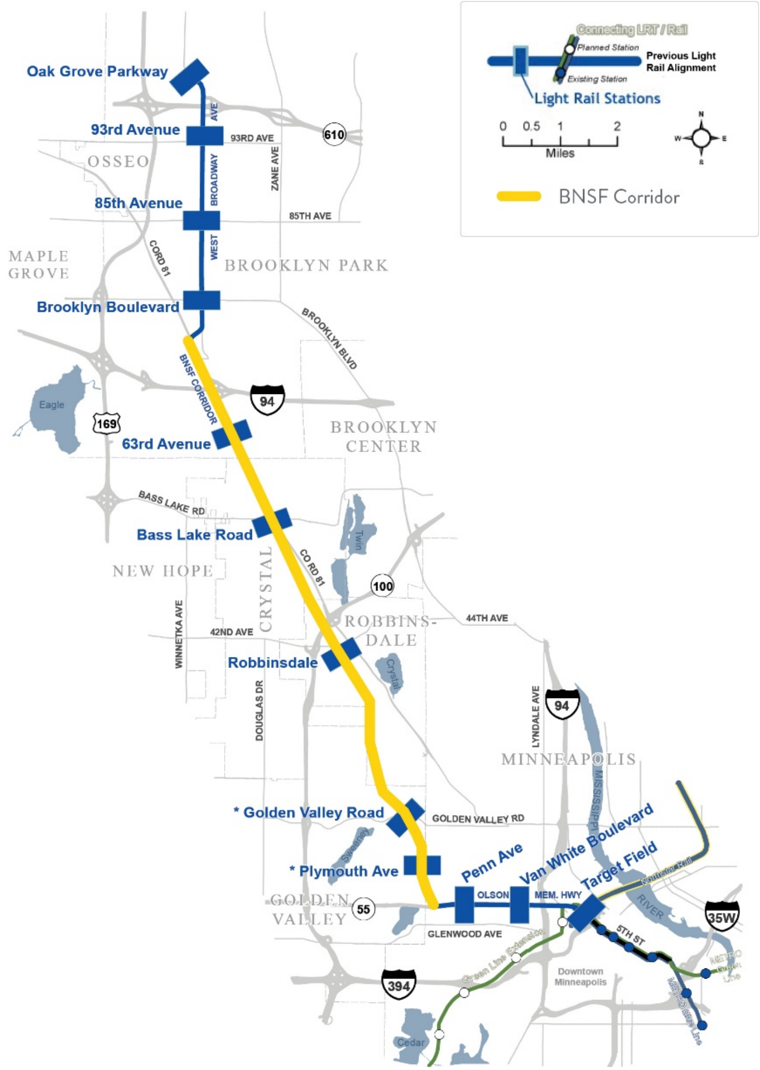
| Project Name | Project Peak Demand (MW) | Project Energy Demand (MWh) | DR (MWh) | Existing Solar (MW) | Increm. Solar (MW) | Battery (MWh) | NWA Cost ($M) | Trad Cost ($M) |
|---|---|---|---|---|---|---|---|---|
| Kohlman Lake | 10.28 | 40.2 | 0 | 0.90 | 0 | 39.4 | 15.8 | 4.5 |
| Birch | 17.9 | 57.5 | 0 | 12.8 | 0 | 45.2 | 18.1 | 7.1 |
| Viking | 9.2 | 55.1 | 2.26 | 0.3 | 0.18 | 54.7 | 22.2 | 4.1 |
| Goose Lake | 23.2 | 116.9 | 0 | 12.8 | 0 | 108.9 | 46.8 | 5.3 |
| Burnside | 12.8 | 111.5 | 0 | 23.7 | 16.3 | 66.9 | 59.4 | 2.7 |
| Stockyards | 13.4 | 77.9 | 0 | 0 | 0 | 77.9 | 68.1 | 4.0 |
| Orono | 10.3 | 186.6 | 0 | 0.3 | 0 | 186.6 | 76.1 | 4.1 |
| Veseli | 3.7 | 32.0 | 0 | 0.9 | 32.0 | 32.0 | 76.8 | 2.8 |
| Cannon Falls | 5.6 | 248.7 | 0 | 0 | 0 | 220.0 | 88.0 | 2.0 |
| First Lake | 15.1 | 259.0 | 0 | 11.1 | 0 | 227.5 | 91.0 | 3.2 |
| West Coon Rapids | 28.1 | 269.2 | 0 | 0 | 0 | 269.2 | 94.7 | 2.2 |
| Faribault | 31.6 | 415.8 | 0 | 3.0 | 2.5 | 401.1 | 165.4 | 2.0 |

Source: Xcel

# Piloting NWAs in central Minnesota

- Focused on existing energy efficiency (EE) and demand response (DR) 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



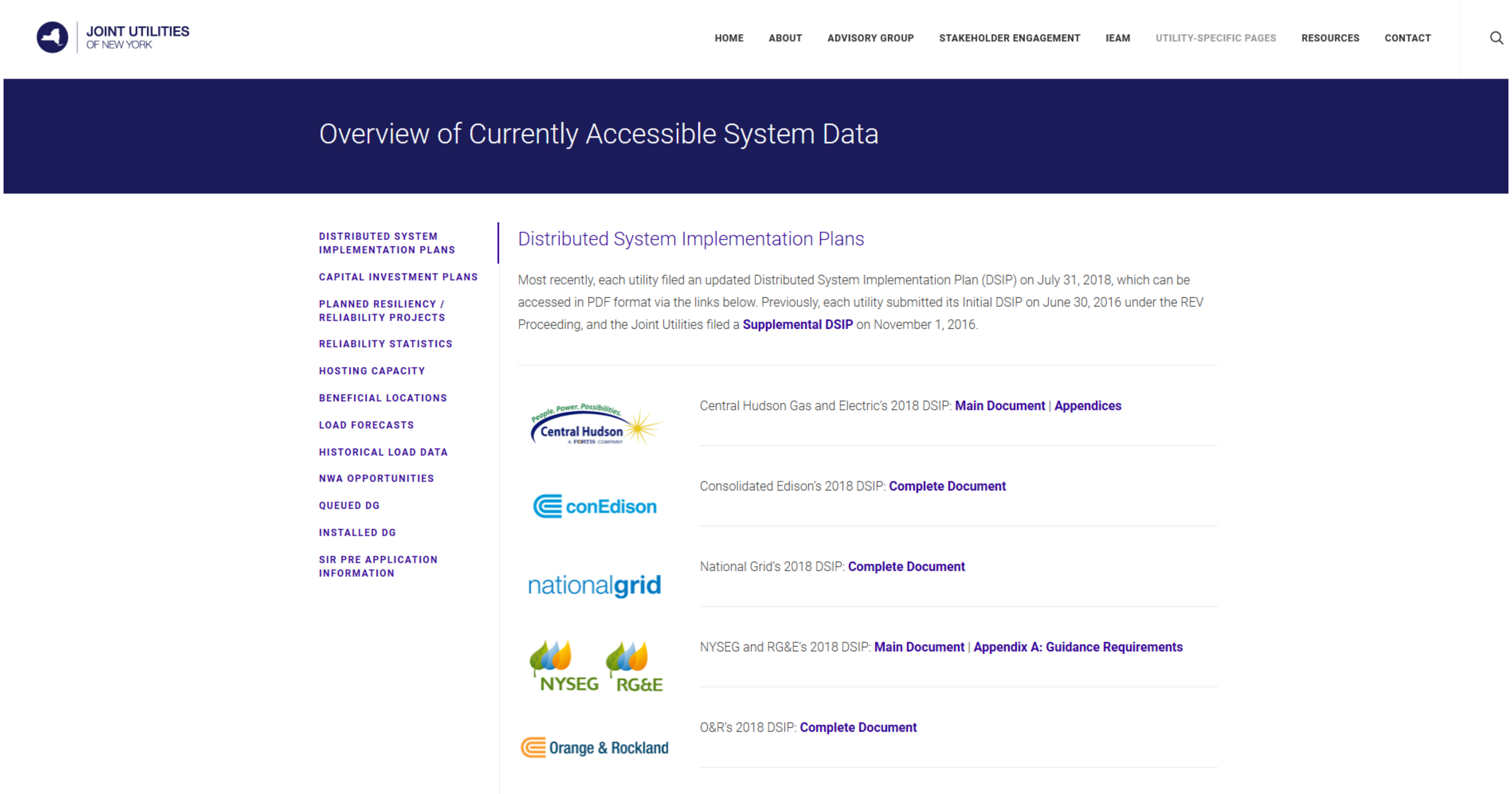

Source: Metropolitan Council

- 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.

# Locational value in New York

- New York Public Service Commission has required utilities to evaluate DERs as an alternative to T&D capital projects since industry restructuring in the late 1990s.
- The 2014 Reforming Energy Vision (REV) proceedings were organized in two tracks: (1) REV Track One focused on the adoption of the Distributed System Implementation Plans and (2) REV Track Two focused on a transition away from net-energy metering via the Value of Distributed Energy Resources (VDER) mechanism.
- VDER uses marginal cost of service studies to define both a non-location-specific "Demand Reduction Value" and a locational system relief value that is added to the demand reduction value in utility-identified locally constrained areas.
- Objectives: New York aims for greater transparency for how utilities operate the grid, plan for system needs and compensate DERs. The location-based system is aligned with using markets and energy supply prices to encourage investment in and appropriately compensate DERs.

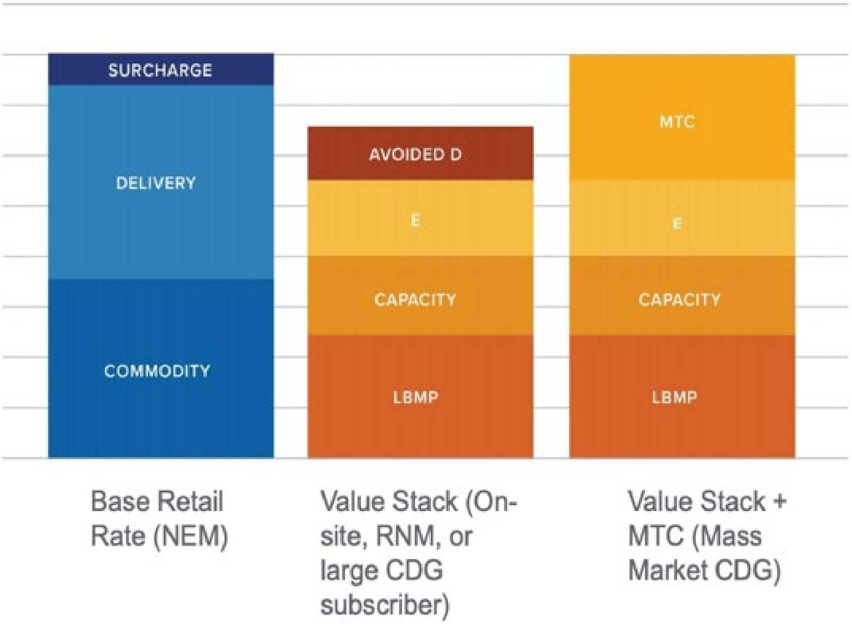
# Track 1: Distribution System Implementation Plans




<u>Joint Utilities of New York</u> - <u>DSIPs</u> and <u>Publicly Accessible System Data</u>

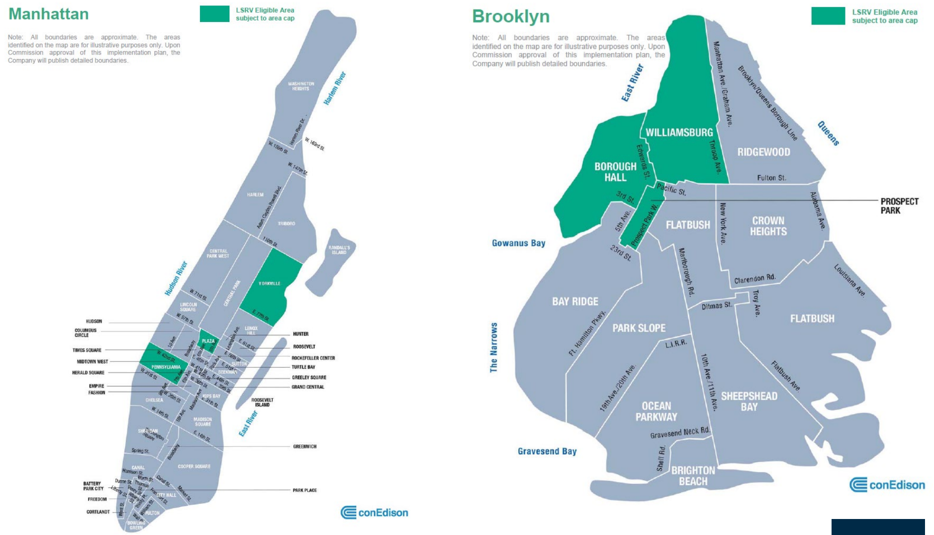
# Track 2: New York Value Stack (VDER)

- Hourly Value Stack consists of:
  - Energy
  - System Capacity
  - Environmental Benefits
  - Market Transition Credit OR Avoided Distribution Value (based on Marginal Cost of Service studies)
- Certain projects also are eligible for Locational System Relief Value (LSRV)
  - LSRV credit is available to projects that are located in areas of the grid that are in need of peak load reduction for local capacity (e.g., congested sub-transmission and distribution areas)
  - Each utility provides maps of LSRV zones and MW limits of needed DG capacity
  - Compensation is tied to the utility's top 10 hours*
  - Zones, limits and credits are posted monthly on the VDER website




- Avoided D – avoided demand
- E – environmental benefit
- Capacity – ICAP
- LBMP – energy commodity
- MTC – market transition credit for CDG (Community Distributed Generation)

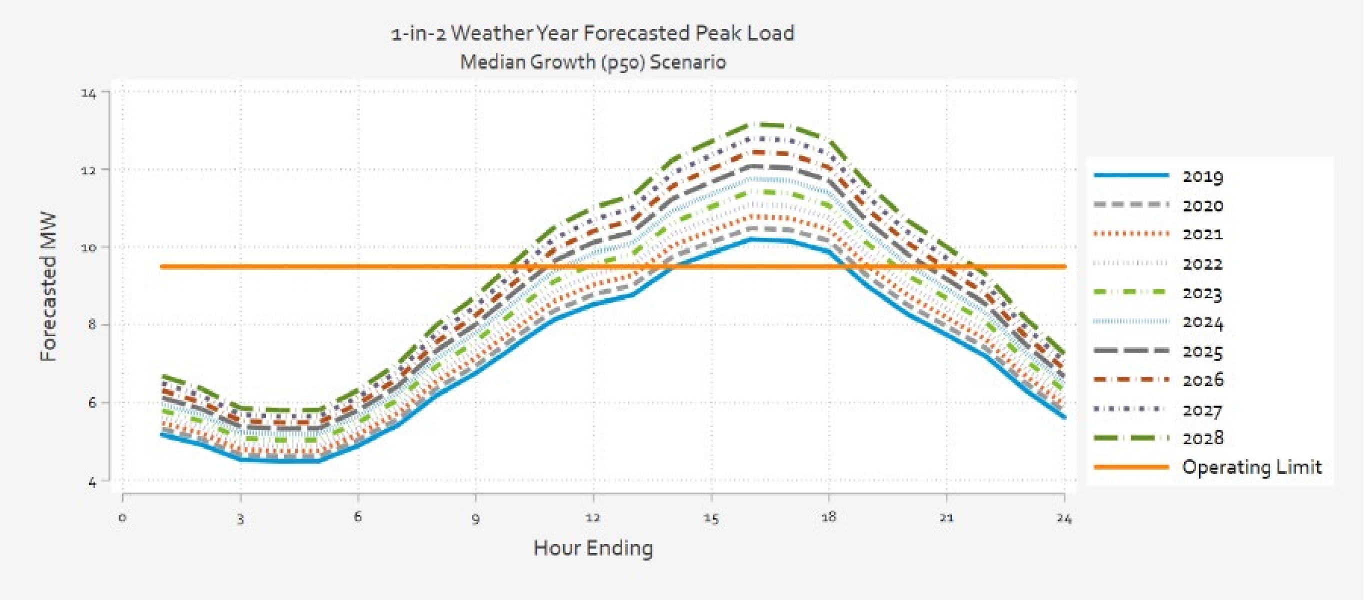
**Example of Manhattan and Brooklyn LSRV Eligible Areas**




* Note VDER has some changes since publication – see website

# 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

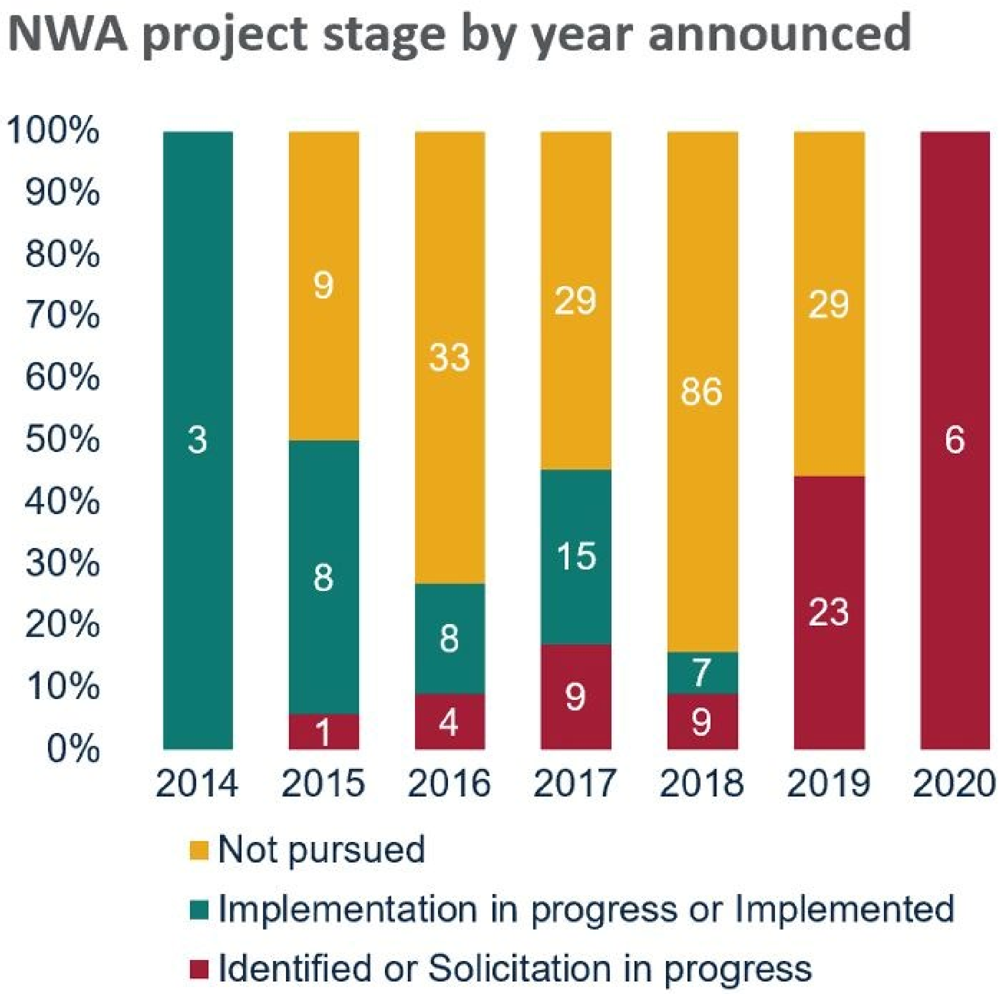



Graphic courtesy of Demand Side Analytics

*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 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 the 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 the share of NWA projects implemented.*
- In addition to analyzing DERs as alternatives to specific projects, utilities can conduct *systematic* studies of DER locational value to:
  - Better understand where to target DERs
  - Calibrate incentive levels
  - Reduce load growth for specific areas of the distribution system
  - Reduce the need for traditional distribution system upgrades.
- These studies can become a routine and transparent part of the utility's distribution planning process. Information also can be used for DER programs and rate designs.




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)

# Resources


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

N. Frick, T. Eckman, G. Leventis, and A. Sanstad. 2021. *Methods to Incorporate Energy Efficiency in Electricity System Planning and Markets*

T. Eckman, L. Schwartz, and G. Leventis. 2020. *Determining Utility System Value of Demand Flexibility from Grid-Interactive Efficient Buildings*

T. Woolf, B. Havumaki, D. Bhandari, M. Whited, and L. Schwartz. 2021. *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges, and Considerations*

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

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

Distribution planning trainings: Midwest region (Oct. 2020), Western region (Feb./March 2021)

ICF. 2018. *Integrated Distribution Planning: Utility Practices in Hosting Capacity Analysis and Locational Value Assessment*

A. Cooke, J. Homer, and L. Schwartz. 2018. *Distribution System Planning – State Examples by Topic*

J. Homer, A. Cooke, L. Schwartz, G. Leventis, F. Flores-Espino, and M. Coddington. 2017. *State Engagement in Electric Distribution Planning*

Berkeley Lab's Future Electric Utility Regulation reports

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

# Contact

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# For more information

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