DOE-OE Energy Storage Technology Advancement Partnership (ESTAP) Webinar

The Energy Storage Interconnection Bottleneck

May 23, 2023

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories

Clean Energy Group

Clean Energy States Alliance

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Clean Energy States Alliance

Clean Energy States Alliance

www.cesa.org

State of California Energy Commission

Connecticut Green Bank

Department of Energy & Environment

Energy Trust of Oregon

IPA Illinois Power Agency

Governor's Energy Office (Maine)

State of New Hampshire Department of Energy

Massachusetts Clean Energy Center

Maryland Energy Administration

EGLE Michigan Department of Environment, Great Lakes, and Energy

BPU New Jersey Board of Public Utilities

New Jersey's cleanenergy program – njcleanenergy.com

New Mexico EMNRD Energy, Minerals and Natural Resources Department

New York State NYSERDA

mn Commerce Department

SMUD Powering forward. Together.

State of Rhode Island Office of Energy Resources

Vermont Department of Public Service Clean Energy Development Fund

Virginia Energy

Rhode Island Commerce Corporation

Commissioner Stephanie Garcia Richard New Mexico State Land Office

Illinois Commerce Commission ICC

OEI Wisconsin Office of Energy Innovation

Prairie Island Indian Community in the State of Minnesota

Washington State Department of Commerce

Connecticut Energy Environment

DOER Massachusetts Department of Energy Resources

Oregon Department of Energy

Inclusive Prosperity Capital

MassDEP

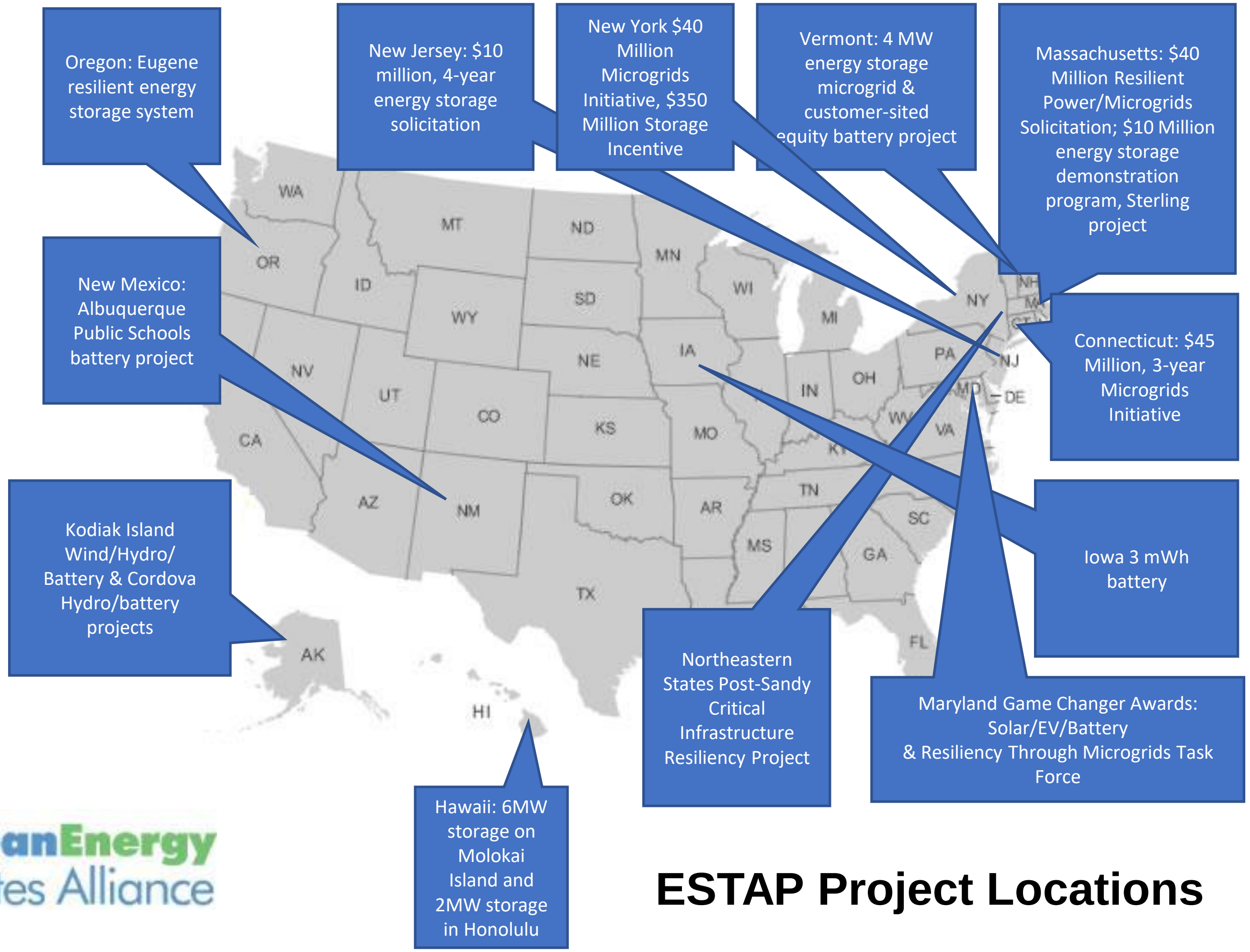
OPC-DC Office of the People's Counsel – Advocacy | Education | Protection

DOE-OE Energy Storage Technology Advancement Partnership

The Energy Storage Technology Advancement Partnership (ESTAP) is a US DOE-OE funded federal/state partnership project conducted under contract with Sandia National Laboratories.

ESTAP Key Activities:

1. Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment
2. Disseminate information to stakeholders
   - ESTAP listserv >5,000 members
   - Webinars, conferences, information updates, surveys.
3. Support state energy storage efforts with technical, policy and program assistance



ESTAP Project Locations

U.S. DEPARTMENT OF ENERGY | Sandia National Laboratories | Clean Energy States Alliance

Thank You!

Dr. Imre Gyuk

Director, Energy Storage Research,
U.S. Department of Energy

Waylon Clark

Energy Storage Program Demonstration
Team Lead, Sandia National Laboratories

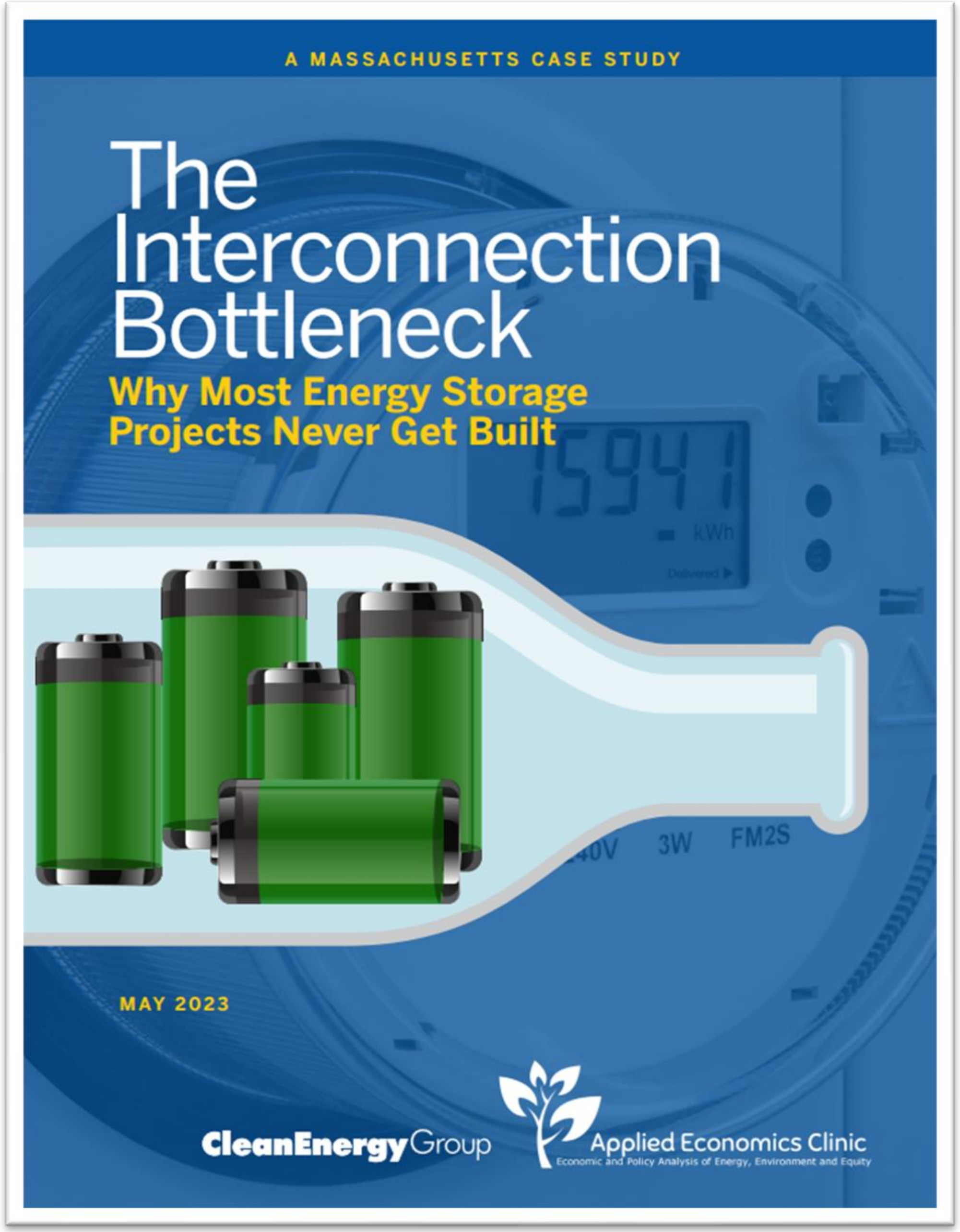
Webinar Speakers

- **Chirag Lala**, Applied Economics Clinic
- **Sachin Peddada**, Applied Economics Clinic
- **Kirk Shields**, Green Mountain Power
- **Schuyler Matteson**, NYSERDA
- **Tony Sparks**, Albuquerque Public Schools
- **Todd Olinsky-Paul**, Clean Energy Group (moderator)

New Report on Interconnection Barriers to Energy Storage and Solar+Storage

Produced by Applied Economics Clinic
on behalf of Clean Energy Group
Published May 2023

Available for download:
www.cleanegroup.org/publication/the-interconnection-bottleneck-why-most-energy-storage-projects-never-get-built/



This webinar was presented by the DOE-OE Energy Storage Technology Advancement Partnership (ESTAP)

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ESTAP Website: https://cesa.org/projects/energy-storage-technology-advancement-partnership/

ESTAP Webinar Archive: https://cesa.org/projects/energy-storage-technology-advancement-partnership/webinars/

Upcoming Webinars

Electric Vehicles and Equity
Tuesday, June 6, 1-2pm ET

Investing in Relationships: Six Community Engagement Models from Energy Trust of Oregon
Thursday, June 8, 3-4pm ET

Read more and register at: www.cesa.org/webinars

The Interconnection Bottleneck

Chirag Lala
Applied Economics Clinic
Report published with Clean Energy Group
www.aeclinic.org
www.cleanegroup.org
May 23, 2023
Report Link: https://aeclinic.org/publicationpages?month=05-2023

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CleanEnergyGroup

MA Interconnection Barriers Report on behalf of Clean Energy Group

1. Describe the interconnection process in MA and nationally
2. Document all major barriers to speedy project implementation
3. Investigate policies in other states
4. Assess the impact of those barriers on solar and storage projects, as well as the ability of states to meet their respective climate goals
5. Interviews

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Interviews

- Insight into the four research questions: process, barriers, policies, and impact
- Experiences with the interconnection process
- Recommendations for additional research, areas of focus, or proposed changes to the process

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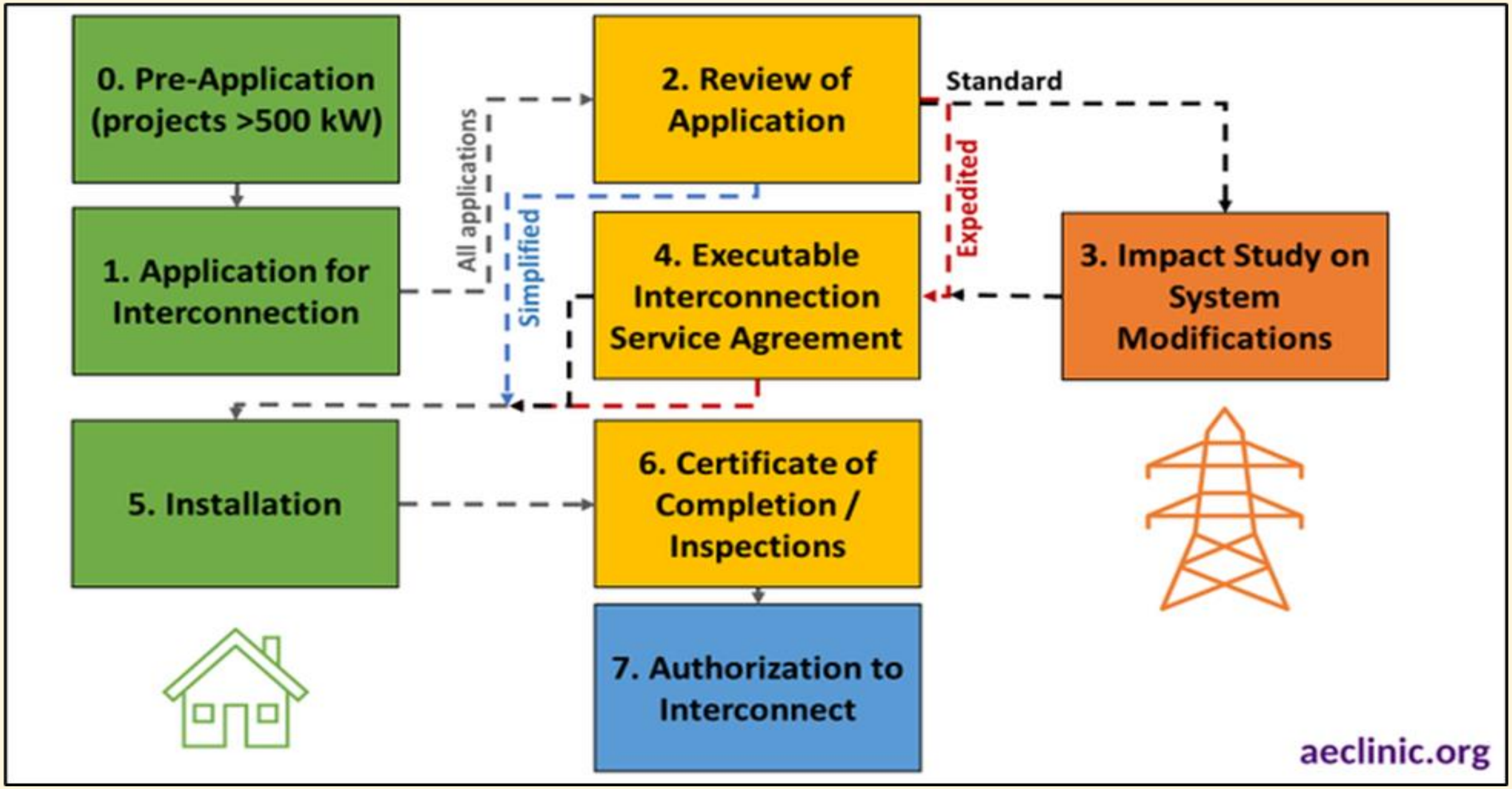
Massachusetts interconnection process



Source: MA DPU Docket No.1320. October 2016.Standards for Interconnection of Distributed Generation. Submitted by Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid. Available at: https://www9.nationalgridus.com/non_html/interconnect_stds_ma.pdf.

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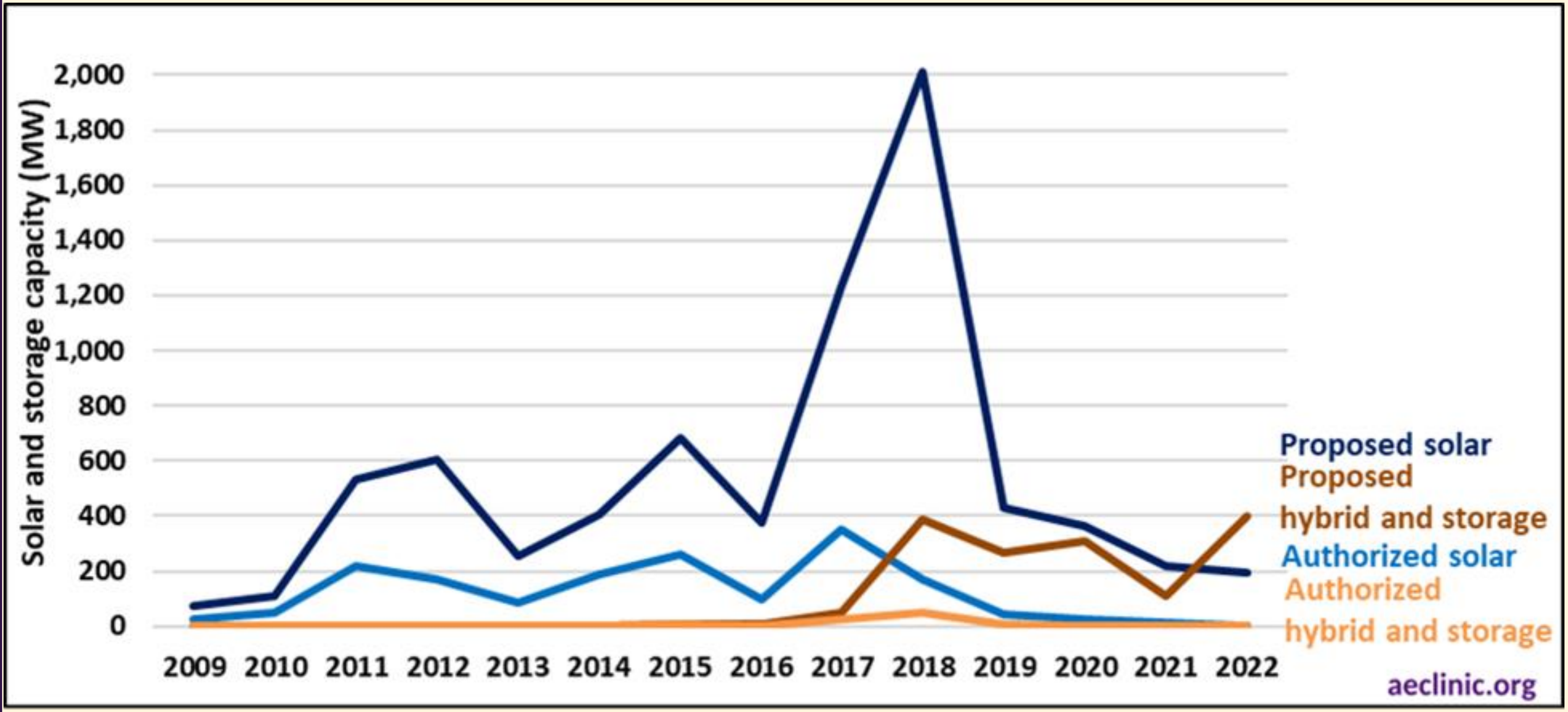
4) Massachusetts proposals and approvals



Note. This figure understates the number of completed and proposed projects because of data that was omitted by AEC due to unclear labelling by the utilities' monthly reporting. "Hybrid" refers to projects containing both solar and storage resources. "Storage" refers to standalone storage projects. AEC calculations used source material from Massachusetts Department of Energy Resources (MA DOER). Aggregated RAW DATA set through December 2022. Available at: https://www.mass.gov/info-details/utility-interconnection-in-massachusetts#:~:text=Interconnection%20is%20the%20process%20of,and%20subsequent%20Authorization%20to%20Connect.

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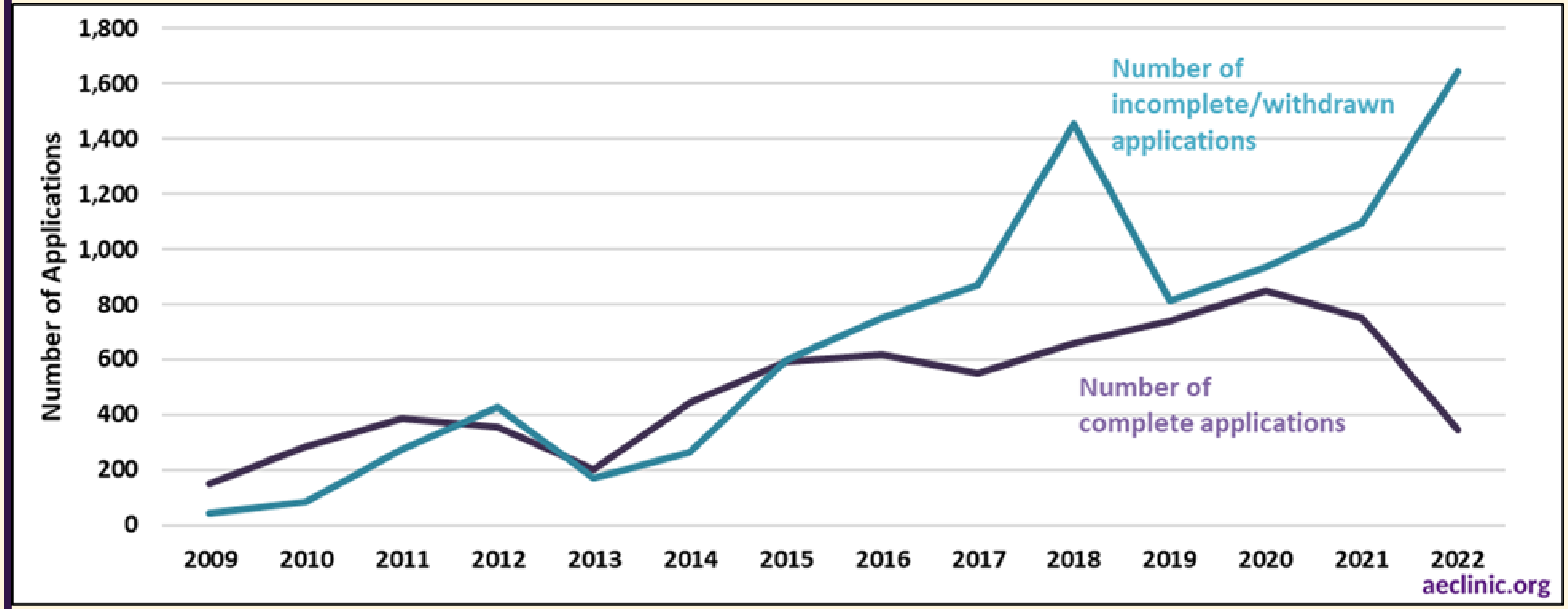
Massachusetts application process



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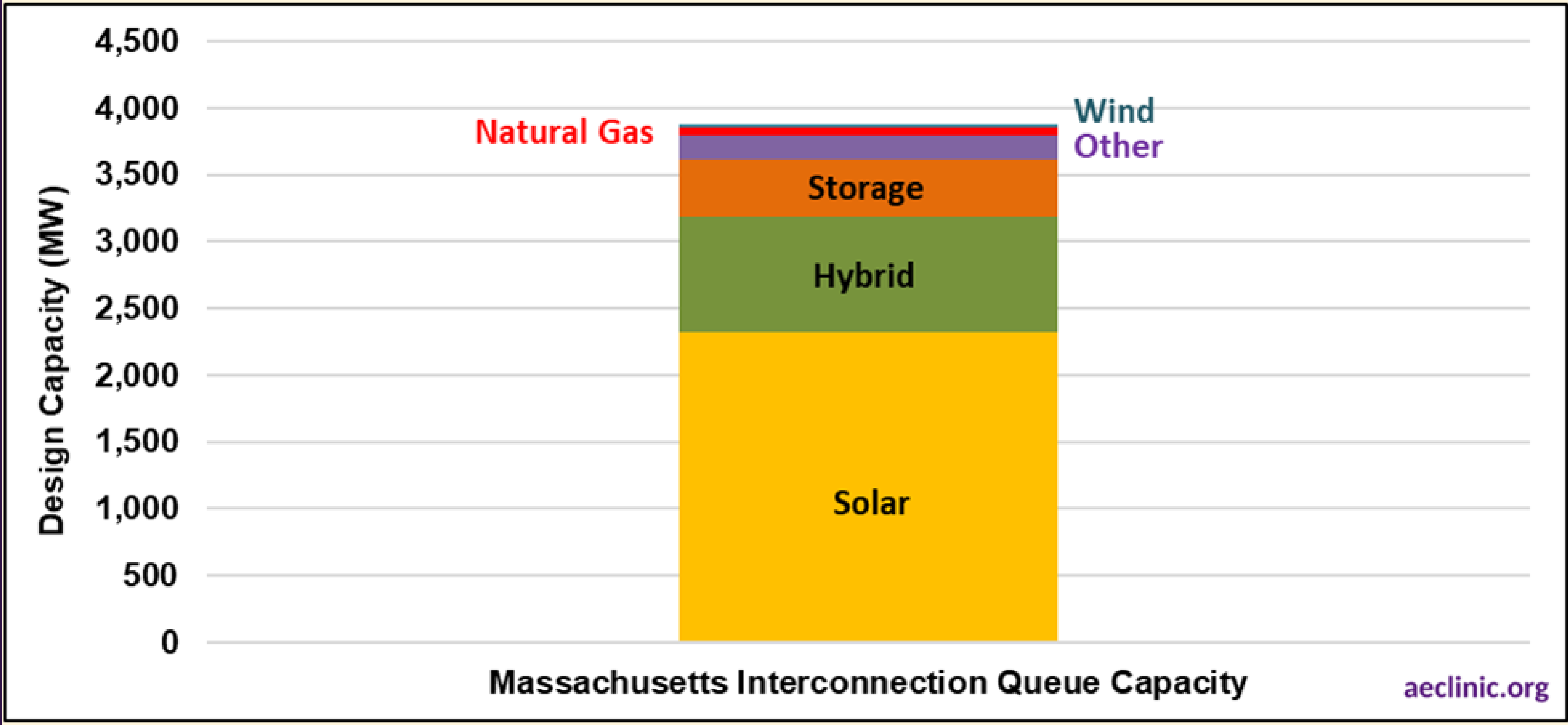
Massachusetts interconnection queue



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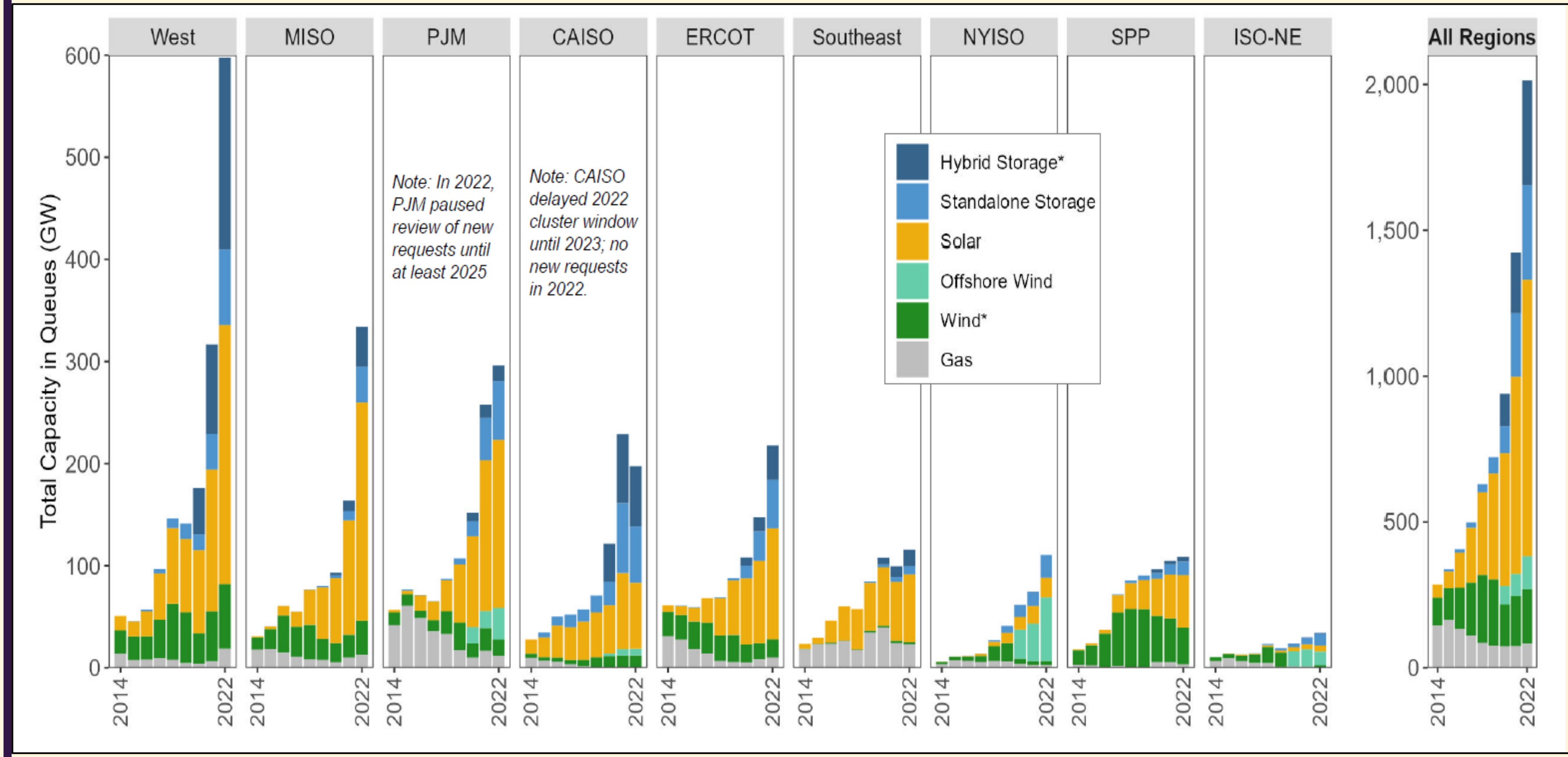
Transmission-level interconnection queues



Source: Rand, J. R Strauss, W. Gorman, J. Seel, J. Mulvaney Kemp, S. Jeong, D. Robson, R. Wiser. April 2023. Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2022. Lawrence Berkelley National Laboratory. Available at: [LINK]. p. 9.

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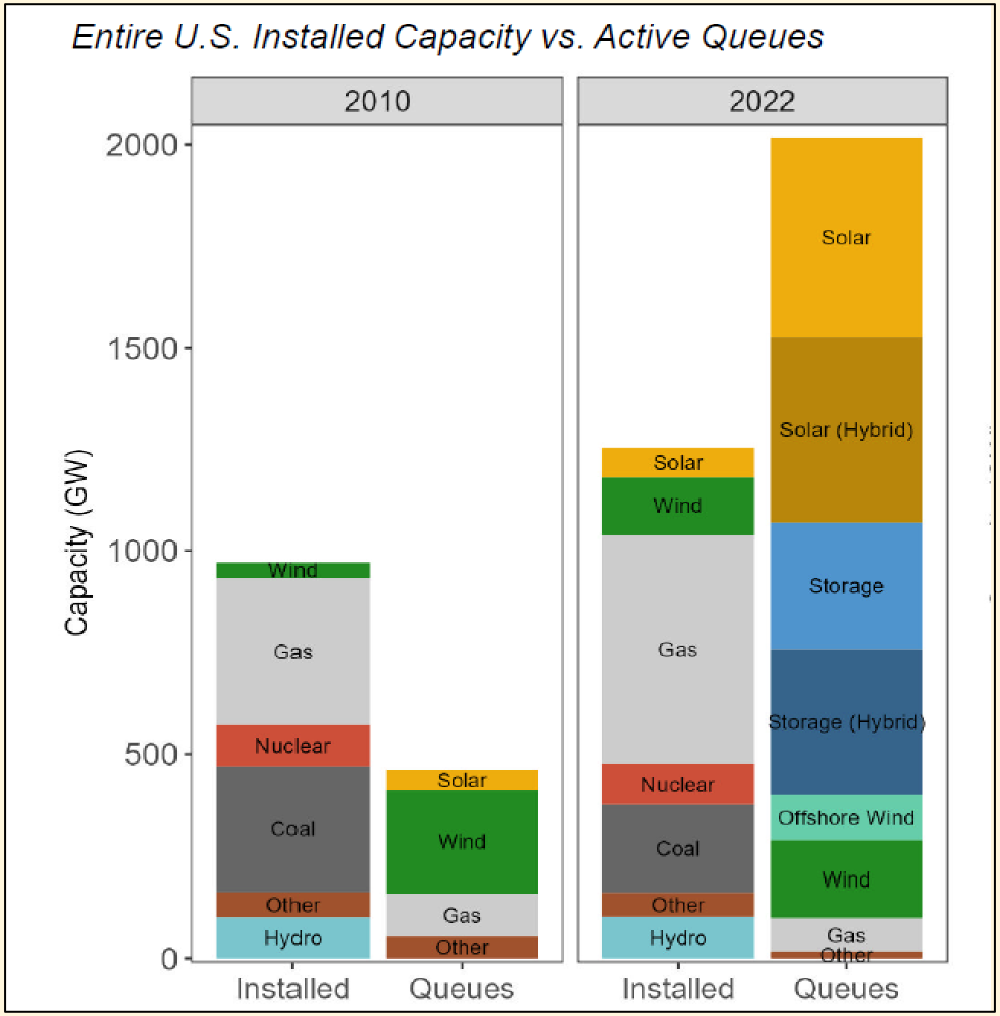
Queue composition



Source: Rand, J. R Strauss, W. Gorman, J. Seel, J. Mulvaney Kemp, S. Jeong, D. Robson, R. Wiser. April 2023. Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2022. Lawrence Berkelley National Laboratory. Available at: [LINK]. p. 10.

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Cost causation

- Assigns the cost of infrastructure upgrades to the project whose application triggered the need to upgrade
  - Even if the upgrade benefits others
- Jockeying and delays in interconnection queues
  - Position in the queue is not outcome-neutral
- Project-dependent hosting capacity upgrades
- Disincentivizes planning by distribution utilities

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Lack of planning for hosting capacity

- Planning for load vs. planning for bidirectional hosting capacity
- Reliance on individual projects
- No anticipation of future hosting capacity needs, target setting, or processes necessary to meet those targets
- Transmission capacity can ease some distribution system constraints

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Project finances and costs

- How projects consider financing
  - Gains
  - Risks
  - Incorporated costs: modeling and process assumptions
- Barriers driving up interconnection costs
  - Lack of agreement between utilities and project applicants
  - Inflated modeling assumptions
  - High supply costs

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Storage-specific barriers

- Lack of inclusion in interconnection rules
- Unreasonable assumptions about storage technologies
- No or scant mention of acceptable export-control technologies
- Non- and limited- export systems are assessed with unreasonable assumptions
- States have not updated interconnection rules to the most recent standards, do not provide sufficient information on the grid
- Utilities lack processes for evaluating operating schedules of storage
- Utility staff may not have the resources or expertise to assess or use export control technologies

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Recommendation 1: Integrated planning

- Framework
  - Forecast DER growth
  - Estimate maximum potential of DER penetration given hosting capacity
  - Determine the available capacity left on the system
  - Plan hosting capacity upgrades based on anticipated DER growth
- Need for continuous iteration
- Connection to other interconnection solutions

Recommendation 2: Reforming cost causation

- Limitations of the cluster approach
- FERC 2022: *Improvements to Generator Interconnection Procedures*
  - 90 percent on MW basis and 10 percent on customer basis
- Post upgrade costs reimbursed to single entity
- NYSERDA's Cost Sharing 2.0: payment only for assigned distribution capacity
- Inclusion of ratepayers?
  - Advantage: spreading the benefits and planning incentives
  - Over-building concerns?

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Recommendation 3: Storage solutions

- Define energy storage clearly
- Distinct screens for non-exporting projects
- Do NOT assume storage resources export full nameplate capacity. Calculate an export capacity based on steps taken to limit export
  - Embrace various standardized control methods and technologies
- Fast-track procedures for smaller systems
- Rules for inadvertent export
- Operational profiles

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Thank you!

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Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

ALBUQUERQUE PUBLIC SCHOOLS

ATRISCO HERITAGE ACADEMY HIGH SCHOOL

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

APS' largest campus, largest utility bills.

Summertime electricity bills over $50K; demand charges more than 50%.

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

Project objectives

- Charge from grid ‘off-peak.’
- Deploy strategically during ‘on-peak.’
- Reduce daily peak demand to below 500 kW.
- Test case for replication elsewhere in District.
- Potential for resiliency during power emergency.

Original concept financially driven.

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

Tesla Mega Pack 2

Largest Tesla installation in New Mexico – 721 kW / 2884 kWh

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

Tesla Mega Pack 2

Completed installation.

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

Added PV to improve the payback

- 850 kW to optimize payback
- 2200 PV panels . . . one per student!
- Without PV – 17 years*
- PV *plus* battery– 13 years

* Entirely dependent on utility rate structure.

Doubled project cost, but provides net savings of $3.5 M over life of battery.

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

PV layout

Arrays on separate buildings required multiple utility production meters.

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

High-Profile 'Demonstration Project'

- Widely supported
- Many eyes, many viewpoints
- Shared financial burden
- Data and Analytics
- *Functional* R & D project!

Highly anticipated pilot with ramifications for school districts everywhere!

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

Interconnection Timeline

APPROVAL TIMELINE

- INITIAL APPLICATION – 9/21/2021
- REQUEST FOR SEPARATE PV/BESS AGREEMENTS – 9/24/2021
- BI-WEEKLY STATUS MEETINGS – Several months in 2021, 2022
- INITIAL REVIEW – Passed 10/17/2022
- SUPPLEMENTAL REVIEWS – Started 11/14/2022

From project team perspective, truly felt like we were getting 'The Run-Around.'

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

Interconnection Timeline

APPROVAL TIMELINE

- INTERVENTION BY ACCOUNT MANAGER – 2/21/2023
- IN-PERSON MEETING WITH DEPARTMENT MANAGERS – 4/6/2023
- CONDITIONAL APPROVAL WITH REQUIRED UPGRADES – 4/28/2023
- UPGRADE DELAYS DUE TO SUPPLY CHAIN & LABOR – 20 weeks
- CONSEQUENCES TO EQUIPMENT & FINANCES – ongoing!

From project team perspective, truly felt like we were getting 'The Run-Around.'

Atrisco Heritage Academy HS – Battery Storage for Peak Shaving

Utility Interconnection Challenges

CHALLENGES

- ACCEPTANCE/INTEGRATION – Technology is still new; lots of unknowns
- WORKLOAD/MANPOWER – Exponential growth has overwhelmed resources
- INFRASTRUCTURE OUTDATED – Infrastructure upgrades are expensive
- POLICIES ARE LACKING – Regulated utilities must abide by statutes
- THREAT TO GRID STABILITY & PROFITS – How eager are private utilities to play nicely?

In the end, these challenges greatly discourage development of new projects!

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ALBUQUERQUE PUBLIC SCHOOLS

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DISTRIBUTED ENERGY INTERCONNECTIONS:

CHALLENGES & SOLUTIONS

GREEN MOUNTAIN POWER

Kirk Shields

ABOUT GMP

- Vertically integrated electric utility serving 275,000 customers
- 7,500 square miles; about 80% of VT
- 510 employees work in 15 offices across Vermont
- Retail Sales of 4,330,000 MWh; peak load 680 MW

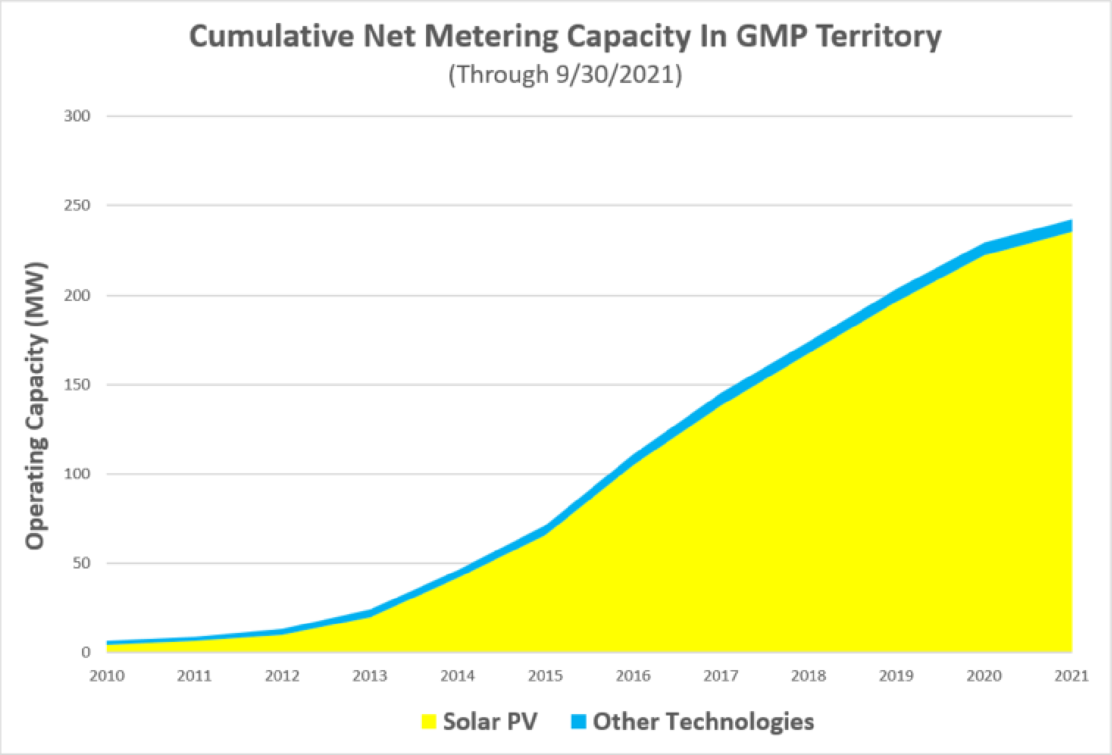
- In 2022
  - GMP named to TIME's list of the 100 Most Influential Companies
  - Fast Company named GMP one of the top five Most Innovative Companies in North America
  - GMP also earned a spot on Fast Company's Most Innovative Companies in the World list in the energy sector four years in a row.
- In 2021 and 2023
  - the Smart Electric Power Alliance (SEPA) honored GMP as a nationwide leader in energy transformation.

RECENT CHALLENGES

- Net Metering
  - VT's 1st net metering Rule 5.100 effective 2001
  - 2008 GMP added a Renewable options for customers
  - 2011 VT legislature implemented $0.20/kWh rate
  - 2017 Refinements to the Rule continued with rate changes, site adjustors, etc.

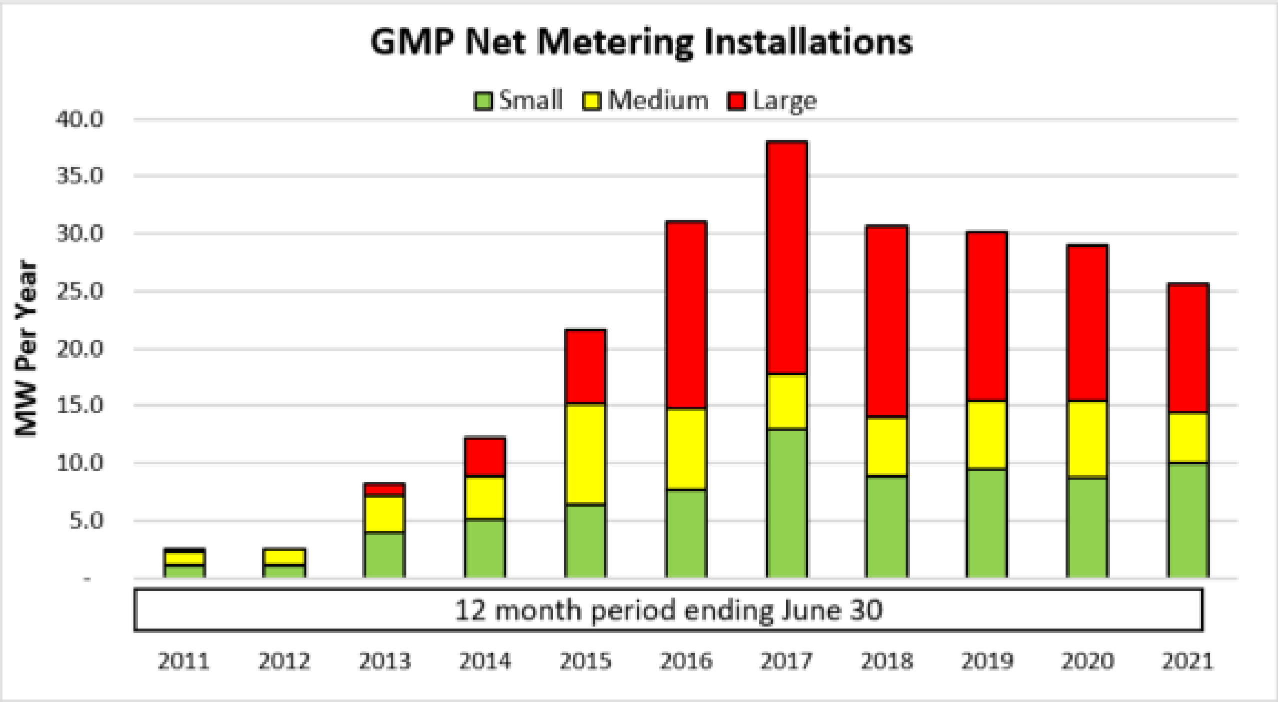
SOLAR EXPLOSION

- Over the last decade, cheap solar created huge demand for net metered projects



INTERCONNECTION REQUESTS

- Interconnection requests also grew tremendously
- Net metering is by far GMP's largest source of solar PV

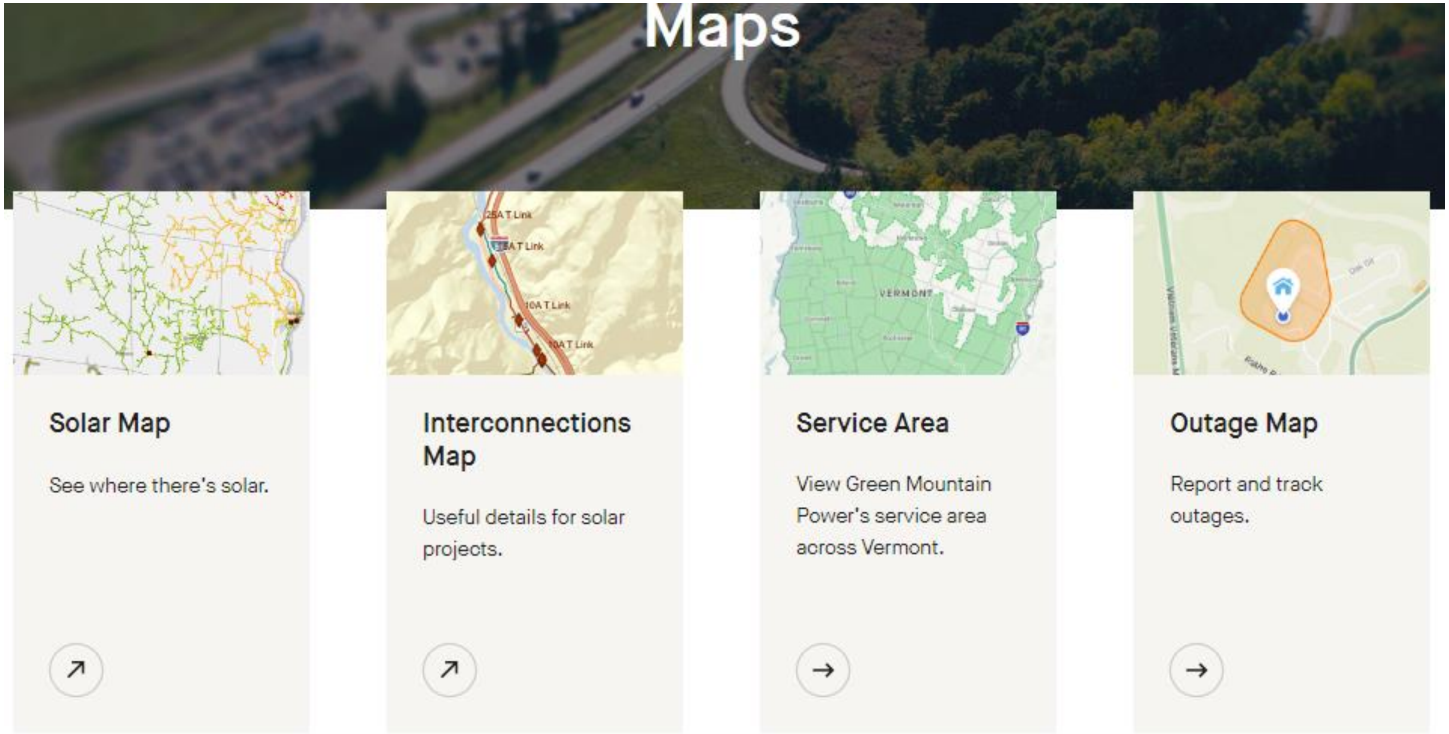


UTILITY BUSINESS EVOLUTION

- GMP decided early on to embrace customer transition
- Opportunity to change the relationship with customers "beyond the bill"
- Developers struggled to site projects effectively and wasted time where interconnection was uneconomic
- GMP created tools to help make siting more efficient

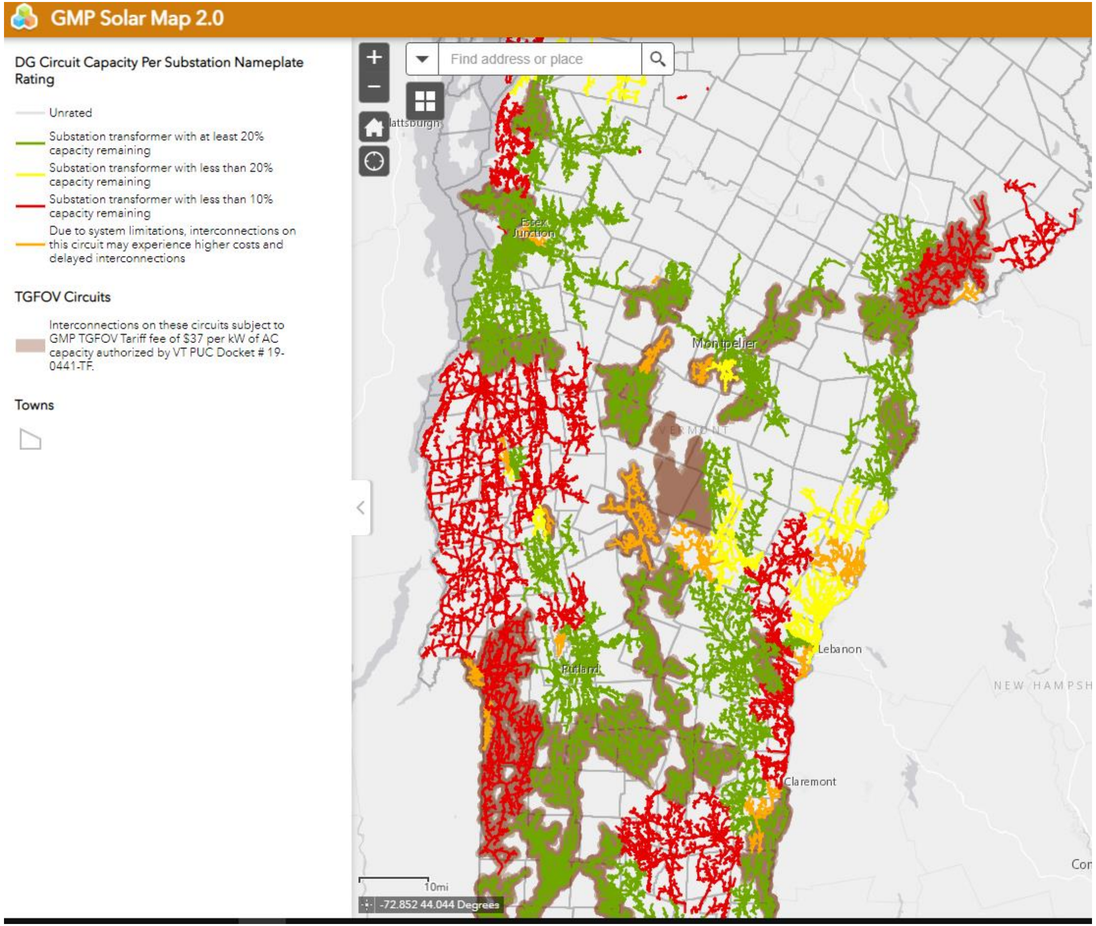
ONLINE DEVELOPER TOOLS

- GMP developed online tools for desktop site screening



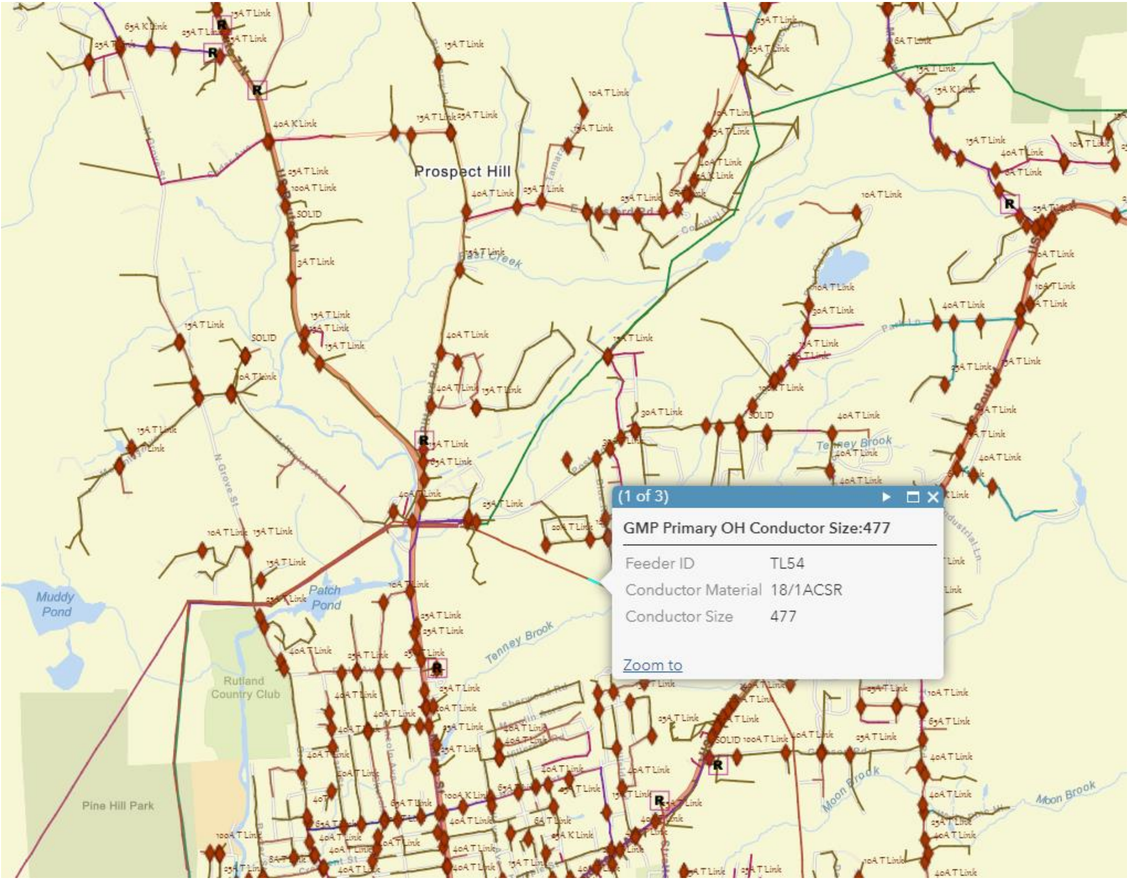
SOLAR MAP

- Solar map color-coded areas of grid constraints
- Substation capacity used & remaining



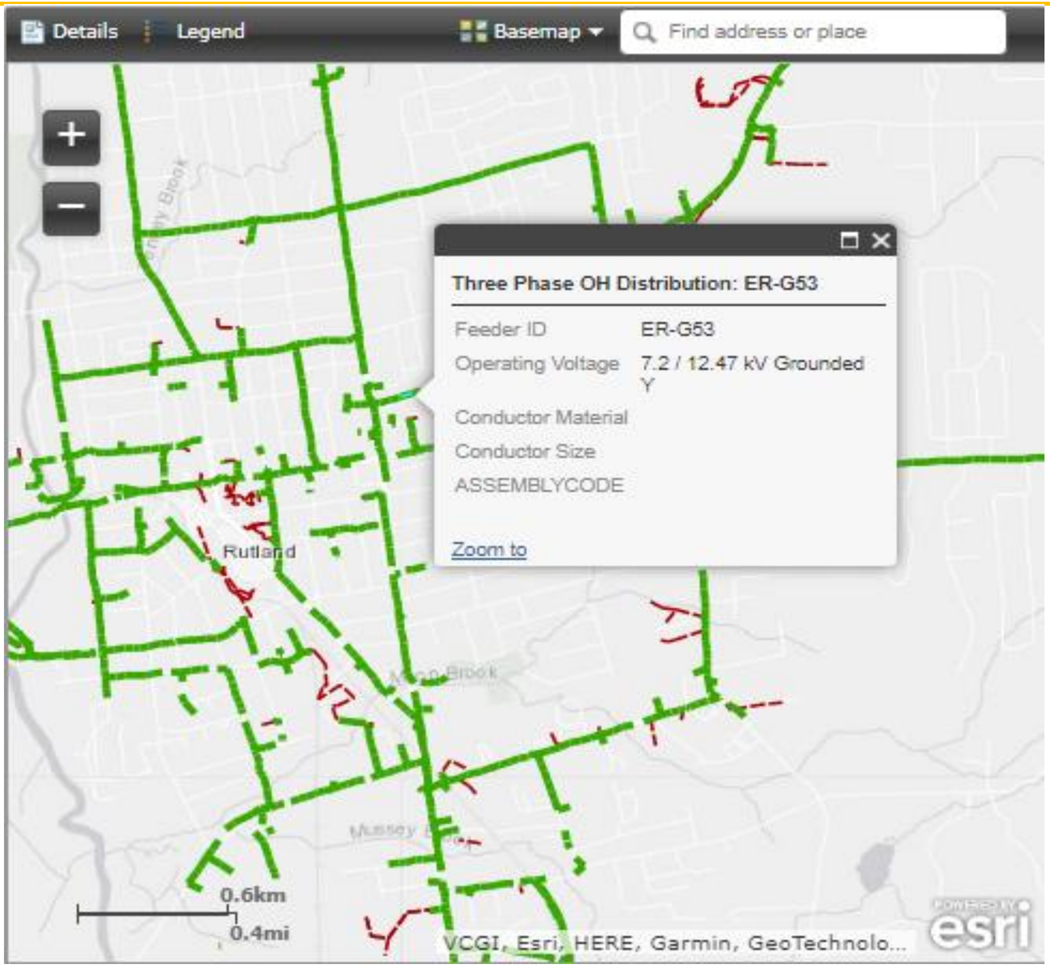
DISTRIBUTION MAP

- Distribution map shows drills into grid details
- Wire size, fuse sizes, fiber optic locations, recloser locations
- Can help determine potential upgrades needed



3-PHASE MAP

- Another layer to help determine solar site viability and potential development hurdles



CONCLUSION

- Tools have been well received by the development community
- GMP develops its own projects and we use the same tools for desktop site screening
- GMP engineering still challenged by volume of interconnection requests, but developer questions and frustrations can be partly addressed with tools

QUESTIONS

Kirk Shields

Director of Development, Risk Management & Fleet Operations

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AEC-CEG Interconnection Webinar

Schuyler Matteson

May 23, 2023

NEW YORK STATE | NYSERDA

Agenda

1. Bulk Storage IX Issues
2. “Retail” (Distribution) Storage IX Issues

Bulk Storage IX Issues

1. Limited IX Information
   a. Projects select POI and hope for the best >> expensive
   b. Some developers put multiple projects into queues at different POIs so they run in parallel instead of wasting time going in series
   c. Result: Clogged queues, long timeframes (extra studies), high risk, high development costs
2. “Material Modification” Rules
   a. NYISO considers storage a “different generation source”, meaning existing facilities must put storage back through the IX queues if they want to add or repower to storage
   b. Result: Extra time and cost to repurpose sites, often kills projects before they start
3. “Double Study”
   a. Storage still studied once as a load (full charge on peak) and once as generator (full discharge at low load) to determine total IX cost >> not realistic representation of impact AND storage is non-firm load
   b. Result: Very high IX costs, ~2x time in SRIS and other studies, extended study negotiations and IA constraints, difficulty financing

Bulk Storage IX Issues

5. Long Wait Times
   a. On top of Double Study, projects must wait for Class Year to come around every ~2 years (Don't Miss It!), then process takes ~2 years and is based on everyone in CY and all project above you in the queue
   b. Result: High costs (land, financing, etc.), financing/development risk from timeline
6. Cost-Allocation Stare-down
   a. "Decision period" in Class Year is a multi-million dollar staring contest. As people drop out, IX costs change.
   b. IX Costs are highly uncertain, dependent on who gets into Class Year with you, then costs are shared, and you must accept Allocation fully (non-refundable) and then negotiate IA which may impact costs.
   c. Result: Very high risk/uncertainty, high attrition (60% of projects drop out after initial IX study and 2 years of Class Year, higher for storage)

Retail Storage IX Issues

1. Limited IX Information – same as before (clogged queues, time, cost, financing)
2. “Double Study” Timeframe – same as before (time, cost)
3. Cost Causative Rates vs. Operation (Theoretically addressed by Appendix K…)
   a. Tariffs are supposed to be designed to reflect cost to system of charging and discharging at given times. Often, IAs specify charging windows that conflict with demand charges and injection timeframes.
   b. Result: High financing cost due to charging cost risk and forfeited revenue
4. Allocated Cost of Service: Demand Charges
   a. Projects currently still pay demand charges for injecting during peak demand calls… Exemptions coming, but even after this, high demand charges, even for off-peak charging, cost nearly as much as projects get paid for reducing demand on peak.
   b. Result: High revenue need, higher cost of charging and project risk.

Solutions

- Limited IX Information: Add transmission hosting capacity information and enhance existing resources
- “Material Modification”: Eliminate the need to restart IX process for adding/repowering with storage
- “Double Study”: Do a single, bounded, realistic, 8,760 modeling study to determine actual impacts of storage (Appendix K on next slide)
- Long Wait Times: Change “batch” structure, add resources, simplify studies
- Cost-Allocation Stare-down: Smaller batches mean faster resolution and lower uncertainty
- Cost-Causative Rates vs. Operation: Update tariffs to agree with current system data
- ACOS Demand Charges: Adopt exemption to injection demand charges and incorporate new rates that properly incentivize the behavior we hope to see

APPENDIX K -

Energy Storage System (ESS) Application Requirements / System Operating Characteristics / Market Participation

<u>n.</u> Indicate any specific operational limitations that will be imposed (*e.g.*, will not charge or discharge across PCC between 2-7 pm on weekdays; ESS will not charge at any time that would increase customers peak demand, etc.). Charge/discharge at any time (24 hours) will be assumed by the utility if not provided.