MASSACHUSETTS CLEAN ENERGY CENTER®

ENERGY STORAGE UPDATE

Presented By

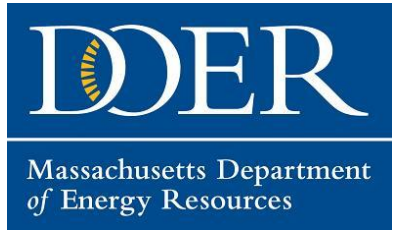
Ariel Horowitz, PhD

Senior Program Director

OUR MISSION

Grow the economy and help meet the state's clean energy and climate goals.

MASSACHUSETTS ENERGY AGENCIES



ENERGY STORAGE MARKET REALITIES: LESSONS FROM THE ACES PROGRAM

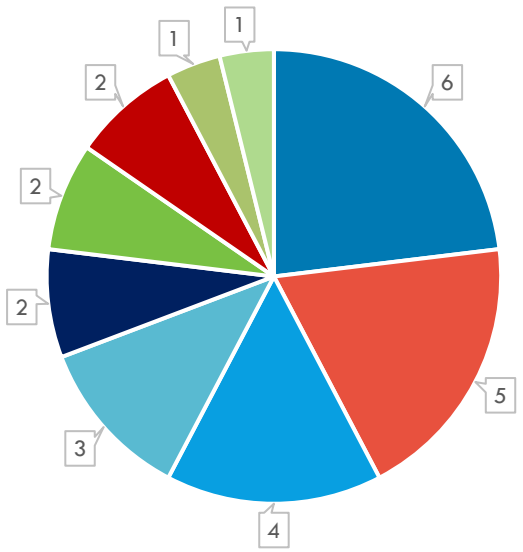
Advancing Commonwealth Energy Storage (ACES)

26
Proposals selected for award

9
Use cases – 8 from *State of Charge*, one new use case

32 MW/85 MWh
Energy storage proposed

$20 MM/$32 MM
Grant funding request / Cost share leveraged

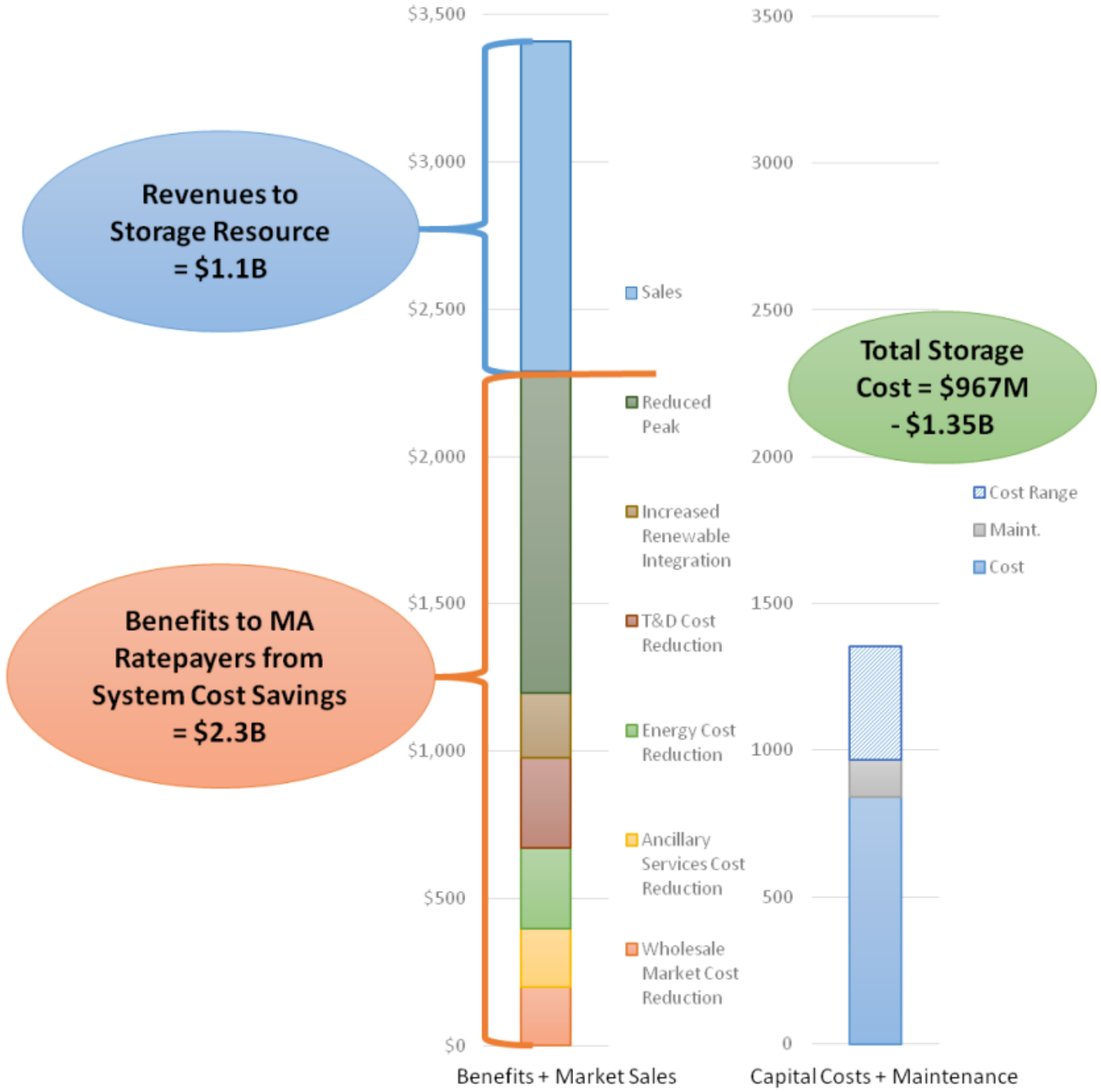


- Behind the Meter - C&I Solar Plus Storage
- Municipal Light Plant (MLP) Asset
- Merchant - Solar Plus Storage
- Resiliency/Microgrid
- NEW USE CASE - Transit
- Behind the Meter - Residential Storage Dispatched by Utility
- Merchant - Co-Located with Traditional Generation Plant
- Investor Owned Utility (IOU) Grid Mod Asset
- Load Serving Entity (LSE)/Competitive Electricity Supplier Portfolio Optimization

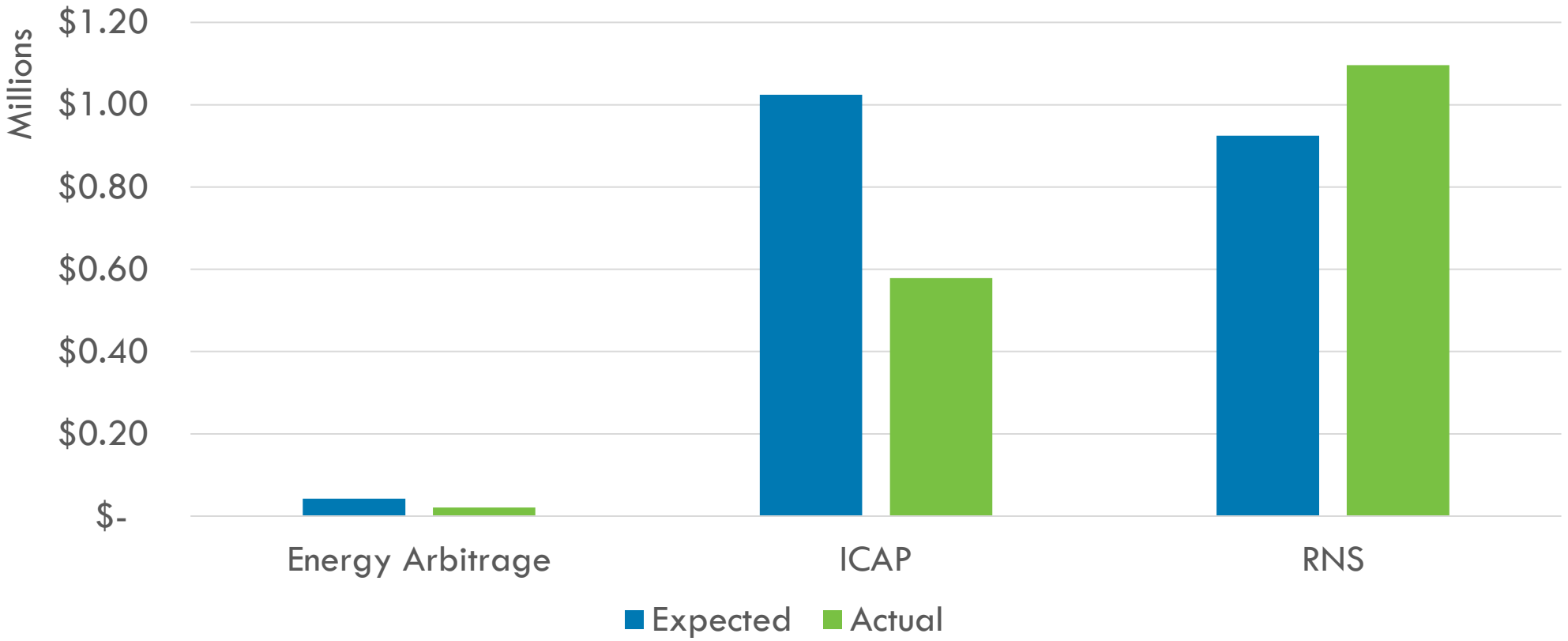
PROJECT DEVELOPMENT LESSONS LEARNED

- Multiple markets of interest:
  - Municipal light plants (front-of-meter)
  - Residential
  - C&I behind-the-meter
  - Public entities
- Project development challenges:
  - Interaction with fire departments
  - Interconnection protocols
  - Supply chain inconsistencies
  - Divergence from anticipated *pro forma*

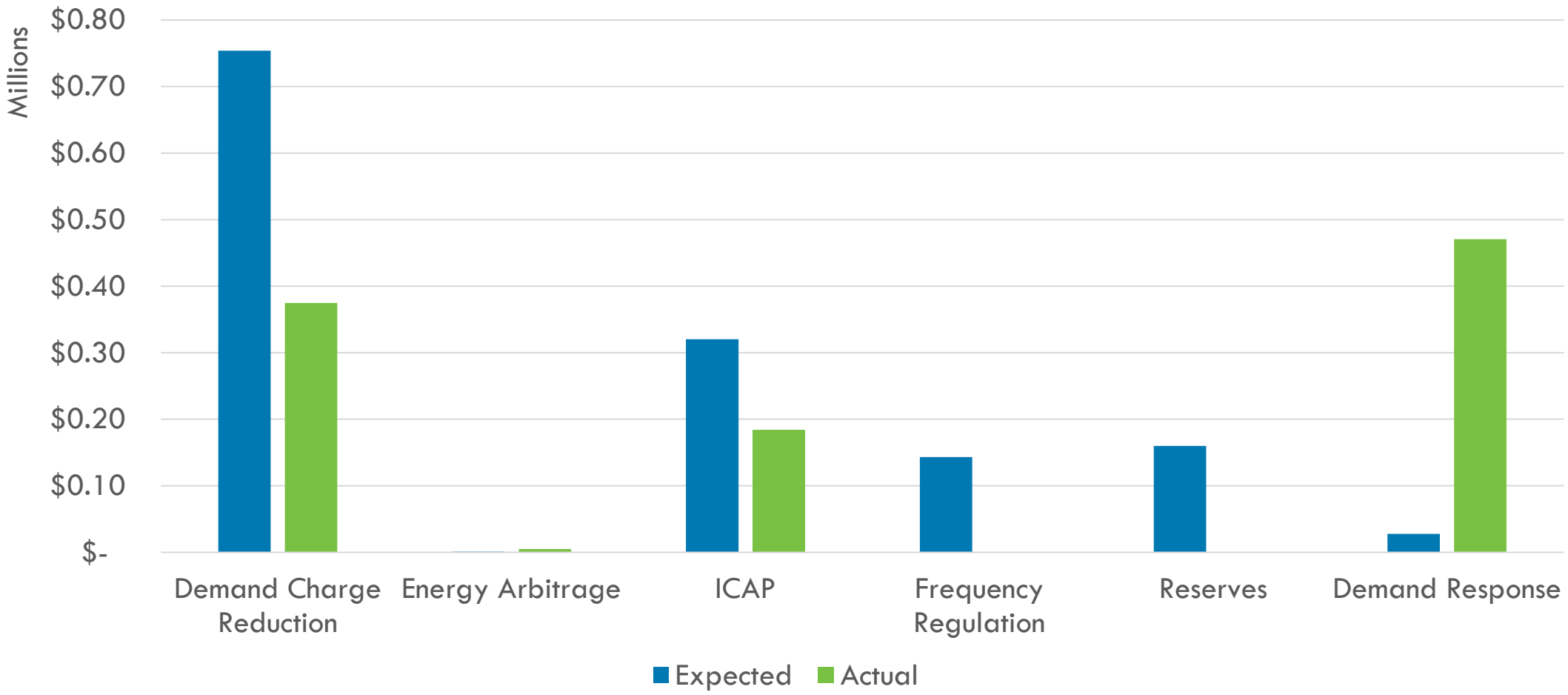
STATE OF CHARGE REPORT: ANTICIPATED BENEFITS FROM ENERGY STORAGE



ACES: ANTICIPATED VS. ACTUAL REVENUES FOR MLP PROJECTS



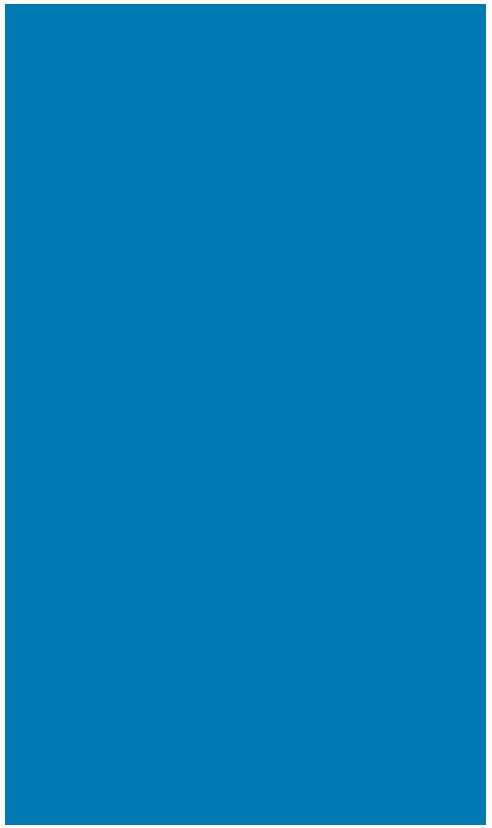
ACES: ANTICIPATED VS. ACTUAL REVENUES FOR BEHIND-THE-METER PROJECTS



ENERGY STORAGE AND RESILIENCE

CLEAN ENERGY AND RESILIENCY ("CLEAR") PROGRAM

- Site-specific studies
  - 14 from Community Microgrid program + 9 from CLEAR
  - Technical design + financial feasibility for providing clean backup power to critical facilities
  - Strong interest especially from coastal communities, communities in load pockets
- Additional scope: resiliency toolkit for communities
  - How much PV + battery do I need for an average MA fire station to ride through a 1 – 3 day outage?
- Additional scope: resiliency certification
  - How can first responders + storm response crews know that a site has ride-through capabilities?



ENERGY STORAGE FOR RESILIENCE: OBVIOUS IN THEORY, TRICKY IN PRACTICE

Dispatch procedure is unclear

- Hard to "value stack" and also reserve energy in the BESS in case of outages
- High-value applications (e.g. demand charge reduction) require deep discharge

Customers need lots of data to design good projects but data is often not available

- AMI data (ideally for several years) is required

Interconnection protocols are unclear and expensive

- Many system designs do not allow for islanding of behind-the-meter systems
- EDCs may require additional relays to ensure large systems are truly disconnected from the grid during an outage/islanding event (added expense)

No one wants to own the risk that a system won't perform during an outage

- "Resilient PPA" structures are not yet widespread or easily replicable

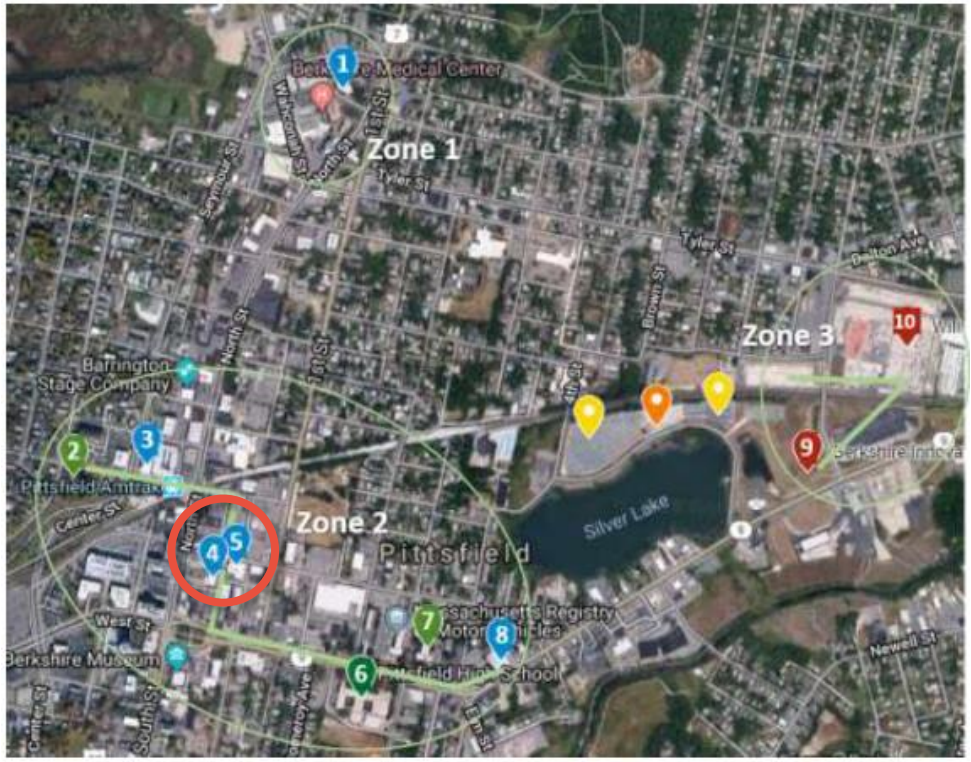
For microgrids, utility franchise rights dictate project feasibility

- Not clear what it means for a utility to "own and operate" the wires component of a microgrid w/customer generation assets

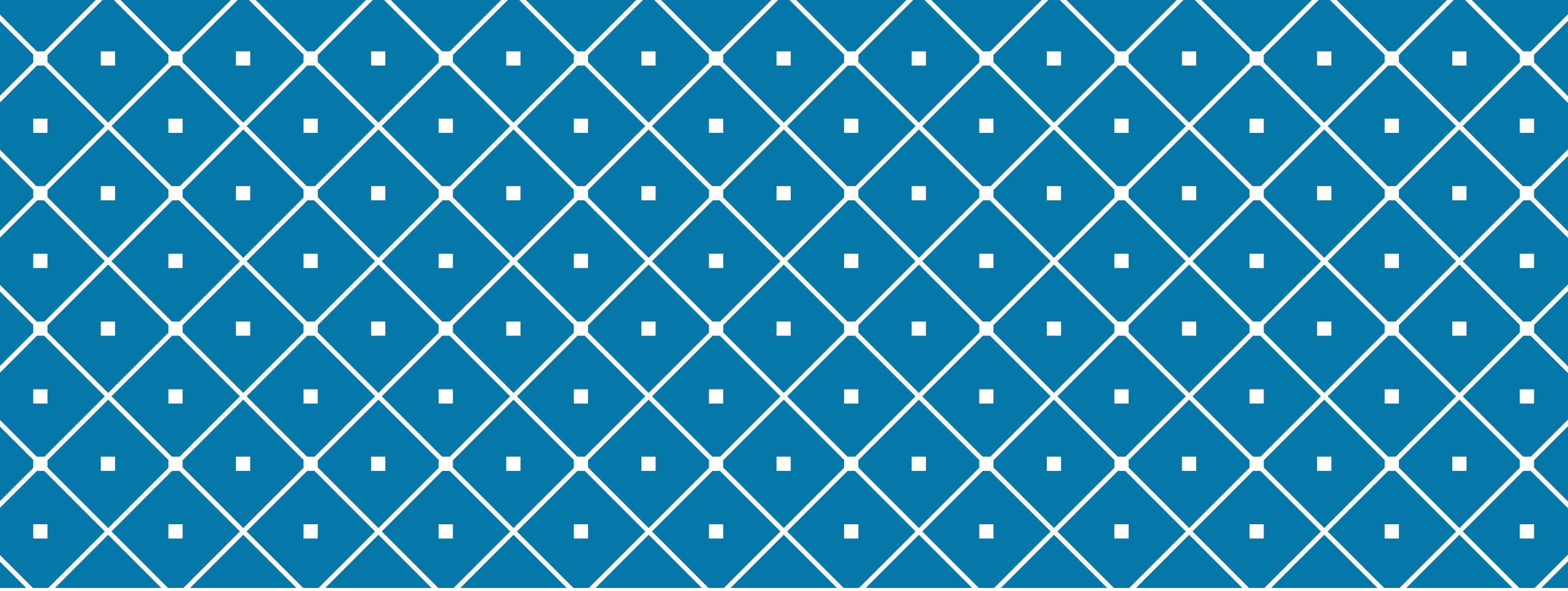
"Value of Resilience" remains undefined

- Market is growing in resi sector but not clear if this benefits "ratepayers" as a class
- Projects at larger facilities w/clearer public benefit rarely pencil, are difficult to execute

UTILITY INVOLVEMENT IN RESILIENCE: TOPOLOGY MATTERS



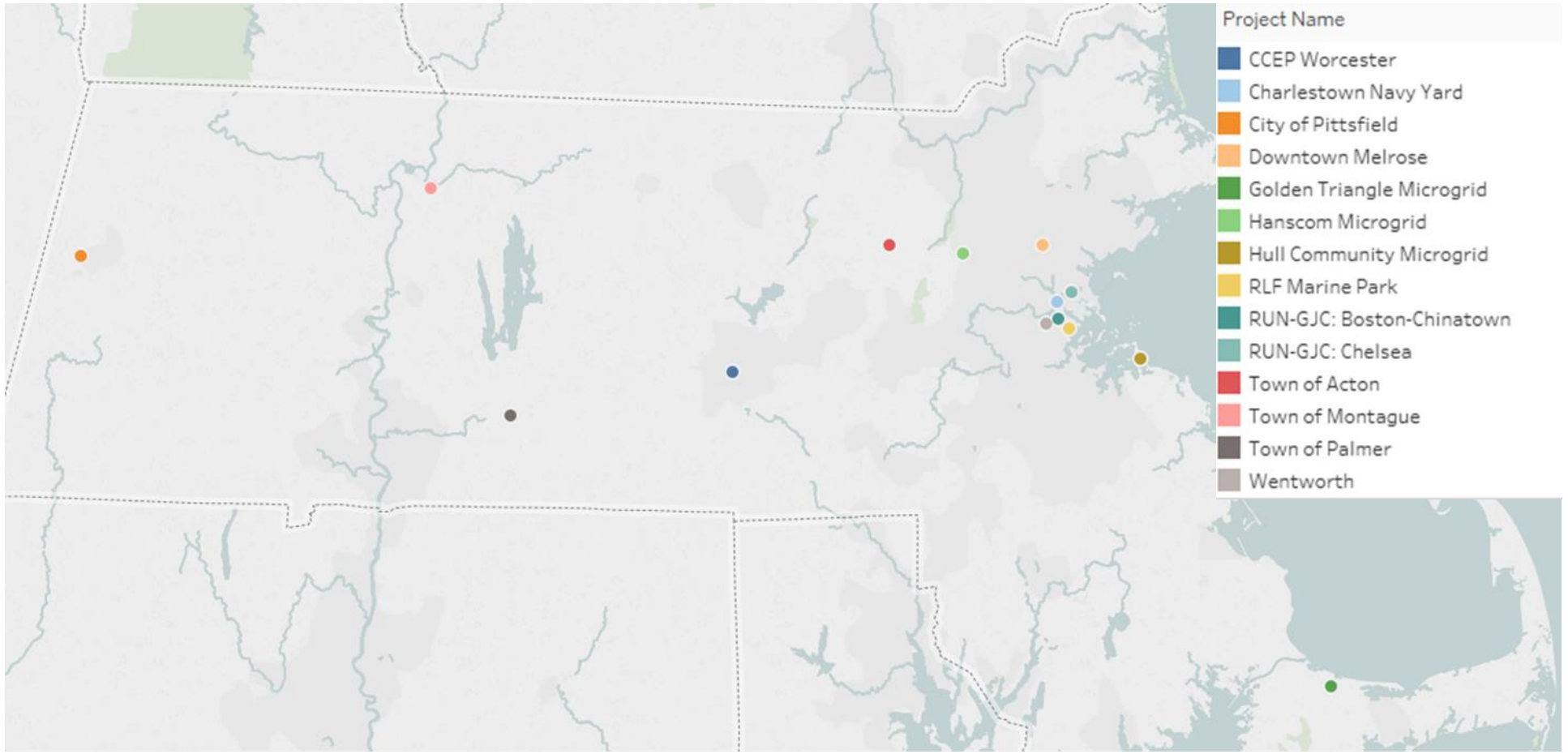
- True "microgrids" require buildings to be isolated from the greater grid
  - Could be one circuit, one substation
- Distribution infrastructure to enable isolation is expensive
- Your nearest neighbor isn't necessarily a neighbor at all on the grid
  - Critical facilities are not clustered by circuit
- EDCs can drive resiliency projects that cover multiple customers/facilities
- EDC collaboration is essential for customer-driven projects

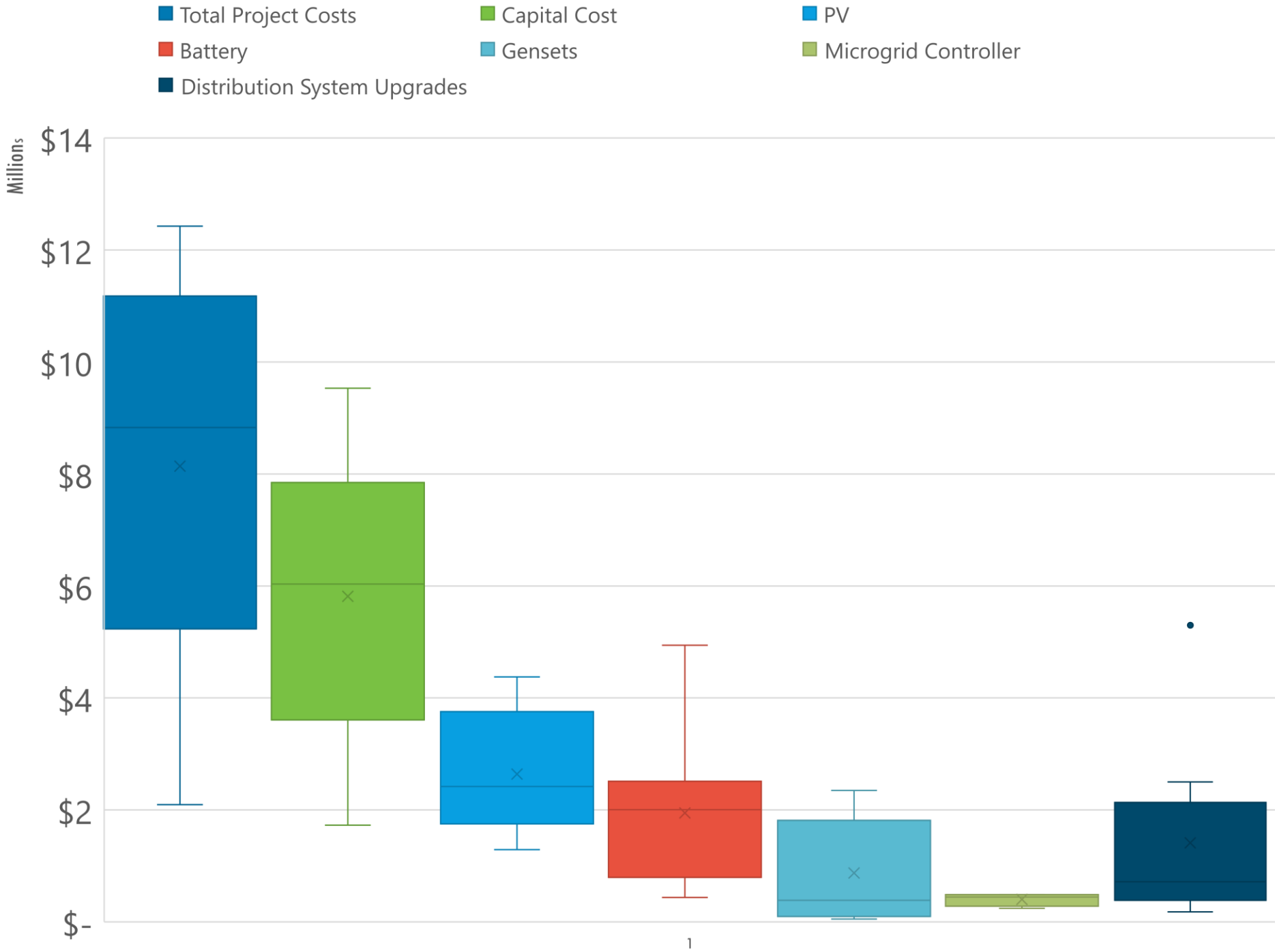


BACKUP

COMMUNITY MICROGRIDS PROGRAM:

FEASIBILITY STUDY LOCATIONS




Total Project Costs
Capital Cost
PV
Battery
Gensets
Microgrid Controller
Distribution System Upgrades
Millions
$14
$12
$10
$8
$6
$4
$2
$-
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