Emerging Distribution Planning Analyses

Forecasting loads with DERs, hosting capacity and interconnection, locational net benefits, non-wires analysis and DER sourcing

Benjamin Sigrin (NREL), Patrick Dalton (ICF) and Debbie Lew (Debra Lew LLC)

Integrated Distribution System Planning Training
for Midwest/MISO Region
October 13-15, 2020

Forecasting Loads with Distributed Energy Resources

Benjamin Sigrin (presenter), National Renewable Energy Laboratory, and Andrew Mills, Lawrence Berkeley National Laboratory

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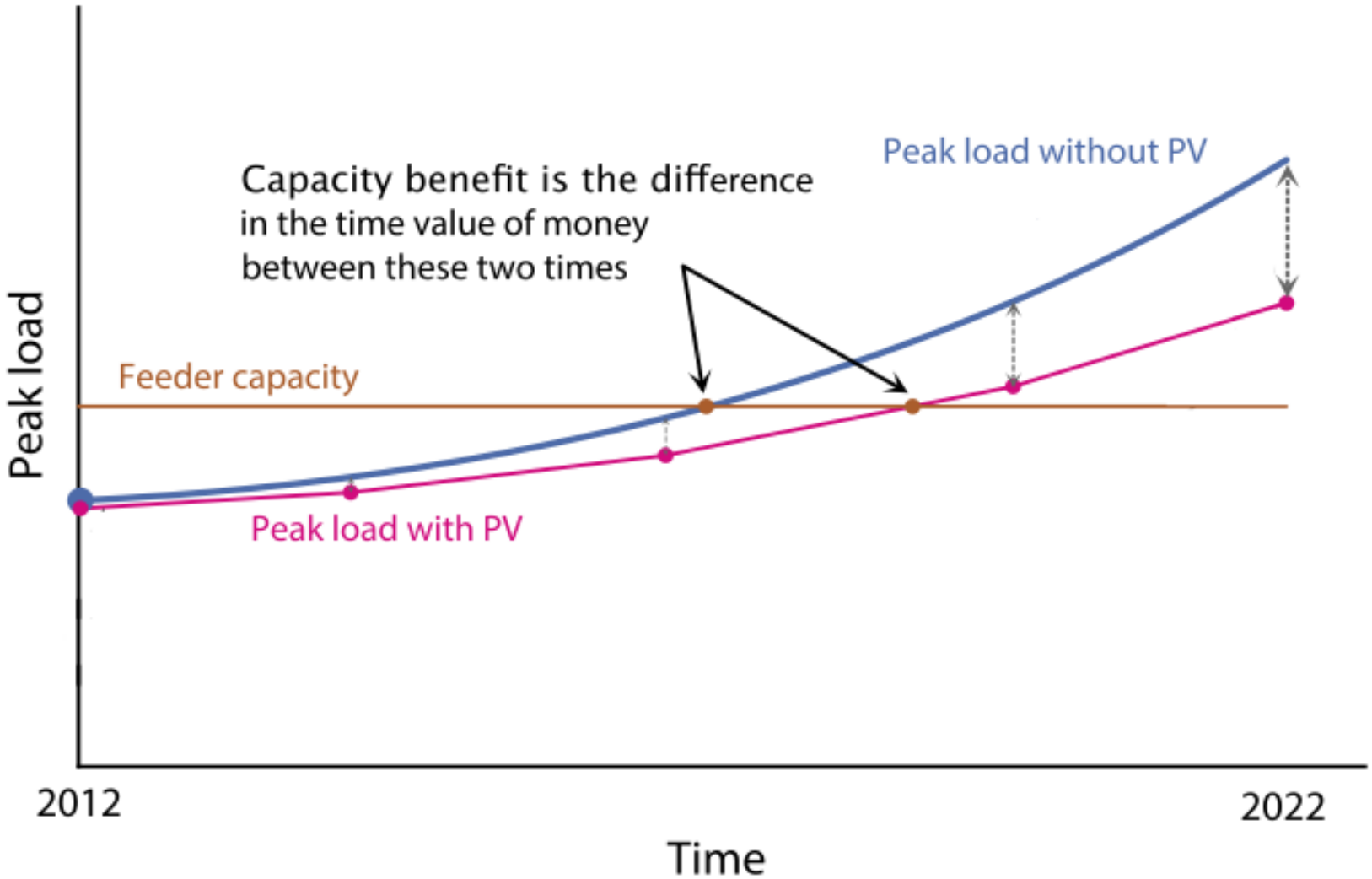
Importance of Including Distributed Energy Resources in Load Forecasts

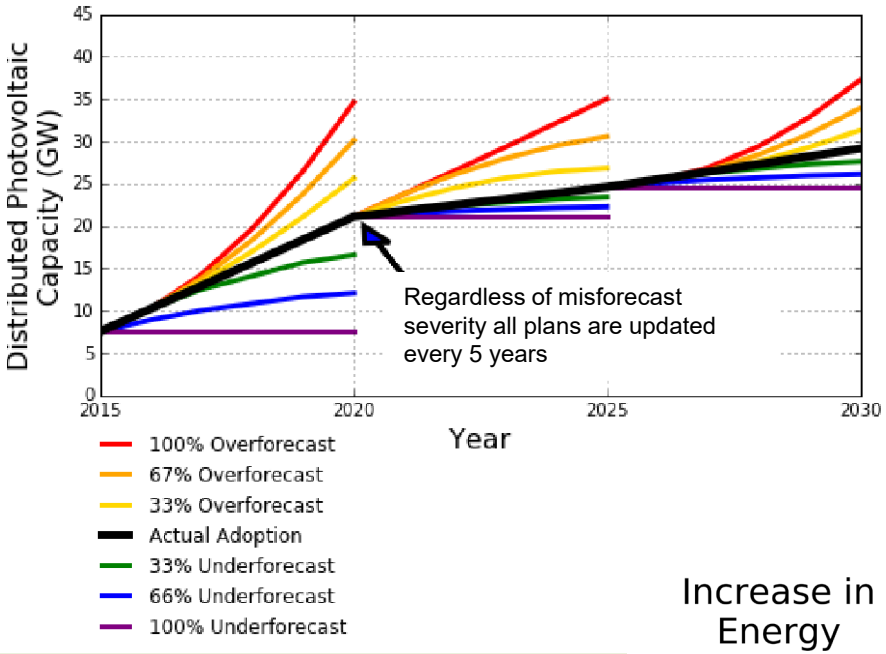
- Distribution system investments: replacing aging infrastructure and distribution expansion
- Procurement of generating capacity to meet peak demand
- Proactive investments to increase hosting capacity
- Evaluating the costs and benefits of incentives or policies to promote distributed energy resources (DER)

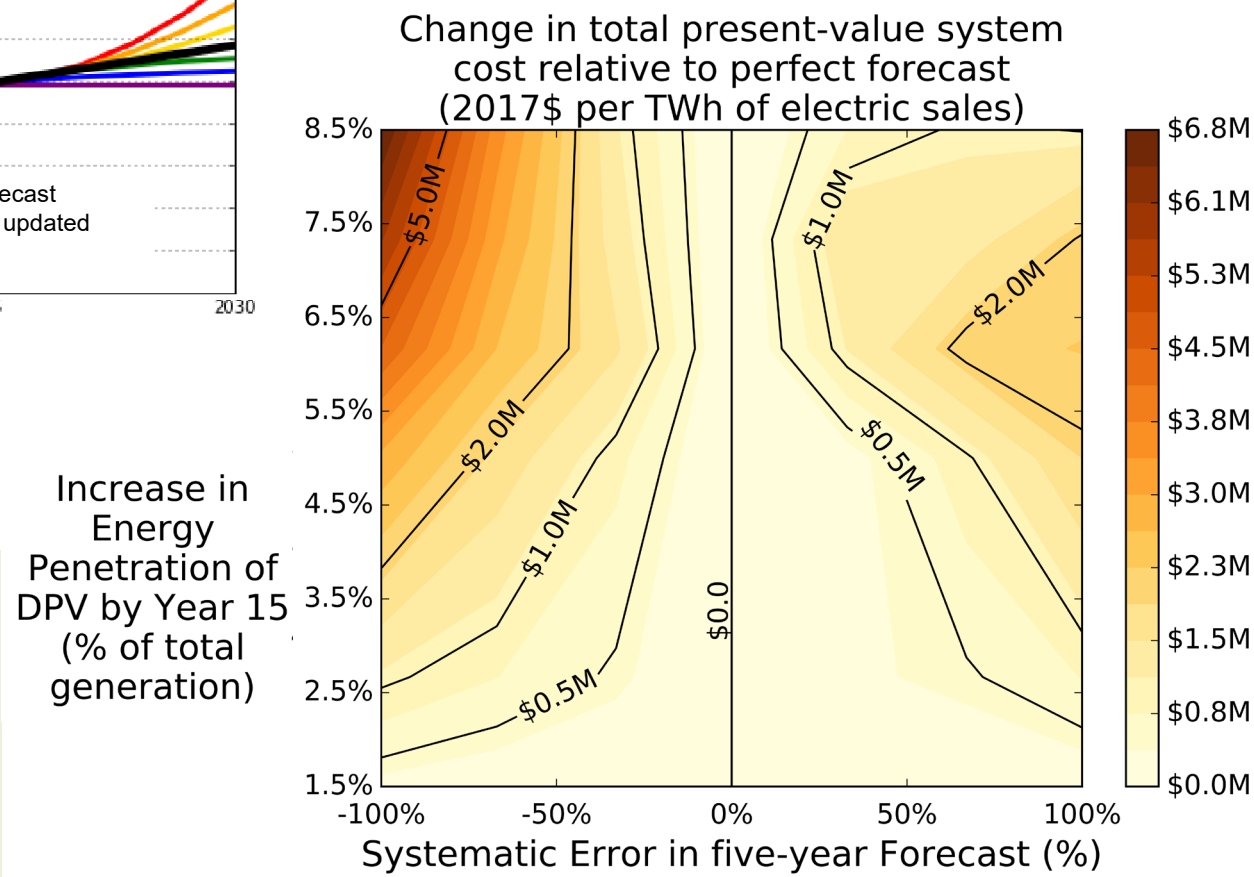
Impact of DPV on T&D Investments: Potential Deferral Value



Source: Adapted from Cohen et al. 2016

Increasing Adoption of DER Increases the Importance of Accurate Forecasts in Planning



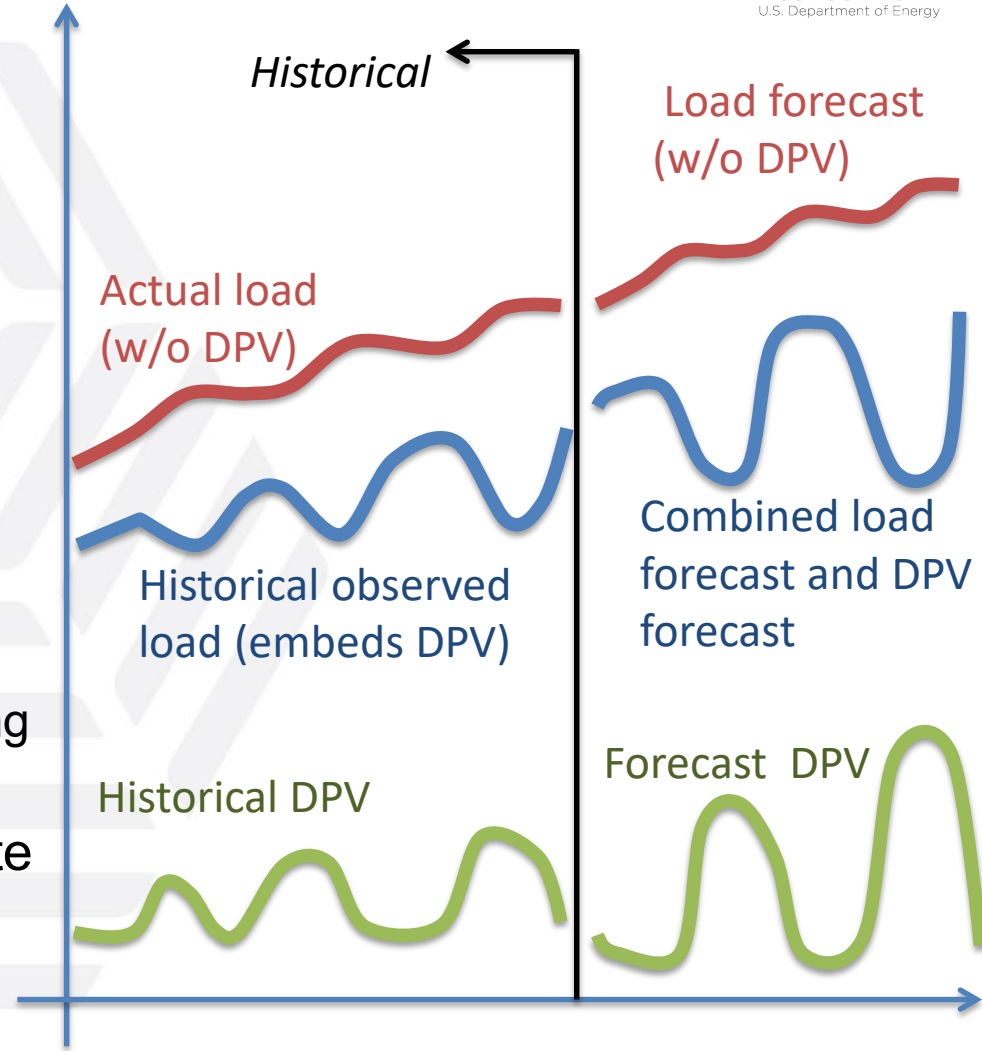


Costs of roughly **$70 million from severe underforecasting** and **$20 million from severe overforecasting** for a utility with sales >10TWh/yr and with up to 8.5% of sales from DPV by the end of a 15-year period

Source: Gagnon et al. (2018)

Additional Challenges: Removing DER from Historical Load to Create Accurate Load Forecasts

- PJM recently adjusted load forecasting methodology to better account for behind-the-meter PV
- Original approach used the observed load to forecast future load, without adjusting for effect of behind-the-meter DPV on the observed load
  - Load reductions from behind-the-meter DPV were being attributed to new end uses in the load forecasting model
- Revised approach removes estimate of historical PV before forecasting load, then adds back in forecast of DPV to new net load forecast



Additional detail: Falin (2015)

Forecasting Other Distributed Energy Resources

- Some DER are similar to DPV:
  - Systems can be installed either in-front-of or behind-the-meter
  - Adoption can occur for residential, commercial, or industrial customers
- These technologies have yet to see significant adoption due to higher cost or other barriers, but adoption might increase in the future. Similar forecasting tools and models can be used for these emerging technologies.
- Other DER systems are different in that the system cost, performance, and design are specific to individual customers and systems tend to be larger (e.g., combined heat and power units).
- In these cases, local knowledge from distribution planners might be more useful than top-down methods.

Tools Available Now to Develop Forecasts

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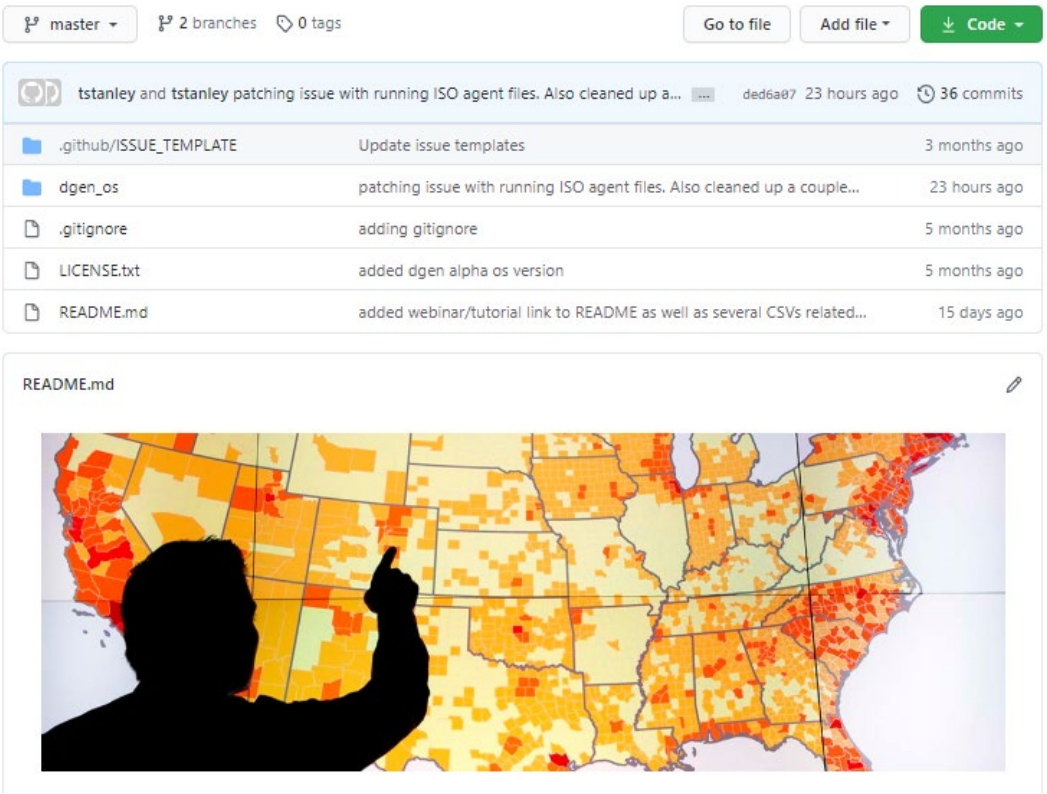
- NREL was funded by U.S. DOE to develop the open-source dGen DER customer adoption model:

  https://github.com/nrel/dgen

- Working with planning staff from all seven ISO/RTOs to develop joint forecasts, develop capacity, and improve methodology

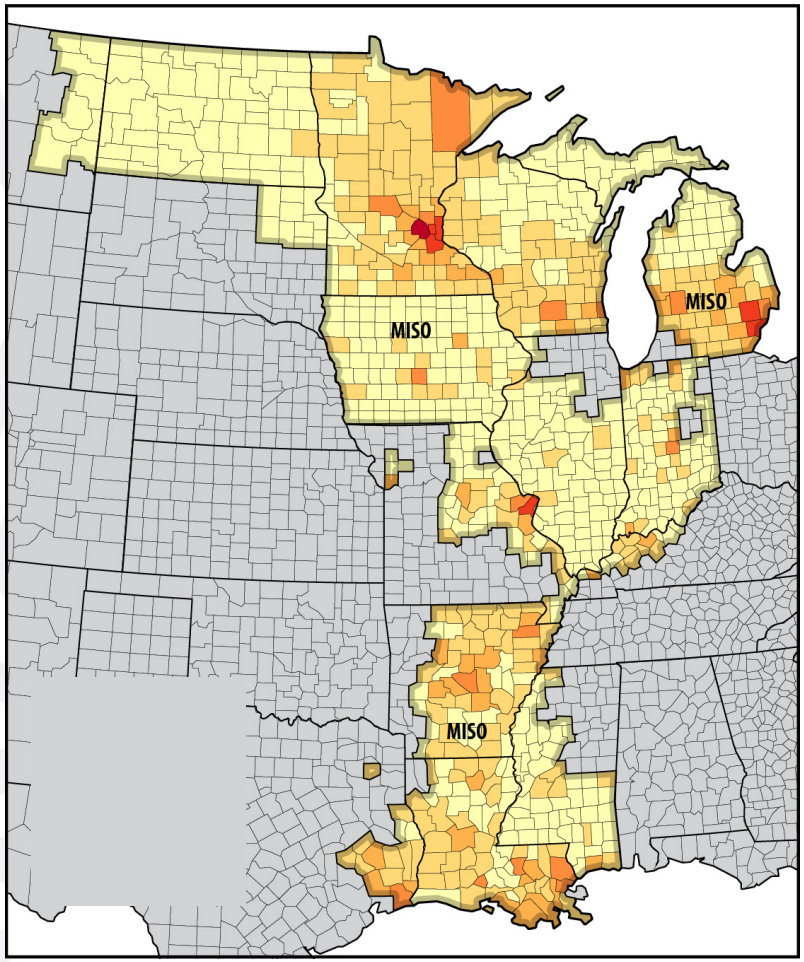
- More info: http://www.nrel.gov/analysis/dgen

- Looking for additional partners for 2020 - 2021



MISO Results

- Developed projection of DPV capacity in 2038 in collaboration with MISO staff (*pending publication*)
- Working with MISO staff to develop capability to use dGen in long-term planning studies
- Also working with MISO to transfer the dGen MISO database — ideally, a resource that is maintained by MISO stakeholders
- State-level databases and forecasts also are available
- We want to work with you!



Projected DPV capacity for MISO in 2038 for Base Case. *Pending publication – Do not cite*

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Questions States Can Ask About Forecasting

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- What are the primary factors that drive your forecast of DER adoption? How do you consider customer economics and factors that might affect customer economics within the forecasting horizon?
- How do you account for the tendency for adoption of technologies to follow an S-shaped curve?
- How does your forecast compare to forecasts from third parties for the same region?
- How do you account for factors that might be uncertain such as availability of future incentives, technology cost, or customer choice?
- Do you use a top-down method to forecast DER adoption at the system level? If so, how do you allocate that forecast down to the distribution level? Do you account for differences in customer demographics?

Resources for More Information

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- Gagnon, P., G. Barbose, B. Stoll, A. Ehlen, J. Zuboy, T. Mai, A. Mills. 2018. *Estimating the Value of Improved Distributed Photovoltaic Adoption Forecasts for Utility Resource Planning.* NREL/TP-6A20-71042. Golden, CO: National Renewable Energy Laboratory; Berkeley, CA: Lawrence Berkeley National Laboratory.
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- Navigant Consulting, Inc. 2016a. *Virginia Solar Pathways Project: Study 1 - Distributed Solar Generation Integration and Best Practices Review.* Richmond, VA: Dominion Virginia Power.
- Pacific Gas & Electric. 2015. Distribution Resources Plan. San Francisco, CA: California Public Utilities Commission. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5141

Hosting Capacity and Interconnection

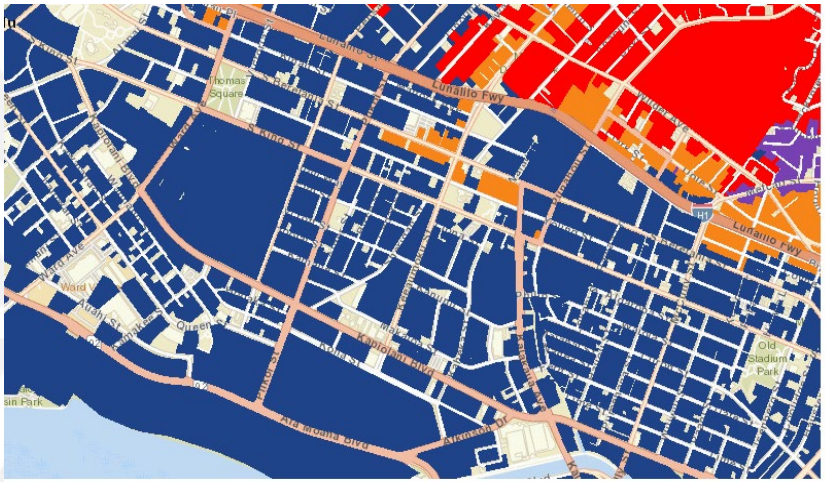
Patrick Dalton, ICF

Key Takeaways

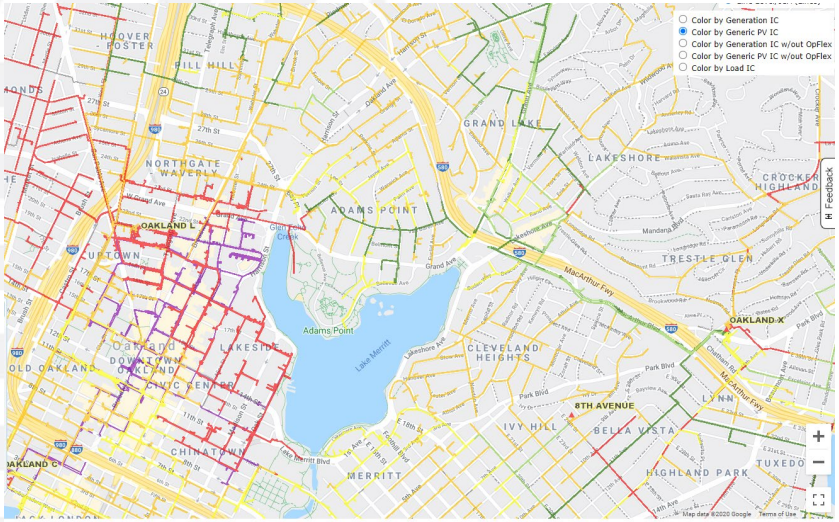
- Defining objectives and use cases is critical for developing hosting capacity roadmaps
- A few fundamental methodologies are available, each with tradeoffs related to accuracy, complexity, and computational intensity
  - Underlying each method are the same basic power system analysis thresholds
- The types of analysis results, granularity, and system information varies significantly among utility implementations

What Is Hosting Capacity?

- The amount of DER that can be accommodated on distribution circuits with existing grid equipment and conditions while maintaining safety, reliability, and power quality.



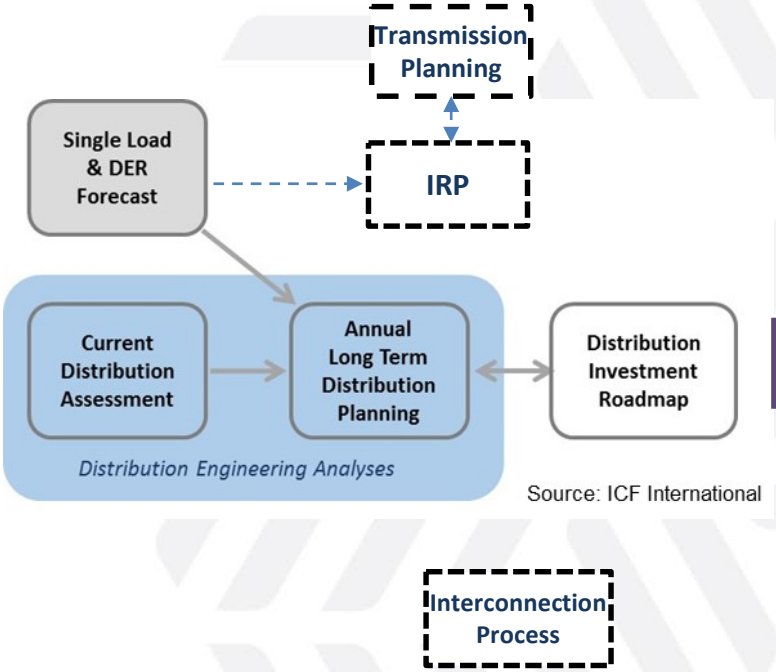
Source: HECO



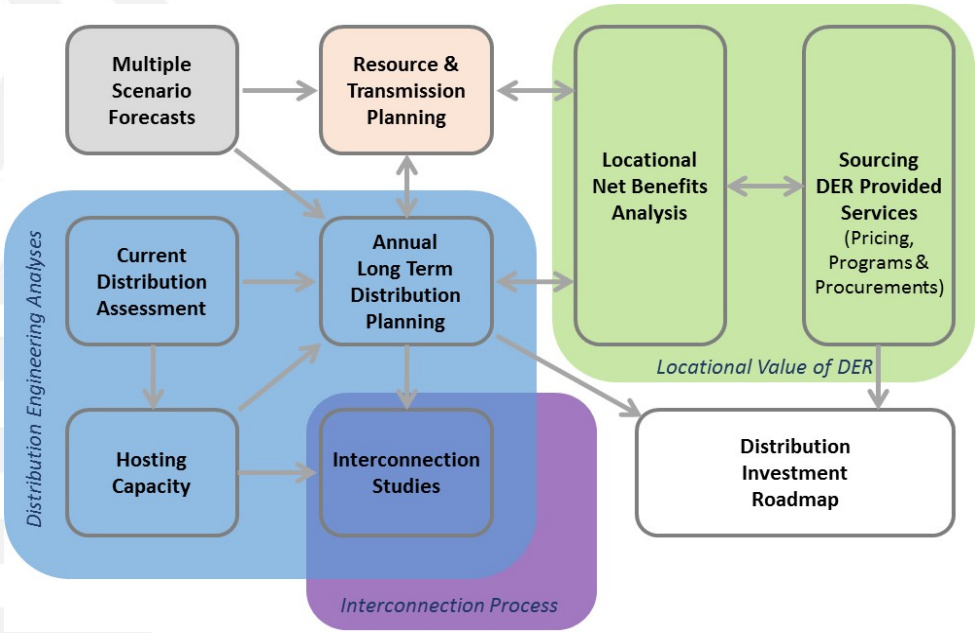
Source: PG&E

Hosting Capacity Is a Feature of Integrated Distribution Planning

Traditional Distribution Planning



Integrated Distribution Planning



Source: ICF International

Defining Use Cases Are a Key for Hosting Capacity

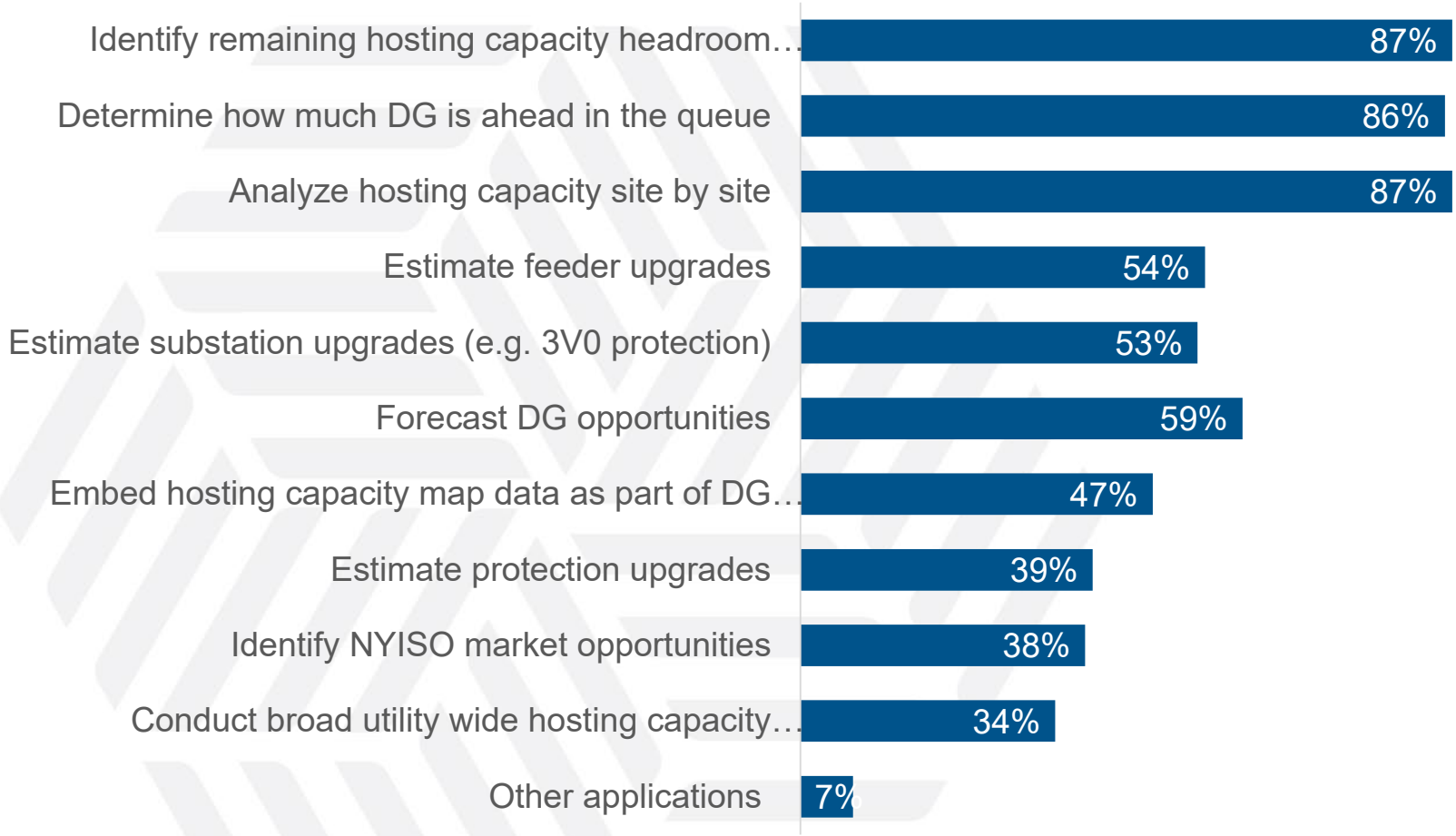
Use Case	Objective	Challenges
Informational Maps for Developers	**Guide DER to locations** with lower interconnection costs and potentially quicker analysis	Regularly updated analysis of the full system and data visualization to facilitate external use
Automate Technical Screening	**Accelerate the screening process** by using hosting capacity results to evaluate interconnection applications	High granularity required, model validation, on-demand updates, benchmarking to detailed studies
Distribution Planning Tool	**Inform locational value** and other Integrated Distribution Planning functions	Specific use cases undefined and evolving

Objectives and use cases are important for selection methodology

Benchmarking Hosting Capacity Use Cases

Use Case	Description	CA IOUs	NY IOUs	HI	Xcel	Pepco
Informational Map for Developers	HCA to identify areas with potentially lower interconnection costs	●	●	●	●	●
Automate Technical Screens	HCA to automate technical screens as part of the state interconnection process	●		●		●
Distribution Planning Tool	HCA to enable greater DER integration by identifying potential future constraints and locational value	●		●		

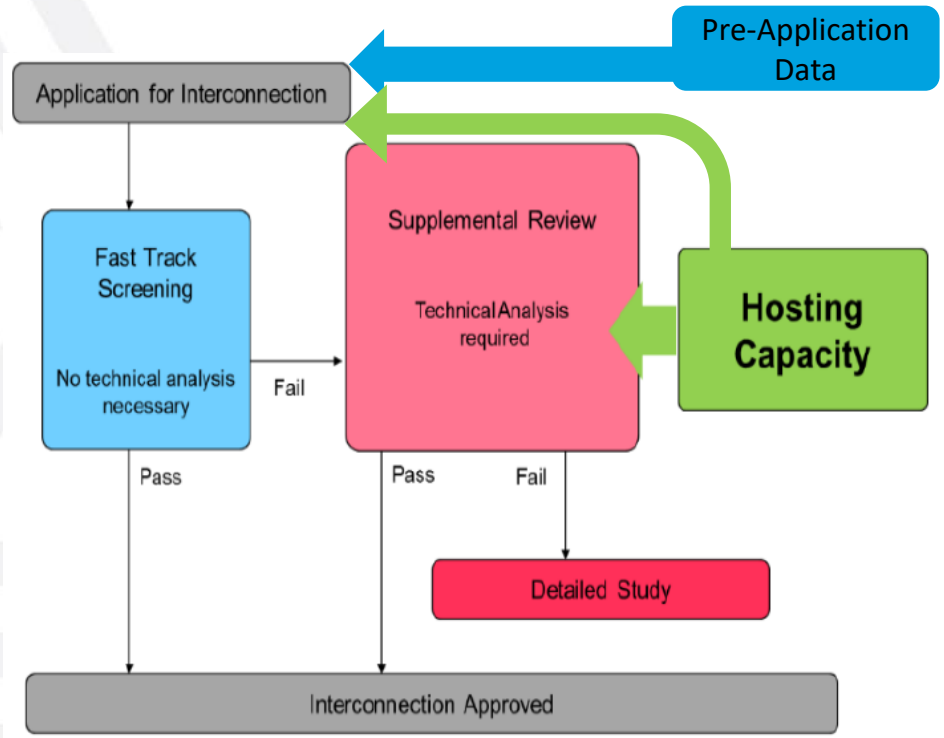
How Stakeholders Are Currently Applying the Hosting Capacity Maps in New York



Source: ICF, New York Joint Utilities Survey of 141 stakeholders (mostly PV developers), March 2020

Hosting Capacity within an Interconnection Technical Review Process

- Actionable information prior to application
- Streamline simplified applications through automated screening



Source: Electric Power Research Institute, Impact Factors, Methods, and Considerations for Calculating and Applying Hosting Capacity, 3002011009, Feb 2018.

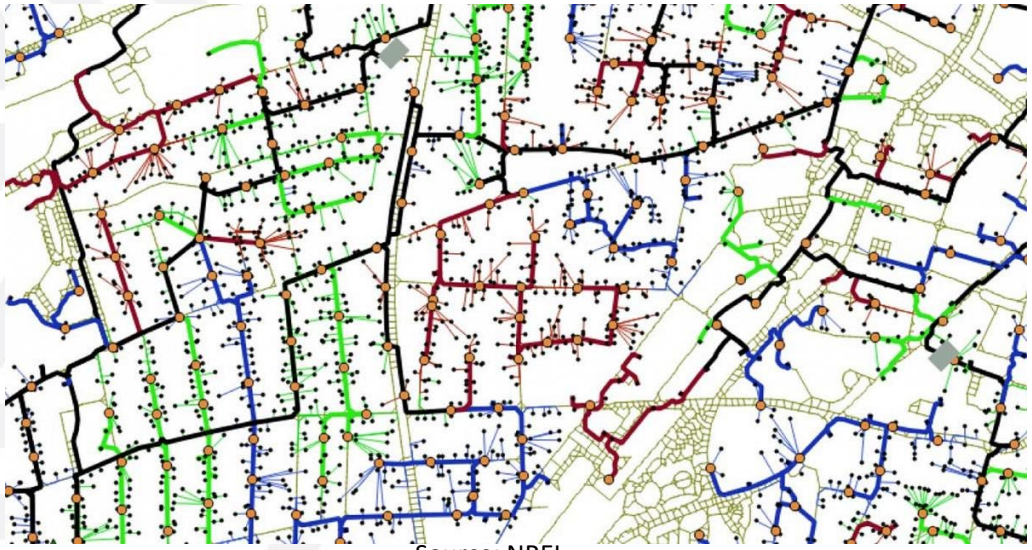
Hosting Capacity Analysis Methodologies

Method	Description	Example Tools
Streamlined	Simple algorithms for each system constraint	EPRI DRIVE
Iterative	Full power flow modeling run iteratively for each system location	Synergi, CYME
Stochastic	Adds DER of varying sizes at random locations to determine range of hosting capacity	Synergi

- Tradeoffs of accuracy and computational accuracy
- Interactive analysis is starting to be incorporated into commercial power flow software (CYME, Synergi)

Data Integrity Is a Persistent Challenge for Hosting Capacity

- Similar data challenge underlying other grid planning and operations modeling
- Data integrity increasingly important for automated screening or locational value use cases
- Example: SCE is developing an automated process to maintain model accuracy as changes to the system occur[1]



Source: NREL

[1] PG&E Appendix to ICA analysis, https://drpwg.org/wp-content/uploads/2016/07/ICA-WG-Final-Report.pdf

Criteria and Thresholds for Hosting Capacity Analysis

Common Hosting Capacity Thresholds

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Power System Planning and Analysis Criteria

Voltage
- Steady State
- Voltage Fluctuation

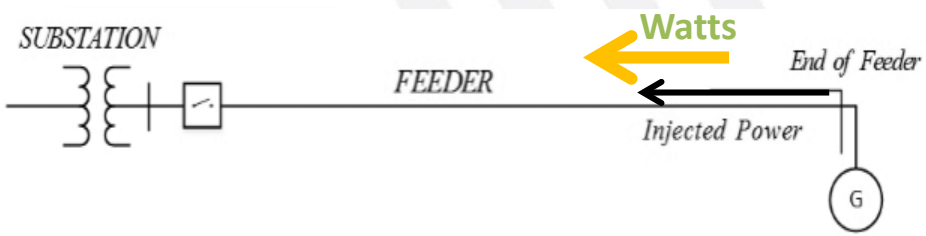
Protection
- Desensitization
- Unintentional Islanding

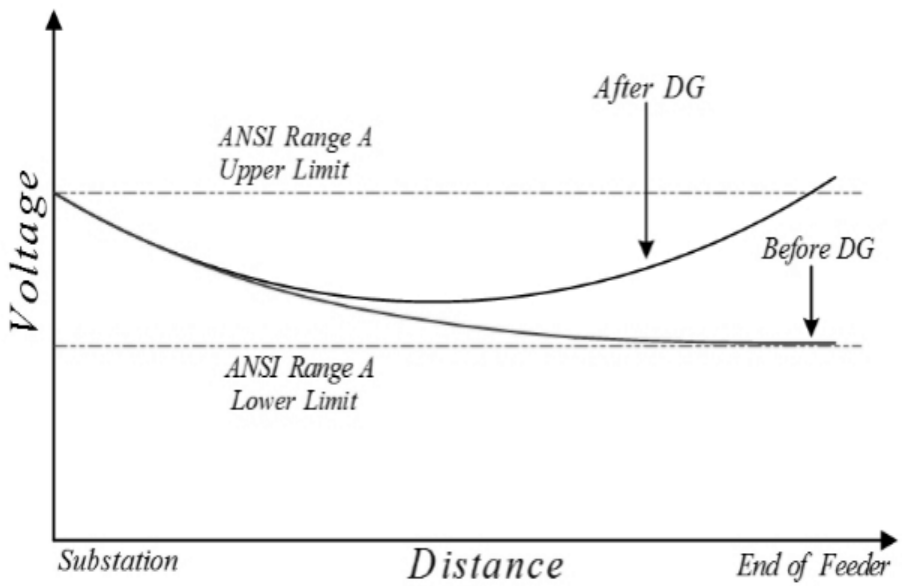
Thermal
- Equipment Ratings

Reliability
- Operational Flexibility
- Equipment Wear

Long-term (steady state) High Voltage Limits Screens for Standard Ranges

Voltage
- Steady State





- Based on widely adopted industry standard ranges (ANSI C84.1-2016)

Voltage Fluctuation Limits Screen for Power Quality Issues

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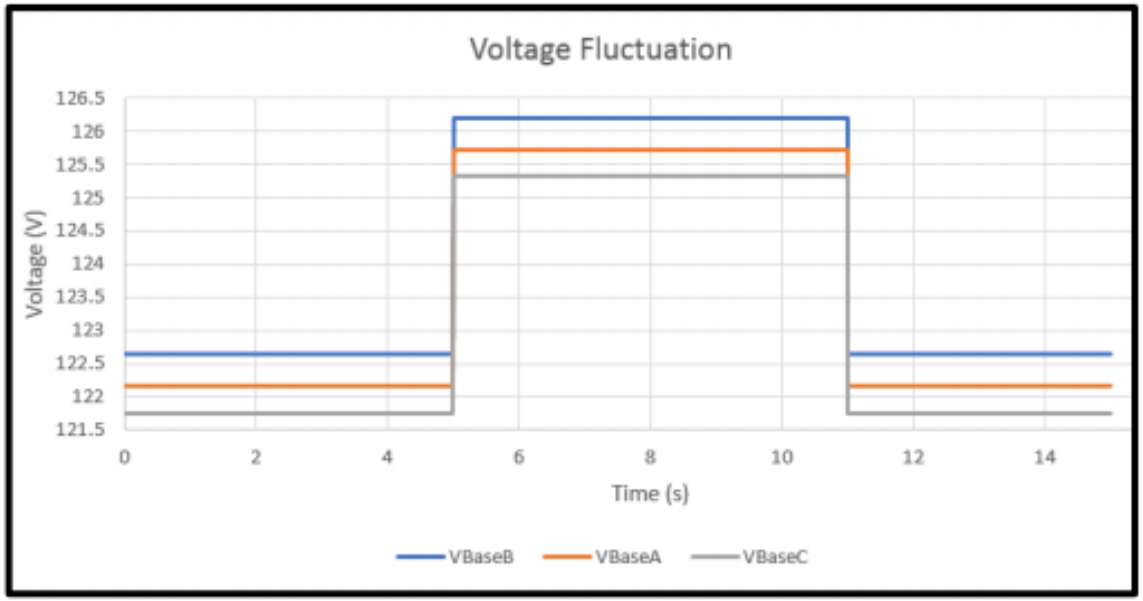
Voltage
- Voltage Fluctuation

- A voltage change of 3% is allowed by IEEE 1547-2018 for typical larger DER configurations[1]



[1] DER with the reference point of applicability (RPA) at a medium voltage level has a 3% RVC limit, while DER with an RPA at low voltage levels has a 5% RVC limit

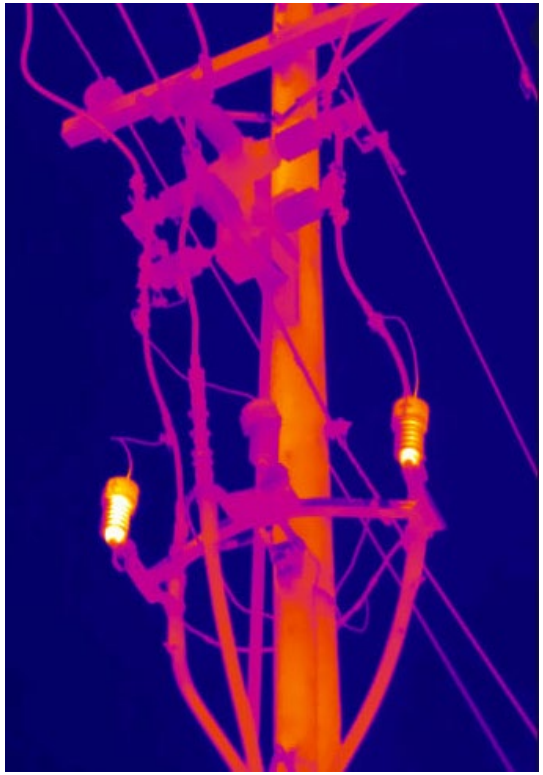
Thermal Limits Preserve Asset Health and System Reliability

- Calculated power flow across elements compared against equipment thermal ratings

- Equipment ratings typically rely on standard calculations with utility specific assumption (e.g., wind speed, ambient temperature, elevation)

Thermal

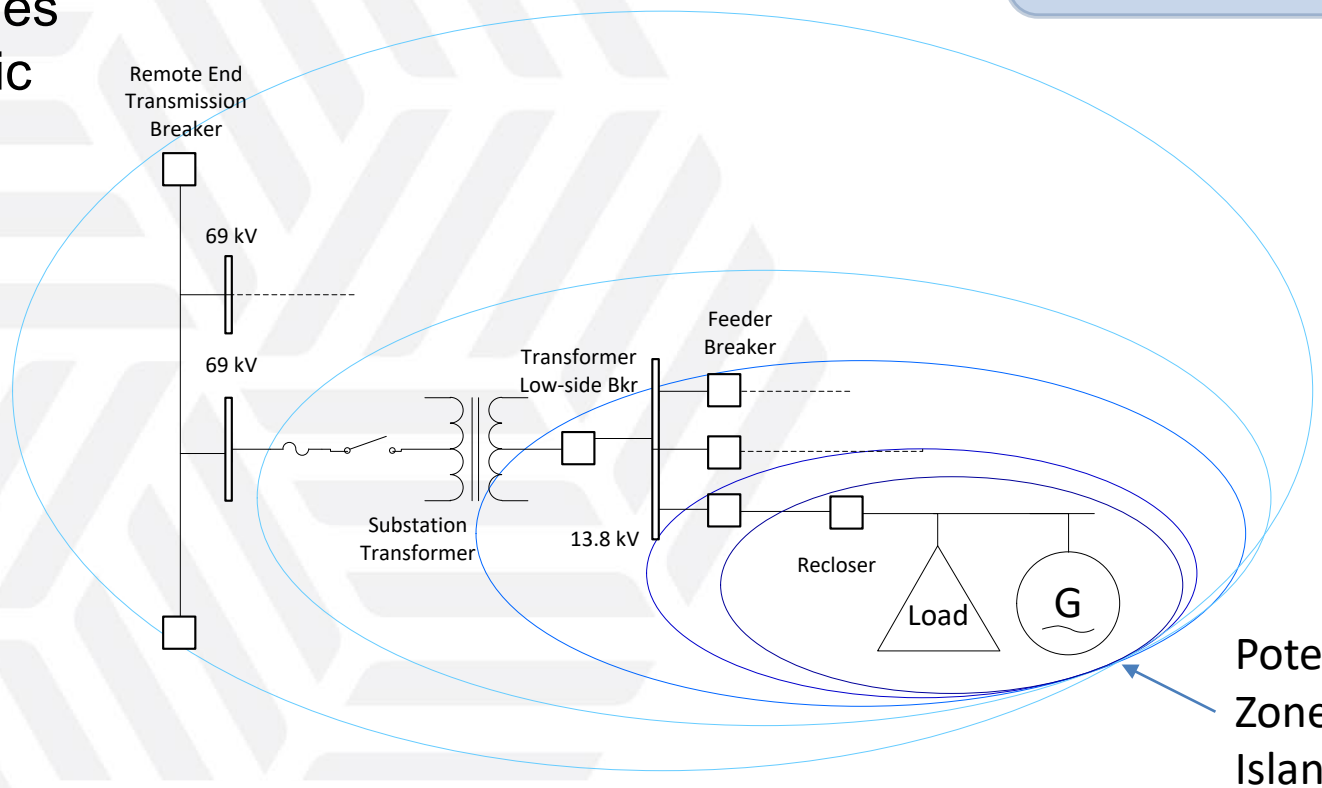
- **Equipment Ratings**



Unintentional Islanding Screens Analyze Potential Load and Generation Balance

Protection
- Unintentional Islanding

- Unintentional islanding zones with automatic reclosing devices pose greatest risk

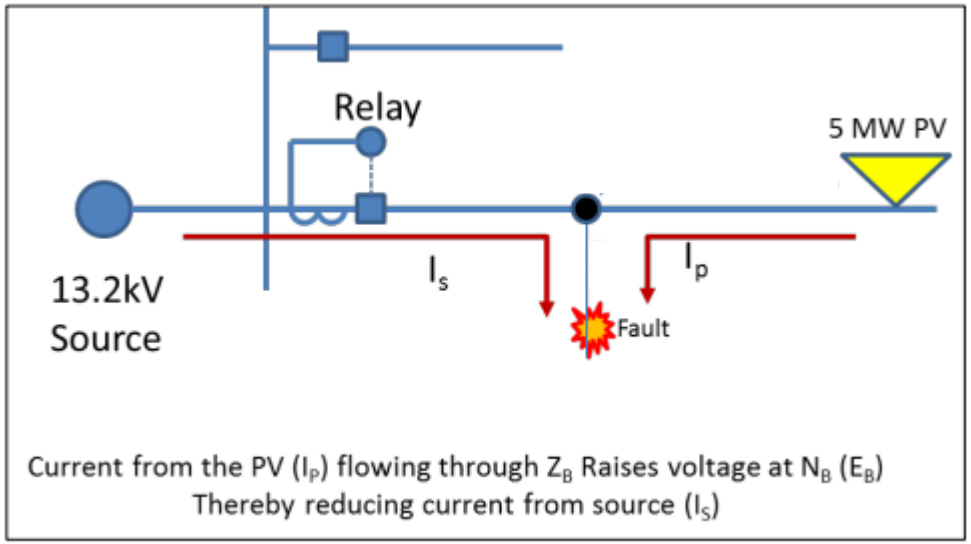


Potential Zones of Islanding

Protection Screens Review Level of "Relay Desensitization"

Protection
- **Desensitization**

- DER fault current props up voltage at fault
- Reducing current from the substation source
- Potentially below the relay pick-up level if not adjusted

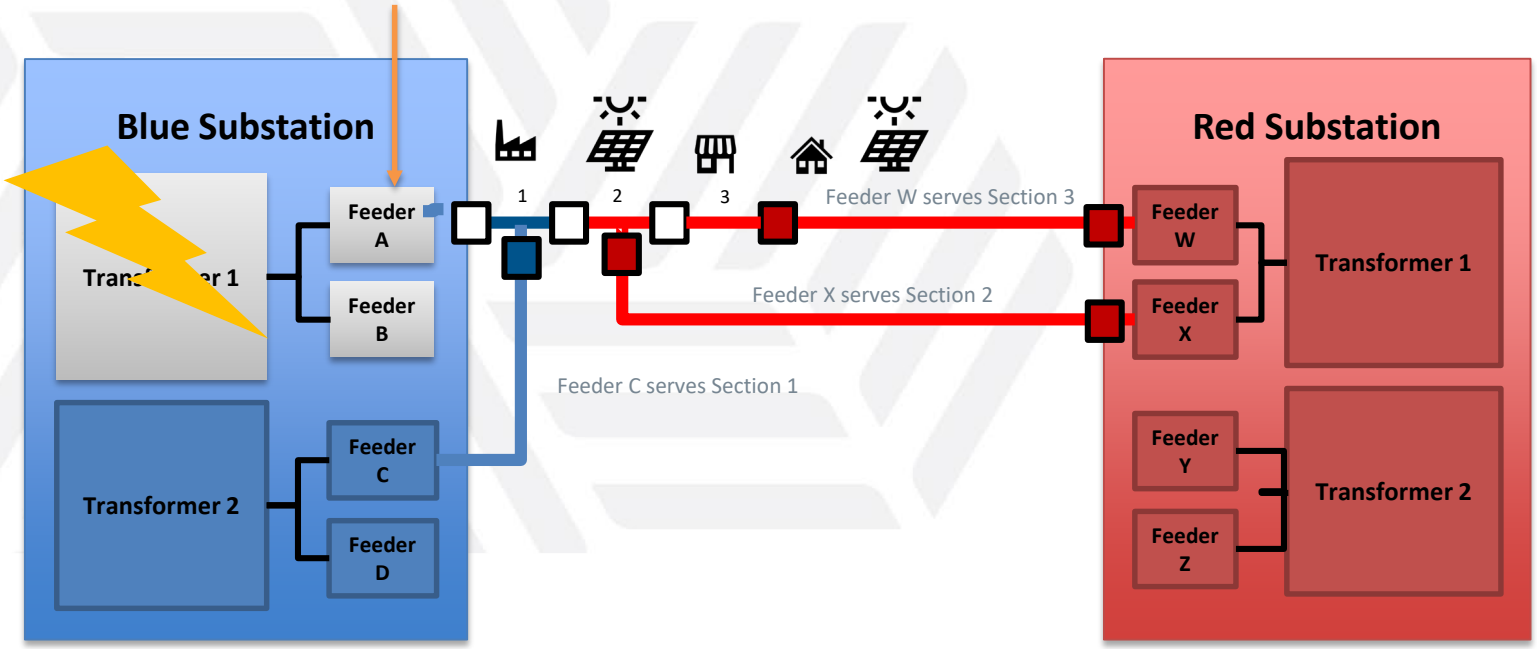


DOE SunShot, NREL High Penetration PV Integration Handbook For Distribution Engineers

Operational Flexibility Screens Show Capacity While Still Allowing for Feeder Reconfiguration

Reliability
- Operational Flexibility

Customers normally on Feeder A are being served by three different feeders



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Impacts to Voltage Regulation Devices Are Often Included in Hosting Capacity

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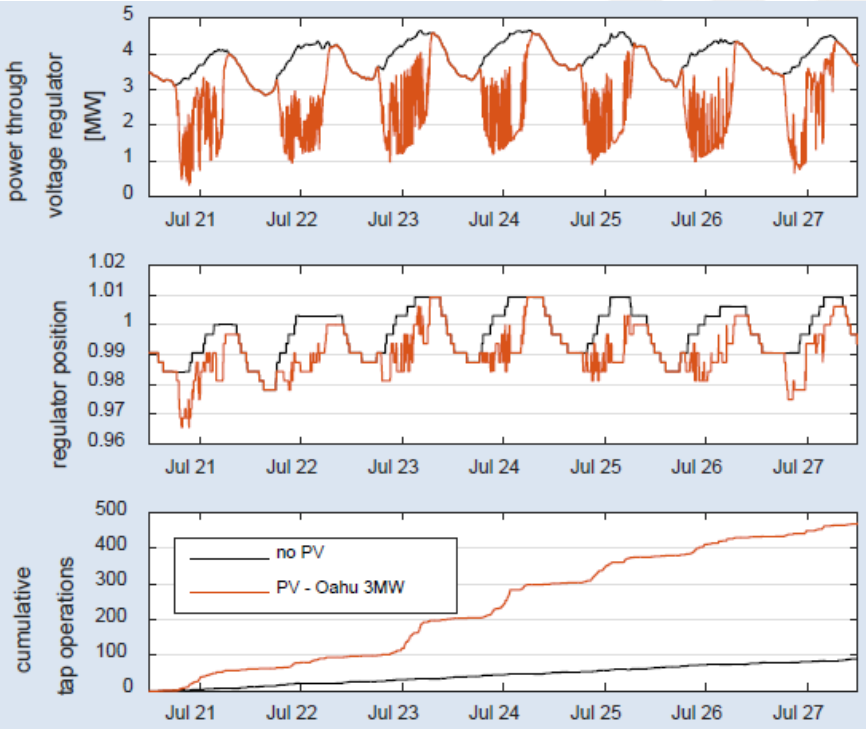
Reliability
- Equipment Wear



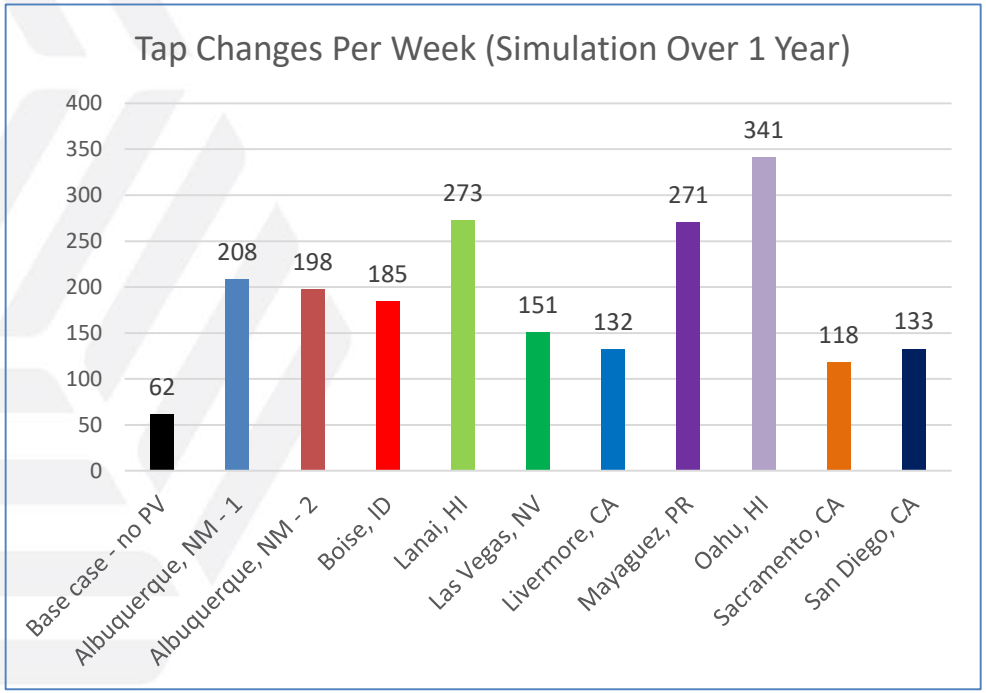


Image and bar chart adapted from: NREL, Sandia National Lab, MIT, On the Path to SunShot: Emerging Issues and Challenges in Integrating Solar with Distribution System, May 2016.

Features of Hosting Capacity Maps

Existing Hosting Capacity Analyses Often Include Common Features

- Pop-up information
  - Feeder load
  - Exiting DER
  - DER in queue
- Inclusion of PV and non-PV
- Inclusion of load or EV analysis
- Locational Value
- Downloadable analysis results and load curves
- Range of Security: Registration, terms and conditions, etc.

Current Hosting Capacity Implementations Are Diverse

Utility	Analysis Method			Features				
	Streamlined	Iterative	Stochastic	Load/EV	PV	Circuit Location	Pop-ups	Locational Value
ComEd			●					
HECO		●			●			
NY JU[1]	●				●	●	●	
NV Energy		●		●	●	●	●	●
PEPCO			●		●	●	●	
PG&E	●			●	●	●	●	
PGE	●							
SCE		●		●	●	●	●	●
SDG&E		●		●	●	●	●	●
Xcel	●						●	

[1] NY JU includes ConEdison, National Grid, Orange and Rockland, Central Hudson, and NYSEG/RG&E

A Trend towards Pop-Up Windows for Additional Information

(1 of 2)

Feeder Level Data

Substation	ELSMERE
Master CDF	36_30_40771
Anti-Islanding Hosting Capacity Limit (MW)	0.48
Local Voltage (kV)	4.80
Local Maximum Hosting Capacity (MW)	3.67
Local Minimum Hosting Capacity (MW)	3.05
DG Connected (MW)	0.12
DG in Queue (MW)	0.01
LOAD ZONE	F-4
HCA Refresh Date	September 9, 2019
DG Connected/In Queue Refresh Date	September 9, 2019
DG Installed Since Last HCA Refresh (MW	0.50
Notes	Fed from NYSEG/RG&E

(1 of 2)

Substation Level Data: ELSMERE

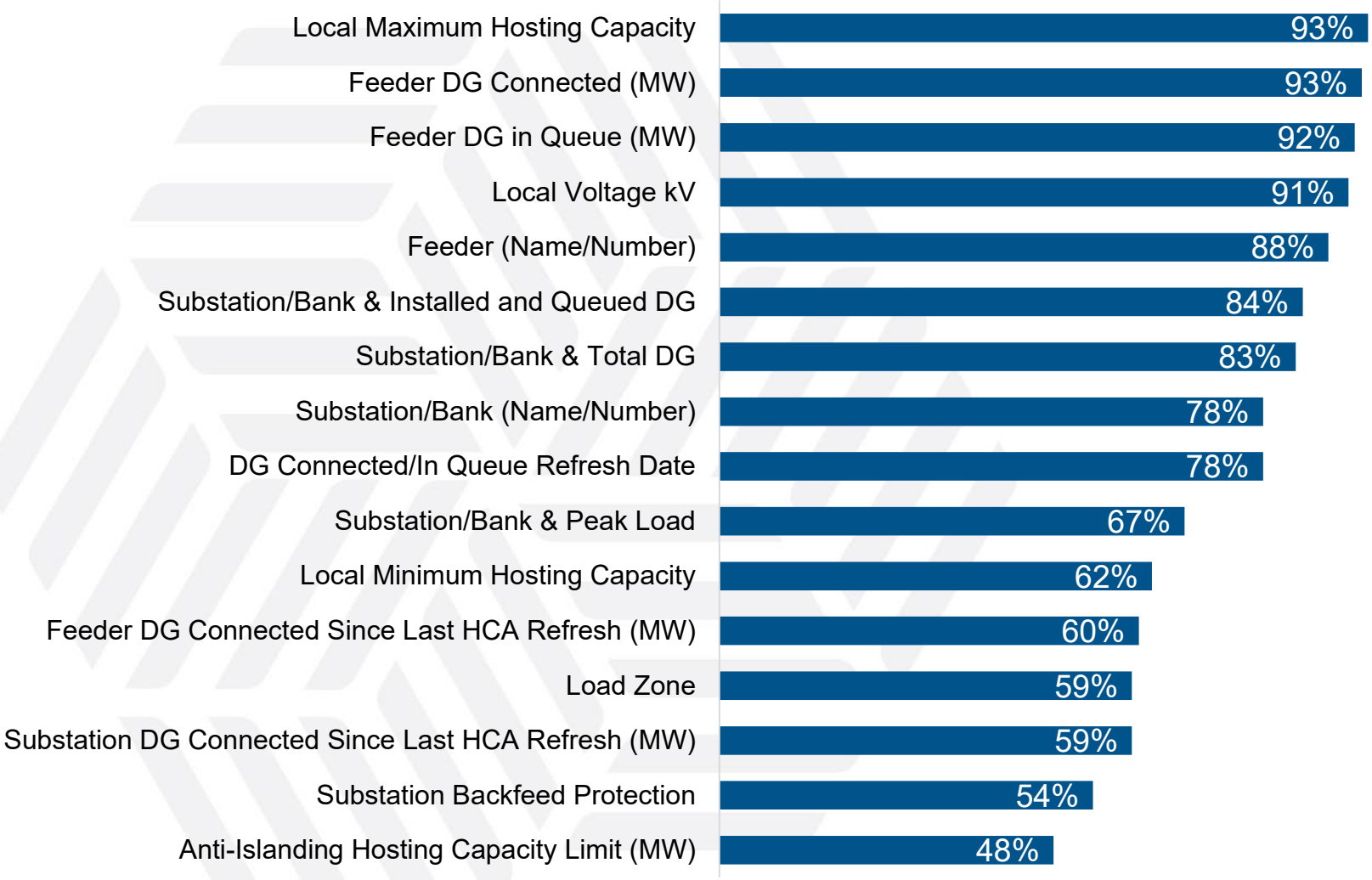
Substation/Bank Name	ELSMERE
Substation/Bank Installed DG (MW)	0.17
Substation/Bank Queued DG (MW)	0.01
Substation/Bank Total DG (MW)	0.18
2018 Substation/Bank Peak (MW)	4.90
Substation/Bank Thermal Capacity	6.00 MW
Estimated 3V0 Protection Threshold	1.25 MW
Substation Backfeed Protection	No
DG Connected/In Queue Refresh Date	September 9, 2019
HCA Refresh Date	September 9, 2019

Zoom to

Stage 3.0 — Stage 3.1

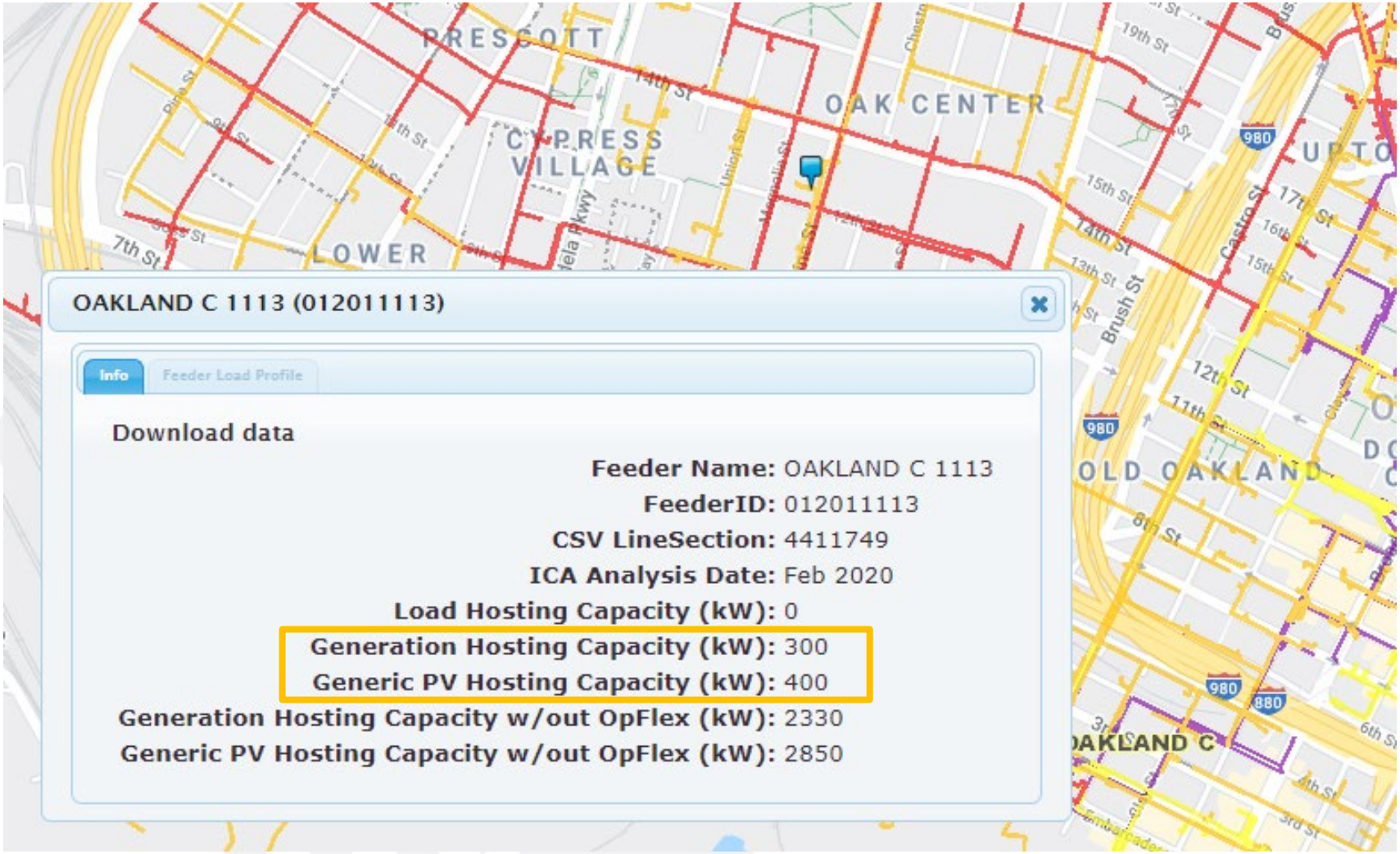
Source: NYSEG/RG&E

Additional Pop-Up Data Most Useful to New York Stakeholders



Source: ICF, New York Joint Utilities Survey of 141 stakeholders (mostly PV developers), March 2020

Some Hosting Capacity Analyses Consider Specific PV Output Profiles



Source: PG&E

EV/Load Hosting Capacity is an Emerging need for Beneficial Electrification

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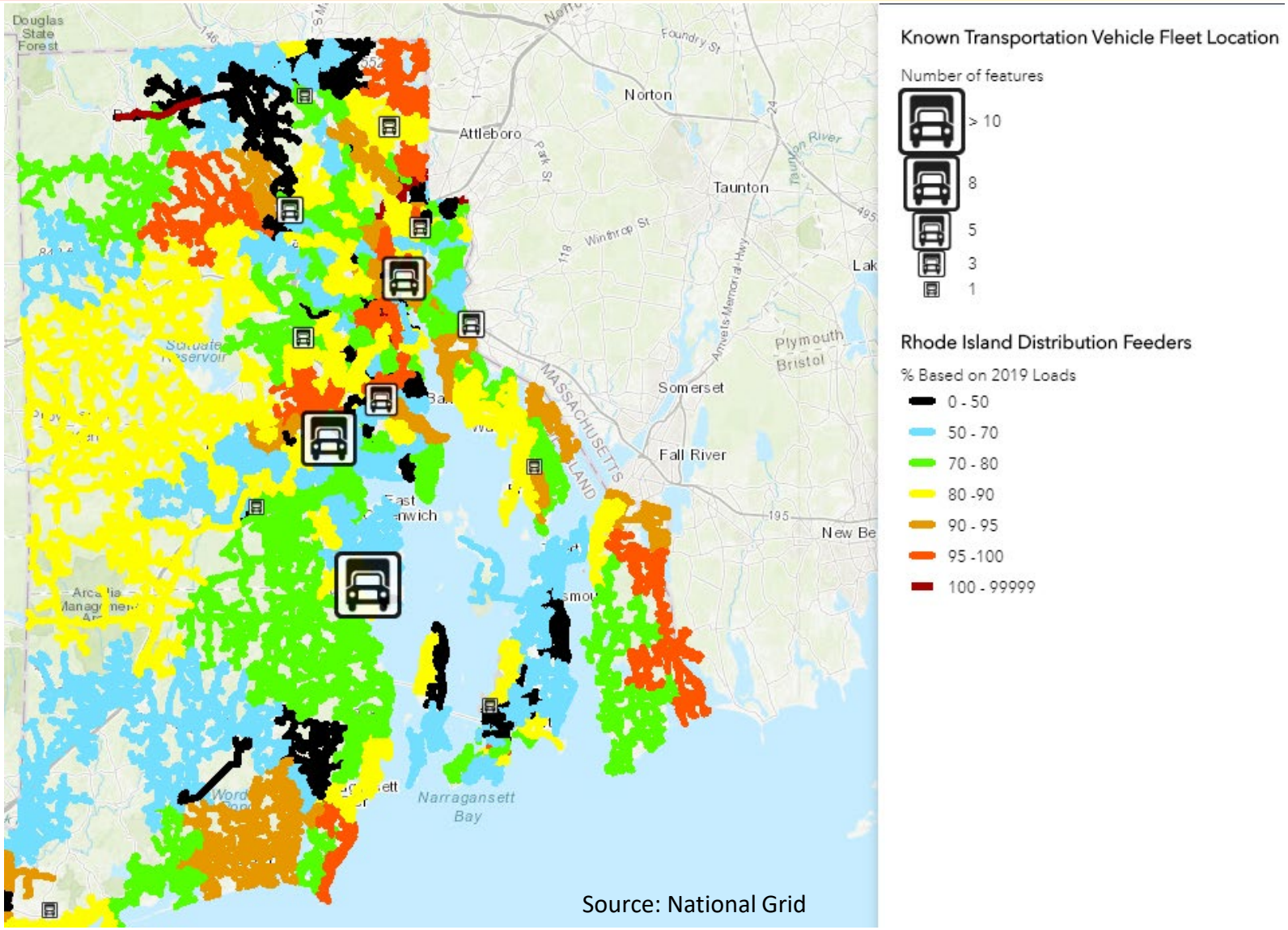
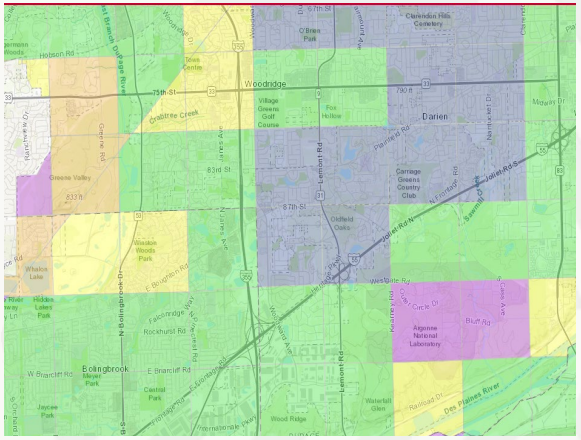
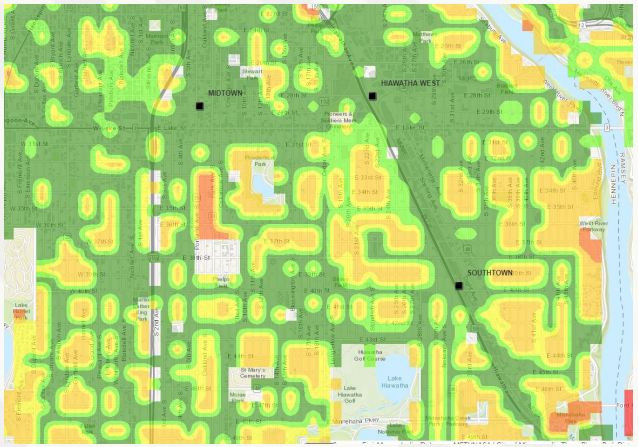


Source: National Grid

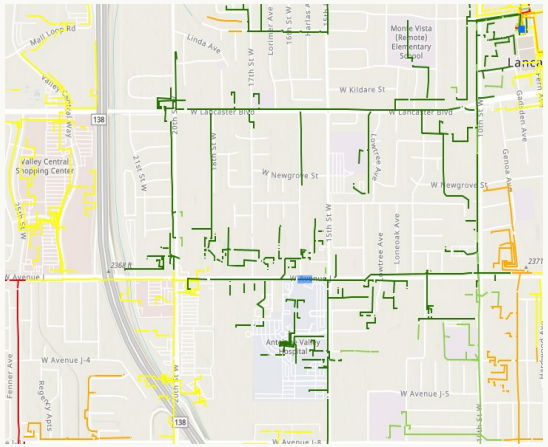
Current Hosting Capacity Maps Have Range of Circuit Granularity



Source: ComEd



Source: Xcel Energy



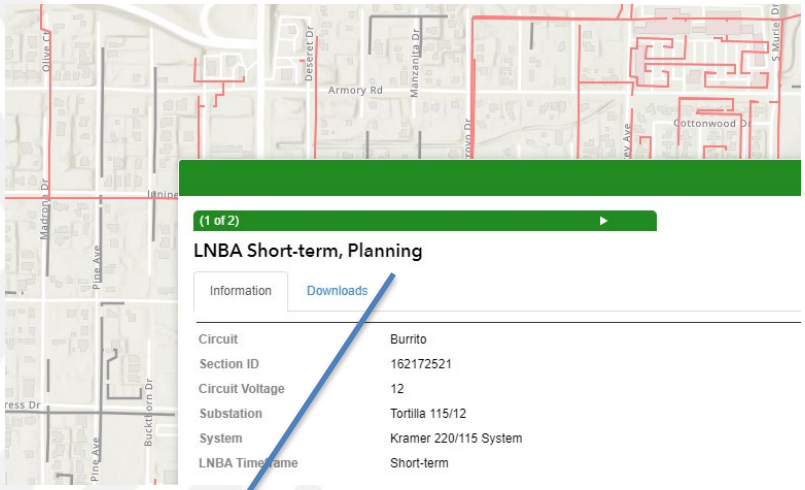
Source: SCE

Less Granular ⟷ More Granular

Locational Value Is Incorporated in Some Hosting Capacity Maps

- Locational value informs where DER could defer distribution reinforcements and the value on $/MW and/or $/MWh basis

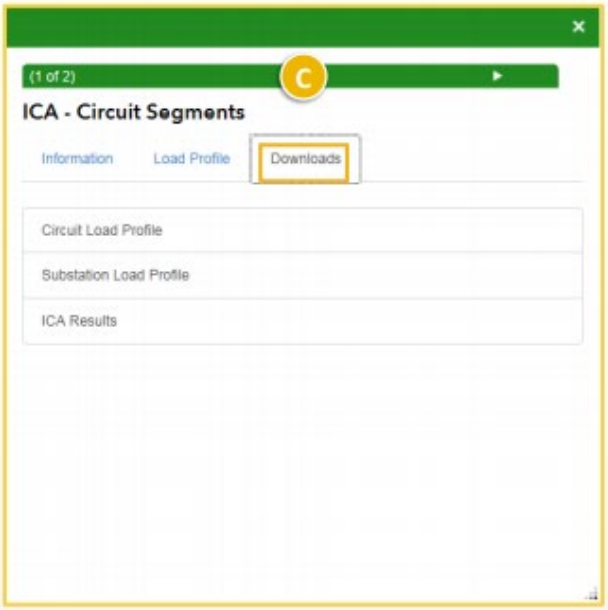
- Example: Southern California Edison map



Project	DER Scenario	Time Period (Short, Medium, Long Term)	LNBA Result ($/MW-yr)	LNBA Result ($/MWh-yr)	LNBA Result ($/MWh-day)
Increase Circuit Capacity, Underground Cable Temperature Mitigation, New Circuit at Saugus 66/16 kV Substation	Planning	Mid-term	48,927.63	23.79	6,120.67
Underground Cable Temperature Mitigation at Limestone 66/12 kV Substation	Planning	Mid-term	57,185.13	1,779.27	26,689.11
Increase Substation Capacity, New Substation, Underground Cable Temperature Mitigation, New Circuit at Saugus 66/16 kV Substation	Planning	Long-term	103,232.50	38.50	10,494.43

Source: SCE

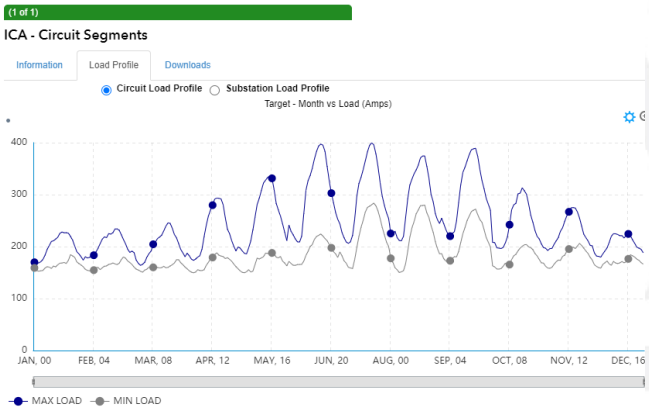
Several Hosting Capacity Maps Allow Users to Download Results and Load Profiles



- **Circuit Load Profile**
  - Circuit Name
  - Voltage
  - Year
  - Month
  - Minimum Load (MW)
  - Maximum Load (MW)
  - Substation Name
  - Month Label
  - Object ID #
- **Substation Load Profile**
  - Year
  - Month
  - Hour
  - Substation Name
  - Minimum Load (MW)
  - Maximum Load (MW)
  - Object ID #

ICA Results

- Circuit Name
- Node ID
- Month
- Hour
- Load Profile
- Uniform Generation Operational Flexibility (kW)
- Uniform Generation (kW)
- Solar PV Operational Flexibility (kW)
- Solar PV (kW)
- Thermal (kW)
- SSV (kW)
- Voltage Fluctuation (kW)
- Protection (KW)
- ICA Operational Flexibility (kW)
- Uniform Load (kW)
- Thermal Load (kW)
- Volt Variation Load (kW)
- SSV Load (kW)



https://ltmdrpep.sce.com/drpep/

Hosting Capacity Challenges and Limitations

- Data Integrity
- Substation and transmission level constraints
- Urban downtown secondary networks
- Secondary and service conductors for rooftop PV
- Smart inverter functions and settings

Questions States Can Ask About Hosting Capacity

- What is the goal or use case for your utility?
- Does HC provide value in this use case?
- Is the HC method appropriate for the use case and the available data?
- Does the utility have appropriate data so that results are meaningful and accurate?
- How will results be communicated to developers and other stakeholders?
- What is the cost of doing this analysis in terms of engineering labor and money? Are the costs outweighed by the benefits?

Resources for More Information

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

- NREL, Hosting Capacity for Policy Makers, 2019
https://www.nrel.gov/docs/fy19osti/74383.pdf

- NREL, Advanced Inverters (1547) capabilities, experiences, and interactions with hosting capacity, 2019
https://www.nrel.gov/docs/fy19osti/73449.pdf

- Minnesota Department of Commerce, Enhanced Hosting Capacity Analysis, 2018
http://mnsolarpathways.org/hostingcapacity/

- California Distributed Resource Plan (R.14-08-013) Integration Capacity Analysis Working Group Final ICA WG Long Term Refinements Report
https://drpwg.org/wp-content/uploads/2018/01/ICA-WG-LTR-Report-Final.pdf

- IREC, Optimizing the Grid: Regulators Guide to Hosting Capacity Analyses for Distributed Energy Resources, 2017
https://irecusa.org/publications/optimizing-the-grid-regulators-guide-to-hosting-capacity-analyses-for-distributed-energy-resources/

Thank you!

Patrick Dalton
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Locational net benefits, non-wires alternatives, and DER sourcing

Debbie Lew

Debra Lew LLC

Integrated Distribution System Planning Training for Midwest/MISO Region
October 13-15, 2020

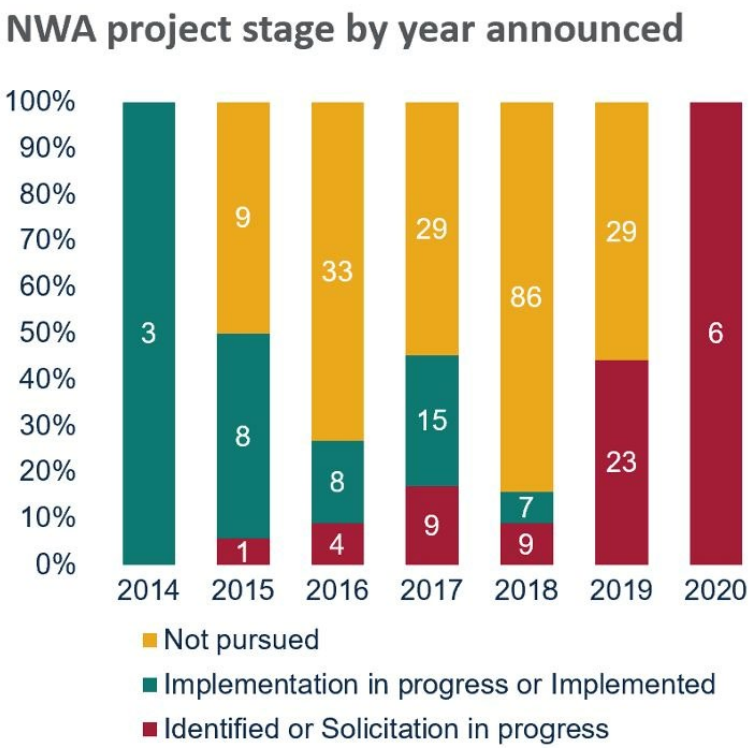
Implementation and compensation for DERs

- There is no one-size-fits-all answer
  - Value that DERs bring vs. avoided costs to utility vs. compensation earned
  - DER types: distributed generation, load modifiers, storage
  - Range from larger procurements to organic uptake of DERs
  - DERs can provide a specific service at a specific time at a specific location
- Compensation mechanisms include:
  - Net metering
  - Value of solar or value of DER or feed-in tariffs
  - Rate design
  - Programs and incentives
- Non-wires alternatives (NWAs) – grid investment using non-traditional T&D solutions to defer or replace the need for upgrades
  - Locational net benefits analysis (LNBA — avoided cost of traditional utility solution) helps prioritize projects

Procurement, Pricing, Programs

Procurement

NWAs are hot – but implementation is slow

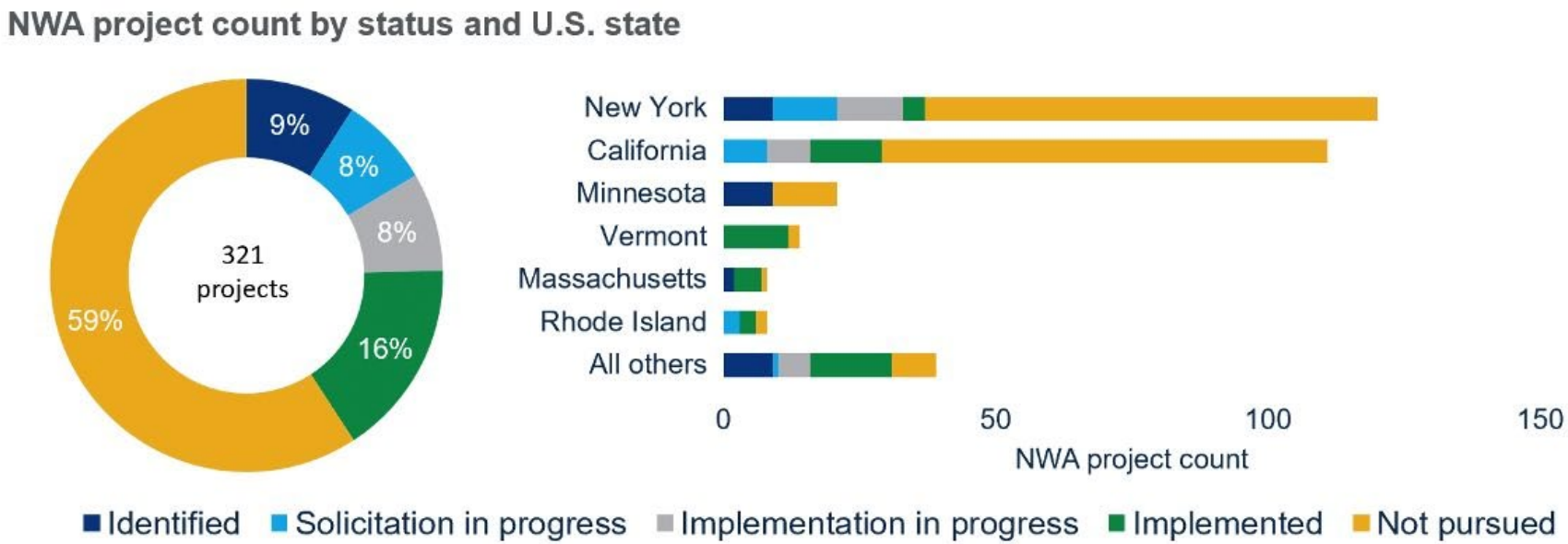


Source: Wood Mackenzie Grid Edge service, Wood Mackenzie Data Hub

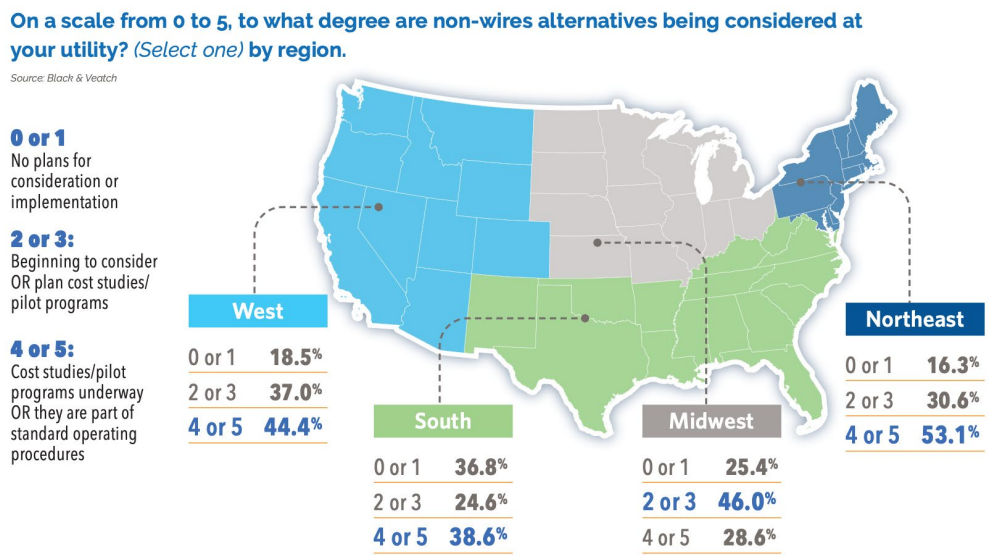
- ~850 MW of NWAs have been identified or implemented in the US
  - Projects only move forward 40% of the time and the number of identified opportunities that are implemented is shrinking
  - Cost and reliability are key reasons for projects not going forward
  - Front-of-the-meter batteries are most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

Wood Mackenzie in GTM, "US non-wires alternatives H1 2020: Battery storage seizes top spot as utilities' preferred non-wires resource", 2020.

Where is the growth in NWAs?



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



Wood Mackenzie in GTM, "US non-wires alternatives H1 2020: Battery storage seizes top spot as utilities' preferred non-wires resource," 2020; Black and Veatch, "2020 Strategic Directions: Smart Utilities Report,"2020.

CPUC's Distribution Investment Deferral Framework (DIDF)

- Process to consider NWAs
- Review historical peak demand data
- Disaggregate load and DER forecasts
- Identify grid needs
- Develop utility-owned projects to solve these needs
- Project screening (3 years to identify project, CPUC approval, solicitation, interconnection study, permits, procurement, installation, operation)
  - Timing
  - Technical
- Prioritization
  - Cost-effectiveness (LNBA $/kW-yr and $/MWh-yr)
  - Forecast certainty
  - Market assessment

Table 4: Summary of Grid Needs by Distribution Service Type and Region

Region	Distribution Service						Total
	Capacity	Capacity (UCT)	Reactive Power	Reliability, Capacity	Reliability, Voltage	Voltage	
Desert	11	20	7	4	2	0	**44**
Metro East	7	25	7	2	0	0	**41**
Metro West	27	14	15	1	0	1	**58**
North Coast	12	14	2	4	0	2	**34**
Orange	0	10	2	5	0	0	**17**
Rurals	15	8	7	1	0	8	**39**
San Jacinto Valley	5	8	2	3	0	2	**20**
San Joaquin	1	5	1	1	0	1	**9**
Total	**78**	**104**	**43**	**21**	**2**	**14**	**262**

Table 23: Summary of Candidate Deferral Opportunities by Project Type and Region

Region	Project Type					Total
	Subtrans. Line	Subtrans. Substation & Subtrans. Line	Subtrans. Substation	Dist. Sub & Dist. Feeder	Dist. Feeder	
Desert Region	0	0	0	0	3	**3**
North Coast Region	2	0	0	1	2	**5**
Orange Region	0	0	0	0	1	**1**
Rurals Region	2	0	1	0	0	**3**
San Jacinto Valley Region	0	1	0	0	1	**2**
Total	**4**	**1**	**1**	**1**	**7**	**14**

Table 30: SCE's 2020 Candidate Deferral Project Summary

Tier	Project	Cost Effectiveness	Forecast Certainty	Market Assessment
1	Alberhill System Project (ASP)			
	New Circuit at Elizabeth Lake Substation			
	New Circuit at El Casco Substation			
	New Circuit at Sun City Substation			
2	Saugus-Colossus-Lockheed-Pitchgen Subtransmission Line Reconductor[78]			
	Saugus-Elizabeth Lake-MWD Foothill Subtransmission Line Reconductor[79]			
3	Slate Circuit Line Reconductor			
	New Circuit at Garnet Substation			
	New Circuit at Farrell Substation			
	New Circuit at Saugus Substation			
	Capacitor Addition at Edwards Substation			
	Kramer-Calcity / Holgate-Calcity Subtransmission Line Reconductor			
	Del Valle 66/16 kV Substation Project			
	Kramer-Edwards Subtransmission Line Project			

SCE, "Grid Needs Assessment and Distribution Deferral Opportunity Report," August 17, 2020

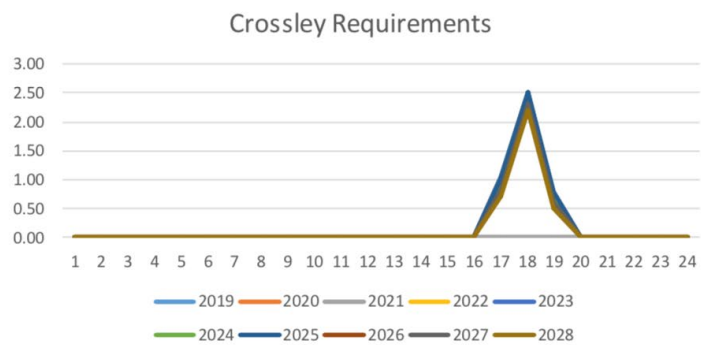
Southern California Edison (SCE) example: DIDF Request for Offers

- Six upgrade needs at five locations identified in Distribution Deferral Opportunities Report process
  - Demand Response (100 kW min)
  - Renewables: 250 kW min front-of-the-meter (FTM), 100 kW min behind-the-meter (BTM)
  - Storage 500 kW min FTM, 500 kW min BTM
  - Renewables+storage: 250 kW min FTM, 100 kW min BTM
  - Permanent load shift (100 kW min)
  - Energy Efficiency (100 kW min)
- Preference for BTM that can provide resiliency for Public Safety Power Shutoffs

SCE DIDF RFO

SCE example: Eisenhower-Crossley

DER Attribute Requirements: Eisenhower 115/33 kV - Crossley 33 kV



Year	Capacity (MW)	Energy Need (MWH)	Season	Monthly Frequency	Yearly Frequency
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	2.5	4.4	Summer	5	15
2023	2.5	4.3	Summer	5	15
2024	2.4	4.0	Summer	5	15
2025	2.5	4.3	Summer	5	15
2026	2.3	3.7	Summer	5	15
2027	2.3	3.7	Summer	5	15
2028	2.2	3.4	Summer	5	15

	Peak Hourly Need (MW)																							
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.5	0.8	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.5	0.8	0.0	0.0	0.0	0.0	0.0
2024	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.4	0.7	0.0	0.0	0.0	0.0	0.0
2025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.5	0.8	0.0	0.0	0.0	0.0	0.0
2026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.6	0.0	0.0	0.0	0.0	0.0
2027	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.6	0.0	0.0	0.0	0.0	0.0
2028	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.2	0.5	0.0	0.0	0.0	0.0	0.0

- A new 33 kV circuit addition at Eisenhower 115/33 kV substation is planned to relieve Crossley 33 kV circuit out of Eisenhower 115/33 kV substation projected to exceed capacity limits.

https://www.sce.com/sites/default/files/inline-files/2020%20DIDF%20RFO%20-%20Bidders%20Conference%20Slide%20Deck.pdf

SCE example: Challenges of procurements

- SCE's new analysis showed that needs changed significantly.
- Data analysis after peak season, disaggregation of CEC forecasts, and known load growth projects resulted in changes.
- Bidders given a week to revise bids.
- Procurements take time which can lead to challenges

Table 1: Eisenhower Project Comparison of 2019 and 2020 Planning Cycles

Eisenhower Project	2019 Planning Cycle	2020 Planning Cycle
Grid Needs	Capacity: Crossley 33 kV circuit out of Eisenhower 115/33 kV Substation	Capacity: Crossley 33 kV circuit out of Eisenhower 115/33 kV Substation
Nature of Grid Needs	Forecasted demand expected to exceed capacity limitations	Forecasted demand expected to exceed capacity limitations
Scope	Construct (1) new 33 kV circuit out of Eisenhower 115/33 kV Substation	Construct (1) new 33 kV circuit out of Eisenhower 115/33 kV Substation
Need Year	2022	2022
Unit Cost of Traditional Mitigation	$3.42 M	$3.42 M
Capacity Requirements (MW)	2.5	16.2
Energy Requirements (MWh)	4.4	107.5

Table 7: Overall Comparison of Capacity Requirements (MW)

		2019 Planning Cycle (Advice 4108-E)	2020 Planning Cycle	Delta
Capacity Requirements (MW)	Eisenhower	2.5	16.2	+13.7
	Saugus-Newhall	12.5	12.5	0
	Pechanga	1.9	0.0	-1.9
	Alessandro	3.9	0.0	-3.9
	Elizabeth Lake 1	6.8	13.5	+6.7
	Elizabeth Lake 2	7.8	14.0	+6.2

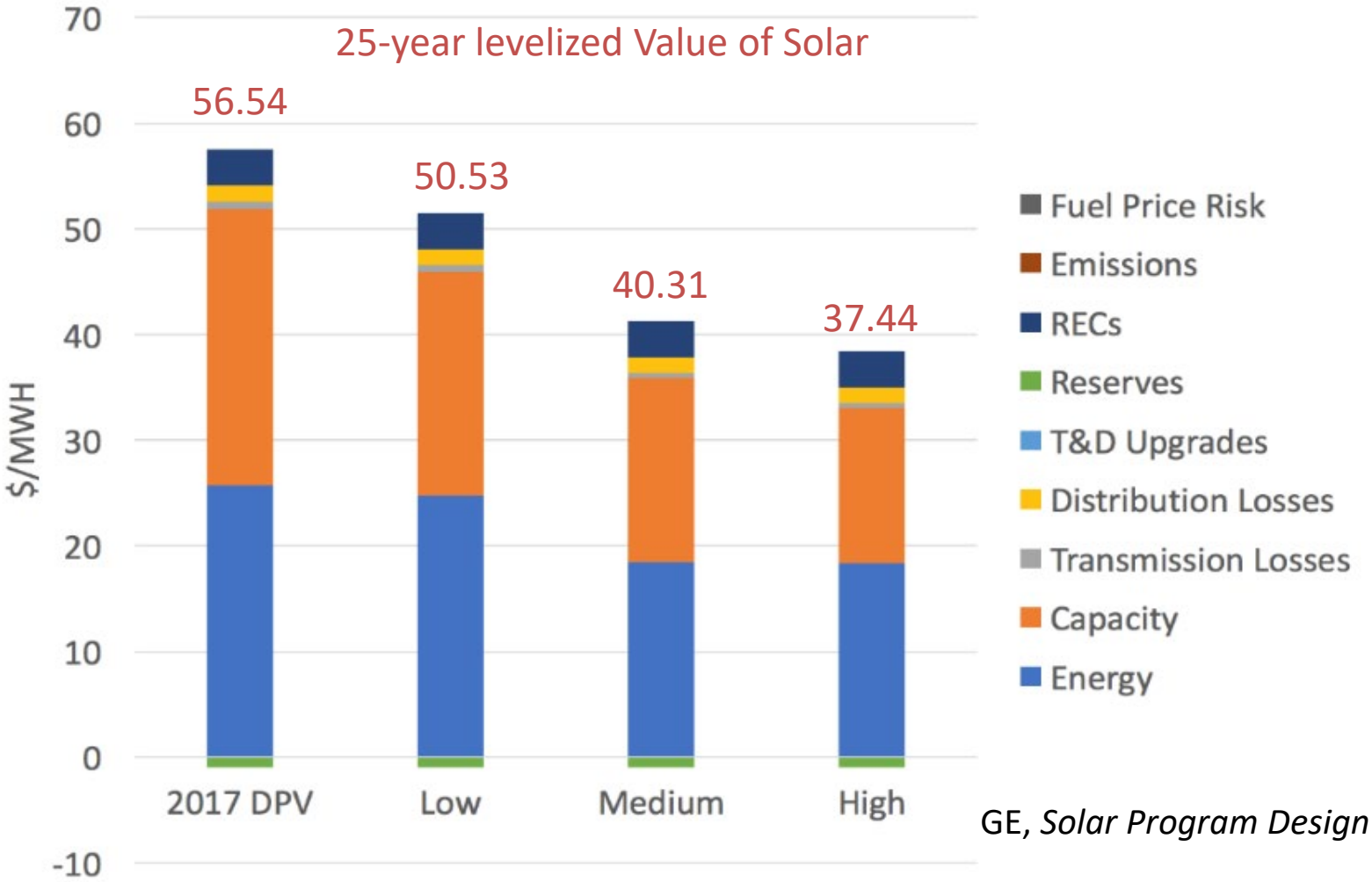
Table 8: Overall Comparison of Energy Requirements (MWh)

		2019 Planning Cycle (Advice 4108-E)	2020 Planning Cycle	Delta
Energy Requirements (MWh)	Eisenhower	4.4	107.5	+103.1
	Saugus-Newhall	39.6	51.5	+11.9
	Pechanga	3.2	0.0	-3.2
	Alessandro	16.8	0.0	-16.8
	Elizabeth Lake 1	18.3	68.4	+50.1
	Elizabeth Lake 2	23.4	72.9	+49.5

SCE https://library.sce.com/content/dam/sce-doclib/public/regulatory/filings/pending/electric/ELECTRIC_4208-E.pdf

Pricing

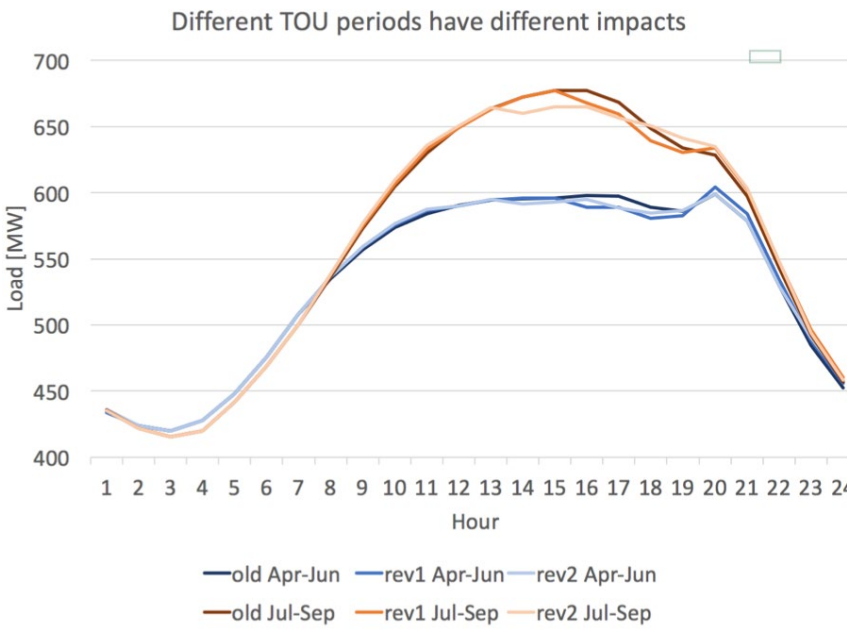
Value-of-solar tariff example

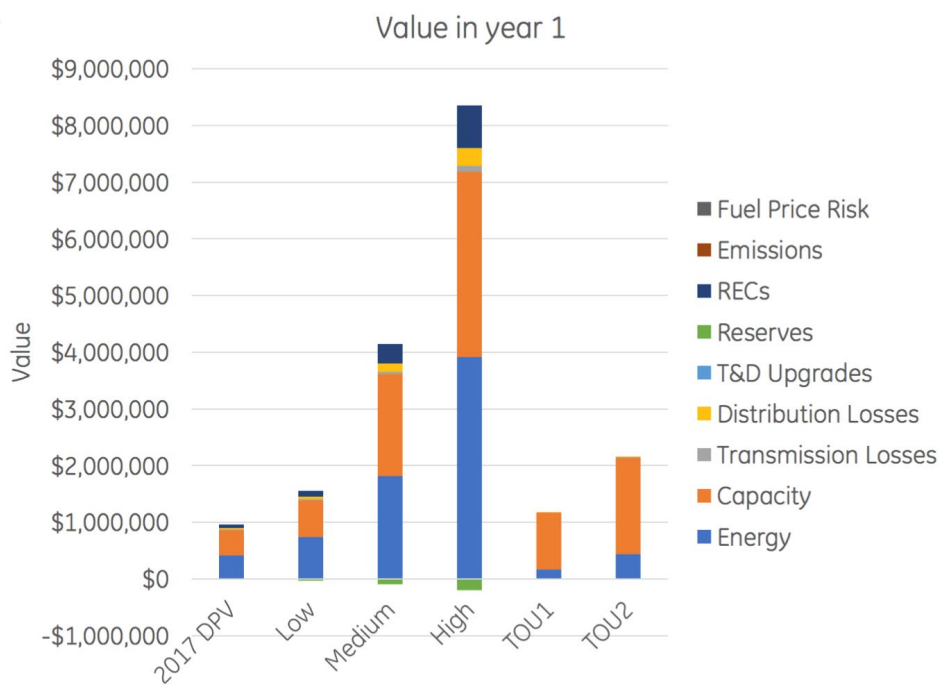


GE, *Solar Program Design Study*, 2017

Distr. PV	7.1MW	20MW	50MW	100MW
Centr. PV	19MW	89MW	89MW	89MW

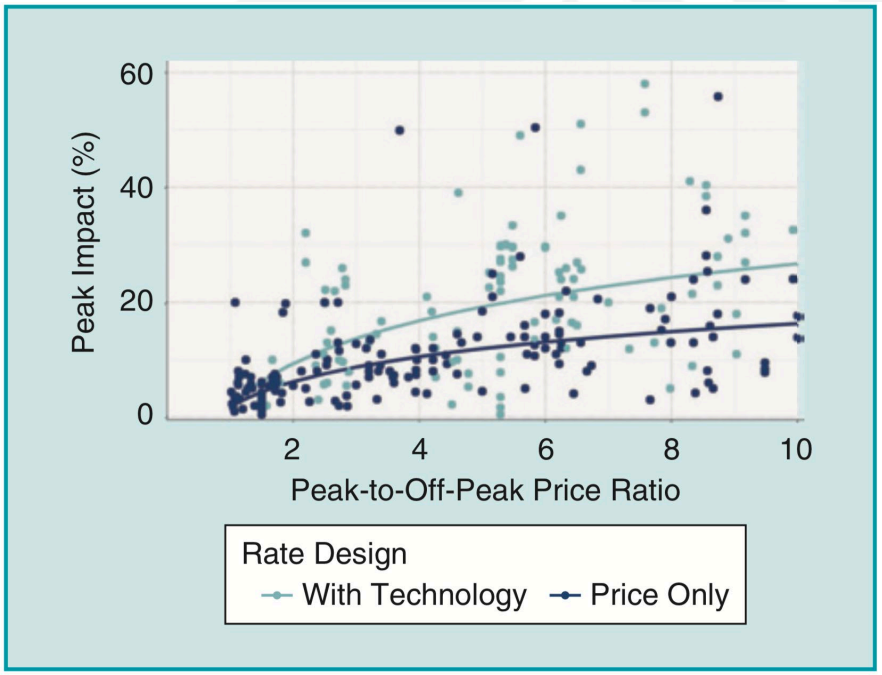
Pricing: Time-of-use rates act like storage on the grid





Lew, et al, "DER Compensation: Colorado Springs Utilities Solar Program Design Study," ESIG Oct 2017

Greater impact with strong price signals and technology

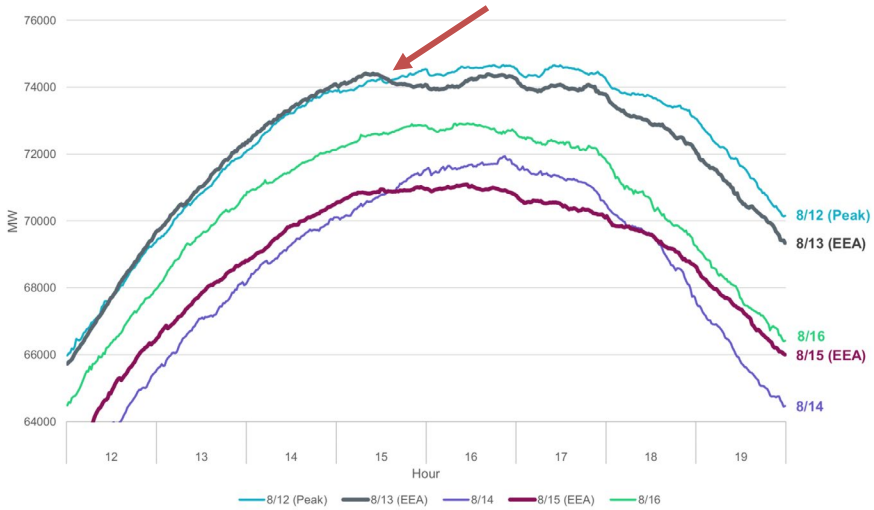


- 332 time-of-use, critical peak pricing, and peak time rebate experiments
- Some experiments were only price-based
- Some experiments combined enabling technologies (e.g., smart thermostat) with pricing signal

Faruqui and Bourbonnais, "The Tariffs of Tomorrow," IEEE PES Magazine, May/June 2020, pp. 18-25.

Strong price signals in ERCOT reduce demand

Deployed 926MW ERS (response exceeded obligation)



Date	Characteristics	Max RT Load Zone SPP	Estimated HE 17 Load Reduction
Aug. 12	Actual 4CP Day	$6,537	2,500 MW
Aug. 13	EEA1/Near 4CP	$9,159	3,100 MW
Aug. 14	-	$1,807	200 MW
Aug. 15	EEA1	$9,053	1,800 MW
Aug. 16	Near 4CP	$1,583	1,600 MW

- Tight reserve margin (8.6%) going into 2019
- New record for peak demand on Aug. 12, 2019, of 74,666 MW
- Estimated load reductions include Emergency Response Service (ERS), 4 Coincident Peak, and response to energy prices

Source: ERCOT, “ERCOT’s Review of Summer 2019”, Oct 11, 2019

Programs

Holy Cross Energy's Distribution Flexibility Program allows for new DERs

- Electric Vehicle Supply Equipment program
  - Utility furnishes level 2 EV charger ($650 value) to customer at no cost to the customer
  - Must enroll in distribution flexibility program
    - Utility has full operational control of EV charger, e.g., charging during renewable oversupply periods rather than peak demand periods
    - Utility sets expectations for up to 96 peak demand events per year (2-3 hour duration), generally between 4pm and 9pm.
- Peak Time Rebate Program
  - $500/MWh for high peak
  - $1,000/MWh for critical peak
  - Expectations: 2-3 hours duration; up to 96 events per year
  - Baseline is historical consumption for the event period
- Distributed battery program under development

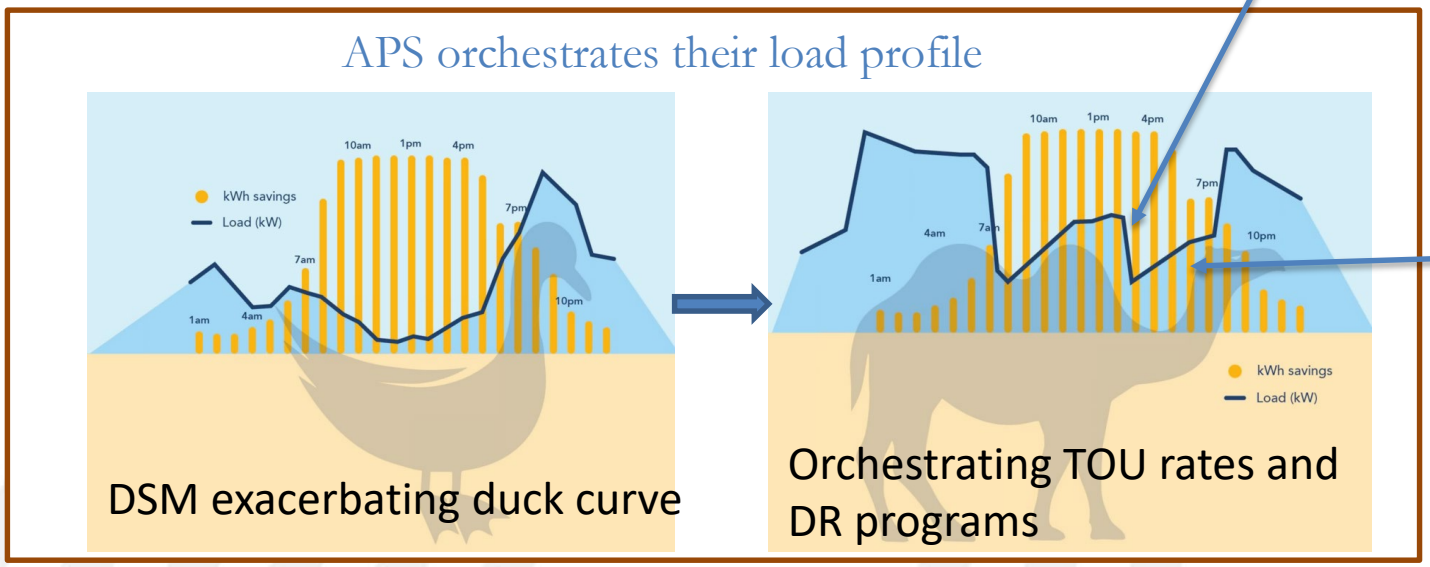
Arizona Public Service (APS) created a DER platform

- Created platform so that DER is an asset rather than an uncontrolled resource problem
- EnergyHub partner provides DER Management System, customer-facing
- Consider direct install, bring-your-own-device, organic vs. incentivized growth
- Programs
  - Water heaters – targeted to specific feeders
    - Rebate full cost of electric water heater
  - Storage – targeted to specific feeders
    - Battery can be used by customer for backup; utility owns/maintains/controls; $500 credit
  - Thermostats - $50 one-time + $25/yr credit; changes thermostat few degrees up to 20x/yr
  - Rooftop solar PV – voltage support and curtailment
  - Pool pump – future
  - EV – future

Hines, Tierra Resource Consultants, PLMA, Apr 2020

Putting it all together

Offpeak ends@ 3pm



Wait until after peak rates hit then do 2-hour DR

- 90 days last year when they could purchase negative priced energy in regional market
- Which energy efficiency is valuable in this situation?
  - Commercial lighting that reduced midday load was the main measure that did not help.
  - Focusing on summer peak, flattening load shapes, and moving consumption to midday were main measures that helped.
  - Seel, et al., also finds efficiency portfolios changing with increased wind/solar
- 2/3 of residential customers are on TOU rates

Hines, Tierra Resource Consultants, PLMA, Apr 2020

Questions States Can Ask About Procurement, Pricing and Programs

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

- What is your overall vision for deployment of DERs to encourage grid-friendly behavior and incentivize DERs to meet grid needs?
- NWA procurement
  - How are grid needs screened? Are these screens so restrictive that they eliminate NWA projects that seem viable?
  - What criteria do you use to prioritize candidate projects? To what extent did engineering (or other) judgment change prioritization of projects and why?
  - Is there data or infrastructure that could give more certainty to the overall process?
- Pricing
  - How can you best take advantage of customer grid-edge devices and automation and also increase access by low-income customers to these devices?
  - How can rate design be used to reduce some types of system investments?
- Programs
  - How are you addressing the wide variety of grid-edge devices so that you don't have one-off programs for each one?

Resources for More Information

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

- California Public Utilities Commission Decision adopting Distribution Investment Deferral Framework, Feb 8, 2018
- Denholm, et al, "Methods for Analyzing the Benefits and Costs of Distributed Photovoltaic Generation to the U.S. Electric Utility System," NREL/TP-6A20-62447, Sept 2014.
- Faruqui and Bourbonnais, "The Tariffs of Tomorrow," IEEE PES Magazine, May/June 2020, pp. 18-25.
- Ngo, et al, "Investing for the Future," IEEE PES Magazine, Jan/Feb 2020 p. 34-42.
- PLMA, "APS and EnergyHub for APS Distributed Energy Resource Aggregations," June 4, 2020.
- SCE 2020 Distribution Deferral Opportunities Report/Grid Needs Assessment
- Seel, et al, "Impacts of High Variable Rneewable Energy Futures on Electric-Sector Decision Making: Demand-Side Effects," LBNL, June 2020.
- Wood Mackenzie, "US non-wires alternatives H1 2020: Battery storage seizes top spot as utilities'preferred non-wires resource," 2020.

Questions?

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303-819-3470