Front-of-Meter vs. Behind-the-Meter Batteries: An Economic Comparison for Massachusetts

October 8, 2025

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Affordable, reliable, clean energy for all.

Climate Resilience and Community Health

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Fossil Fuel Replacement

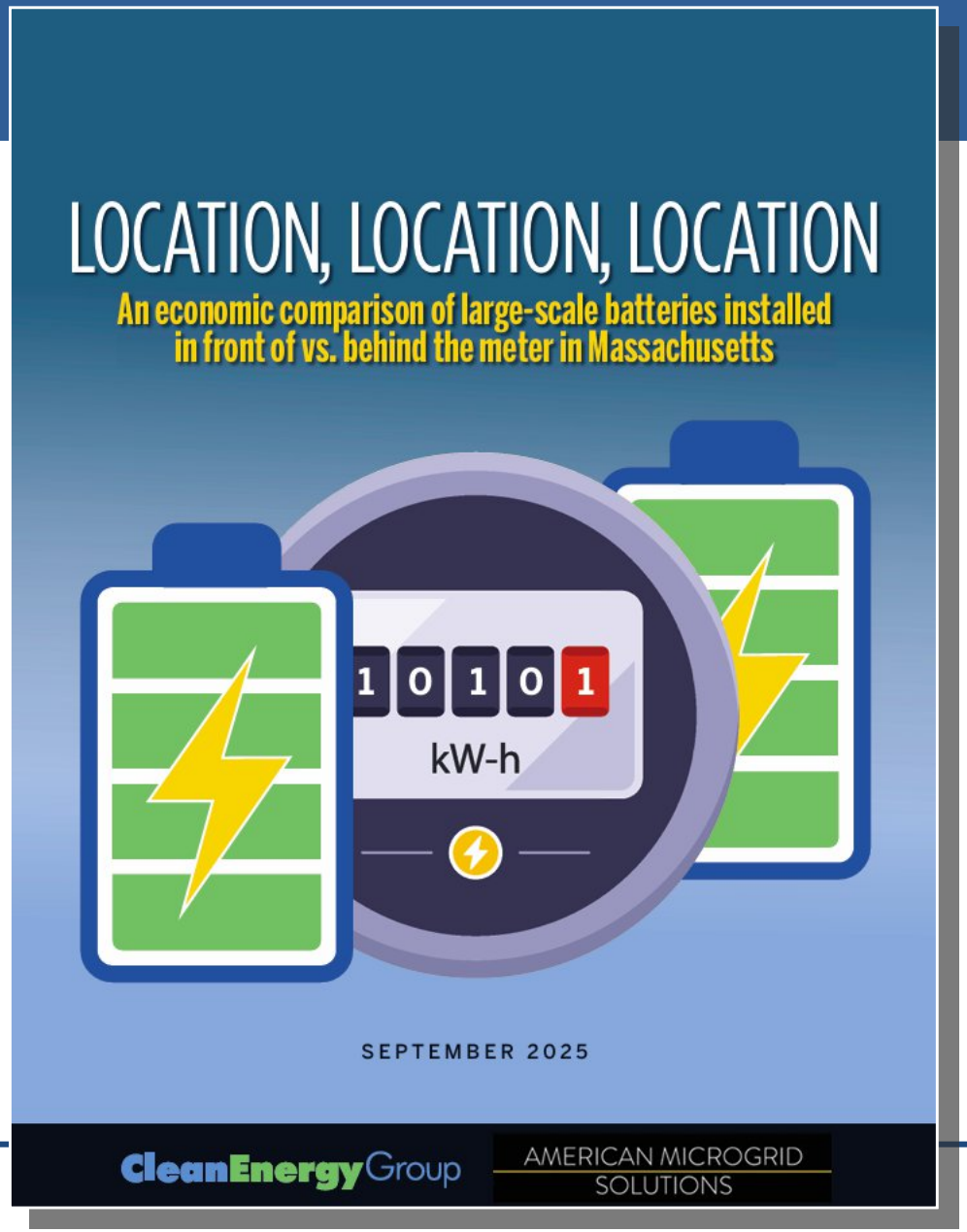
SEPTEMBER 2025

Location, Location, Location: An Economic Comparison of Large-Scale Batteries Installed in Front of vs. Behind the Meter in Massachusetts

Nate Mills

Clean Energy Group | American Microgrid Solutions

Available at: www.cleanegroup.org/publication/cvec-report



WEBINAR SPEAKERS

Front-of-Meter vs. Behind-the-Meter Batteries: An Economic Comparison for Massachusetts

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Thank You

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Tools to Tackle Affordability and Cost Allocation in Electricity Rate Design (November 6)

MassCEC's Vehicle-to-Everything Demonstration Program (November 12)

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C:VEC | Cape & Vineyard Electric Cooperative

an intergovernmental partner for energy-related projects

CVEC is grateful to the Clean Energy Group for its generous technical support on behalf of CVEC's 25 member towns, counties and participants from the Cape & Islands and SE Massachusetts.

And we are grateful for the expertise of the professional team at **American Microgrid Solutions**.

	Annual kWh (millions) when operational
CVEC 7 (7 projects)	0.85
R1 (8 projects)	19.80
R2 (7 projects)	13.60
R3 (7 projects)	1.00
R4 (13 projects)	10.40
R5 (13 projects)	8.00
R7 (2 projects)	.136
Total 74 Projects	**53.79**
3rd Party	10 MW
BESS (1 Project)	250 KW

C V E C:

- Operates under MGL c. 164, § 136 and § 137 which as a MA electric cooperative offers government entities a more comprehensive way to procure and manage renewable energy projects.
- Provides project development and management over the life of the project.
- Offers municipal procurement and project expertise and the ability to bundle multiple projects for joint procurement resulting in economies of scale.
- Is available to any MA government entity which can enter into an intergovernmental agreement or an energy-related contract, generally.
  - Any municipality or county or political subdivision thereof, or body politic that meets the requirements IRS Code § 115 is eligible to apply for membership.

25 Members: Aquinnah, Barnstable, Barnstable County, Bourne, Brewster, Cape Light Compact, Chatham, Chilmark, Dennis, Dukes County, Eastham, Edgartown, Falmouth, Harwich, Oak Bluffs, Orleans, Marion, Mashpee, Nantucket, Provincetown, Sandwich, Tisbury, Truro, West Tisbury, and Yarmouth.

10 Governmental Participants (to date): Cape Cod Gateway (former Barnstable) Airport, Barnstable Fire District, D-Y Regional School District, Harwich Water District, Monomoy Regional School District, Martha's Vineyard Airport, Nauset Regional School District, Cotuit-Osterville-Marston Mills Fire District, Sandwich Water District, and Upper Cape Regional Water District.

CVEC Projects with BESS

www.cvecinc.org

Oak Bluffs Elementary School Roof & BESS

Nauset Regional Middle School Canopy & BESS

W.Tisbury Library

Tisbury Senior Center

CVEC evaluates the economics of a PPA with or without a battery and has focused specific locations.

Projects from 2013-2015 were primarily large-scale solar with benefits shared among multiple members.

Since 2017-2018, projects have been site-specific.

1) What benefits do Towns want the most?

- **Bill savings**
- **Net Zero**
- **Resilience / backup power.** Keep critical loads on during outages (DPW, public safety, shelters). This drives enclosure type, duration (often 4-8 hours for resiliency), and interconnection (islanding with transfer switch or microgrid controller).
- **Program revenues ("stacking").**
  CVEC's model allows Developers to retain incentives to lower PPA Costs.
  - **ConnectedSolutions** (utility demand response)—performance payments for discharging during summer peaks.
  - **Clean Peak Standard (CPS)**—earn Clean Peak Energy Certificates.
  - **SMART storage adder** : Updated SMART rules for eligibility by size and site.

2) Incentives & financing structure (public entities).

ITC flows to owner of system. Should result in lower PPA cost.

- Federal Investment Tax Credit (ITC) for standalone storage is available at 30%; municipality CVEC's model is for CVEC to execute PPA with a developer who monetizes tax benefits and passes value through in a fixed price. CVEC resells energy to Town.

3) Interconnection Costs.

Costs and timeframe due to Capital Improvement Plan for Grid. $357/ kW

CVEC's current procurement model

MGL c. 164, s. 137

- *Because batteries at individual locations did not pencil out, we opened the discussion with CEG about one large-scale battery.*
- *CVEC may develop/own renewable systems for itself and pass benefits to members.*

CVEC begins a ROUND of projects upon receipt of Commitment Letters

Participation Fee (non-refundable installments).
Installments, so that a Project Participant may withdraw before a Phase begins for any reason.

Phase 1 Project Evaluation

- **CVEC conducts site visit, prepares a feasibility (e.g., size, right-sizing the BESS) and financial analysis*** by reviewing 12 months of utility bills, making preliminary interconnection evaluations, and assessing past, current and future needs.

Phase 2 Request for Proposals

- CVEC prepares, issues and manages all aspects of the RFP
- A team of experienced staff, legal counsel and expert consultants ensure that procurements are well-planned and comprehensive.

Phase 3 Proposal/Developer Selection

- CVEC reviews the proposals, conducts an analysis, confers with the Host and makes a developer selection.

Phase 4 Contract Execution

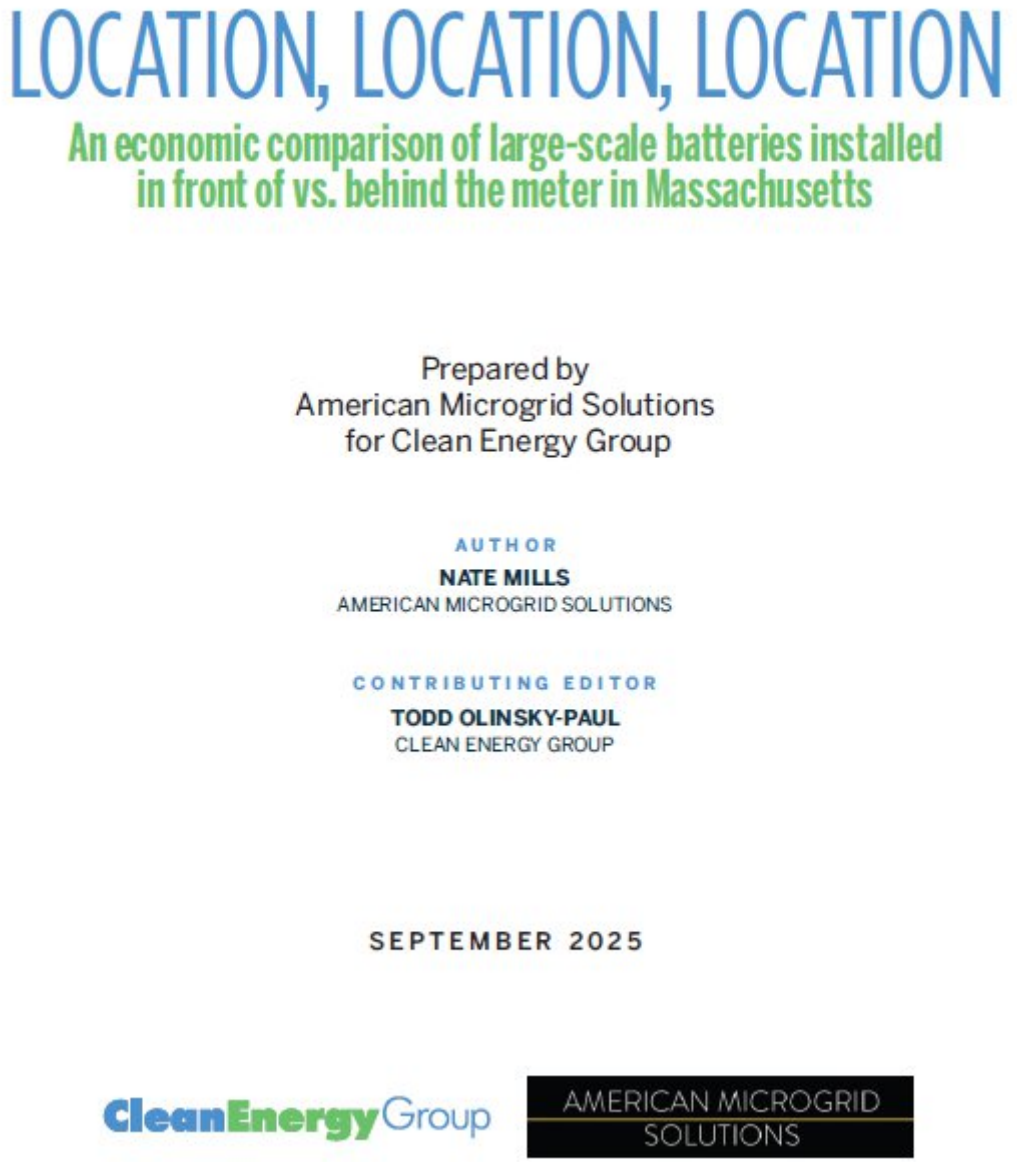
- CVEC negotiates and facilitates execution of Participant and Developer contracts which CVEC's attorneys have prepared.

CVEC coordinates the construction process and manages the project over its term.

And … the question for CVEC became:

Which is “better” ? individual behind-the-meter (BTM) locations or one utility-scale, front-of-the-meter (FTM)

Which model has the better economic profile for the member and/or for CVEC collectively as a cooperative?


LOCATION, LOCATION, LOCATION

An economic comparison of large-scale batteries installed in front of vs. behind the meter in Massachusetts

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SEPTEMBER 2025

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CVEC Battery Analysis

FTM vs BTM Comparison

American Microgrid Solutions

October 2025

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American Microgrid Solutions: Turnkey Services

Operate & Maintain microgrids

Identify facilities that will benefit from microgrids

Model, optimize and design microgrid solutions

AMERICAN MICROGRID SOLUTIONS

American Microgrid Solutions manages each stage to deliver turnkey projects

Manage installation and commissioning of the systems

Secure Permits & Authorizations

Source, secure & manage project finance for the microgrid

Methodology

Category	Common Assumption	Notes
Financial Horizon	20 years	All financial proformas modeled over a 20-year lifespan.
Discount Rate	6%	Used for Net Present Value (NPV) calculations.
Financing Structure	Cash transaction	No debt financing assumed for either system.
Prevailing Wage	Required	Municipal installations assume required.
ITC Eligibility	Investment Tax Credit (ITC)	Both eligible for Direct Pay; Energy Community adder applied if applicable.
Cost Basis	Equal capital budget ($4.54M)	Ensures apples-to-apples comparison of outcomes.
O&M Costs	Included annually	Both include O&M and software costs.
Inflation / Escalation	Same across both systems	Held constant to ensure comparative parity.
Technology Type	Lithium-ion battery	Assumes commercial-scale lithium-ion systems with similar degradation curves.
Performance Degradation	Modeled	Capacity adjustments or replacement as needed.
Labor / Materials	Massachusetts market rates	Reflects current regional pricing.
Installation Assumptions	No major utility or facility upgrades	Simplifies cost comparison for both configurations.

Front-of-the-Meter (FTM) Systems

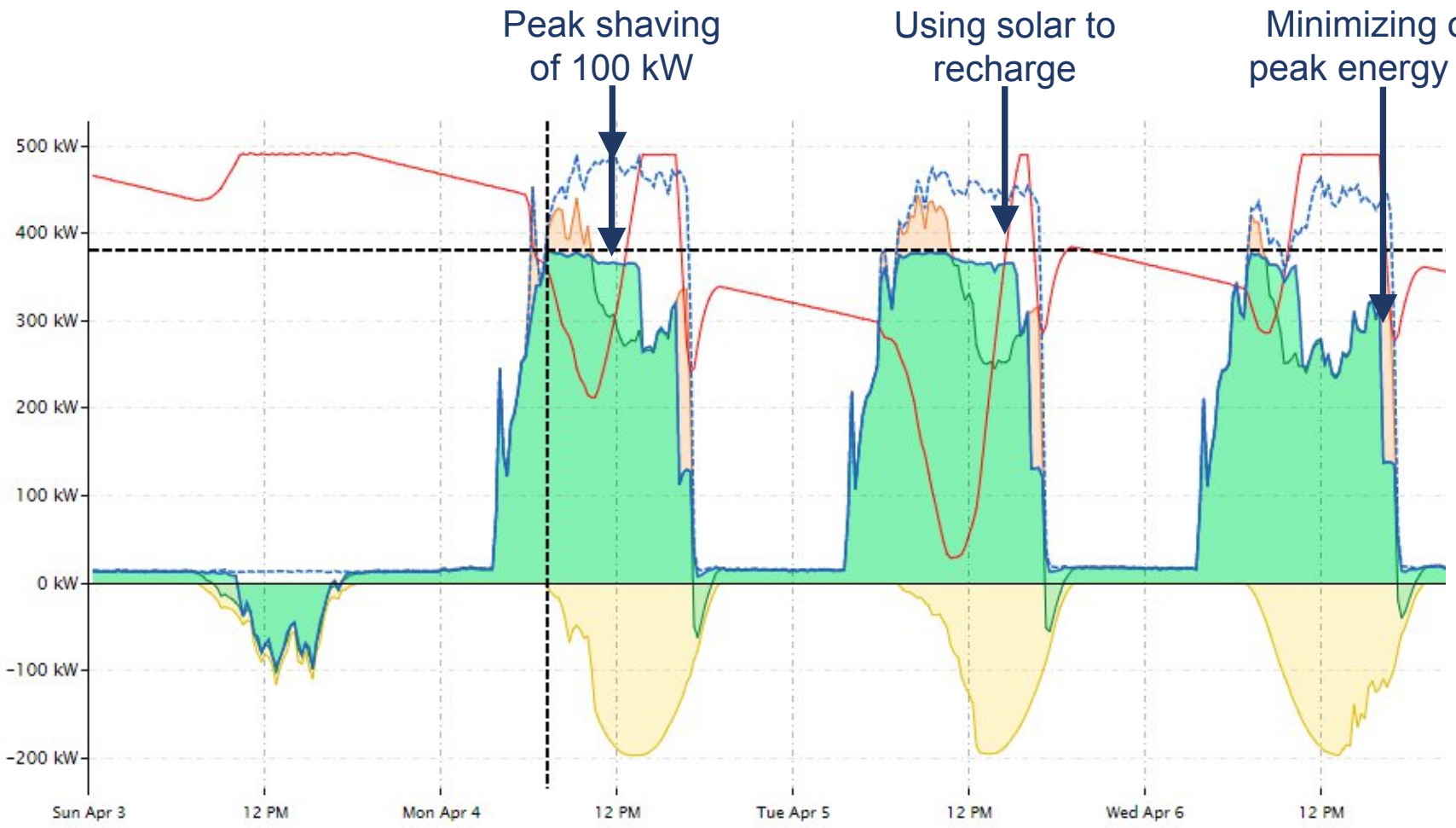
Front-of-the-Meter (FTM) system – Source: BusinessWire / Lightshift Energy, June 18, 2025

- A single municipal site
- No associated on-site load
- No associated solar
- Fewer revenue streams
- Provides no resilience
- Multiple shipping containers
- Total size:
  - Solar: 0 kW
  - Storage: 2 MW / 12.5 MWh
- Total Cost: $4.54M

Behind-the-Meter (BTM) Systems

- Five municipal sites
- Directly serving on-site load
- All with rooftop solar
- Multiple revenue streams
- Provides resilience to the site
- Parking spot size
- Total size:
  - Solar: 567 kW
  - Storage: 490 kW / 1,175 kWh
- Total Cost: $4.54M

BTM On-Grid: Value Stacking



Value Streams

Least complex Controls

- TOU
- Self-Consumption
- Peak Shaving
- Export Avoidance
- Incentive Participation
- Market Participation
- Virtual Power Plant

Most complex controls

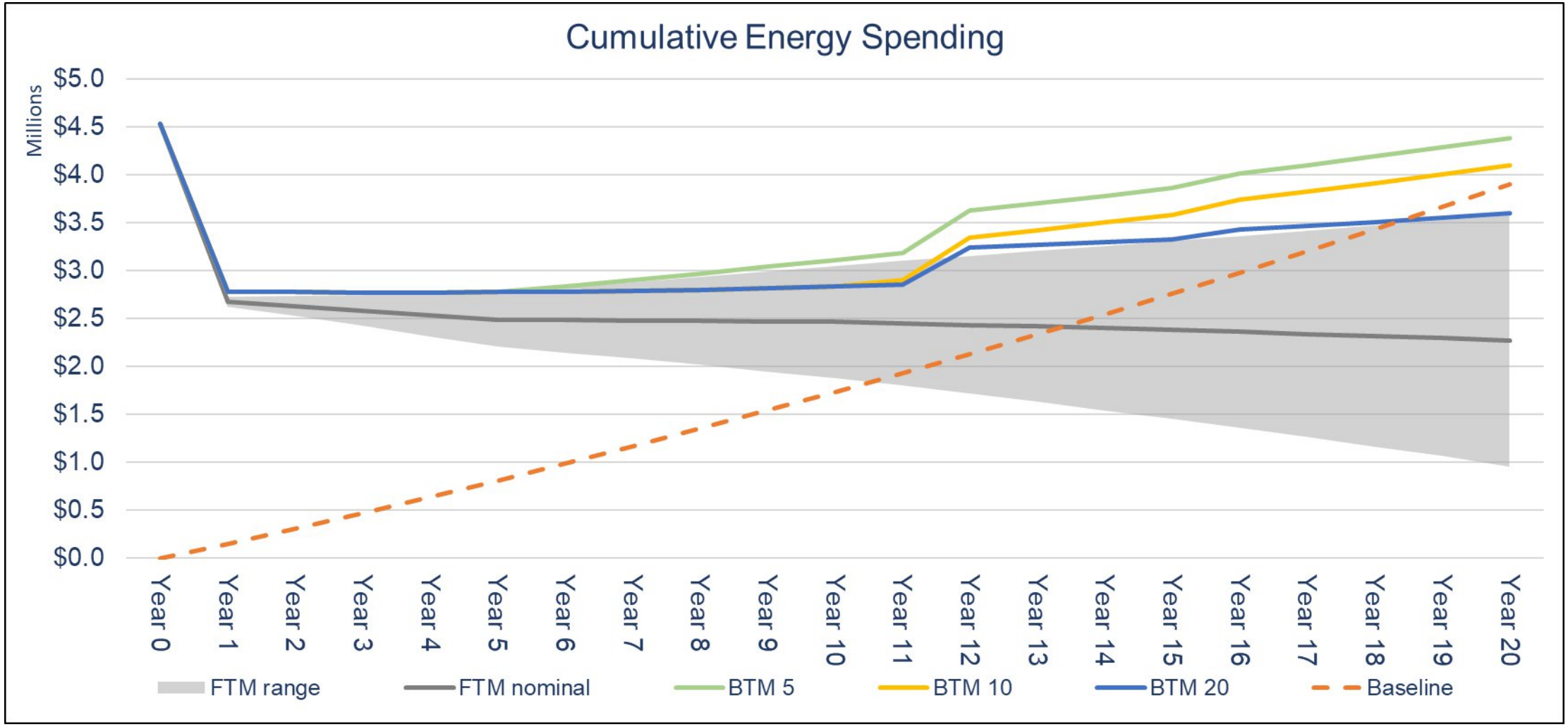
Qualitative Comparison

Category	Behind-the-Meter (BTM)	Front-of-the-Meter (FTM)
Resilience	• Provides local backup power during outages • Improves community resilience.	• Does not provide backup capability for individual facilities.
Implementation Speed	• Faster to implement, simpler permitting • Can be phased in over time.	• Longer development and permitting; interconnection queue delays likely.
Regulatory Risk	• Low — standard municipal permitting and fewer approvals.	• High — requires utility coordination, EIAs, and public engagement.
Operational Complexity	• Simple local operation and maintenance • Fewer stakeholders	• Complex grid integration • Requires utility management/coordination
Sustainability	• Paired with rooftop solar for emissions reduction and on-site renewable use.	• Supports renewables indirectly through grid-level stabilization.
Scalability	• Modular and flexible — easy to expand over time.	• Efficient once built, but less flexible to modify later.
Key Risks	• Limited physical space and electrical capacity at some sites.	• Potential interconnection delays, regulatory hurdles, or public opposition.

Quantitative Comparison

	BTM (5-year incentives)	BTM (10-year incentives)	BTM (20-year incentives)	FTM (single battery)
Solar	567 kWh	567 kWh	567 kWh	--
Battery	490 kW / 1,175 kWh	490 kW / 1,175 kWh	490 kW / 1,175 kWh	2 MW / 12.5 MWh
Capital Cost	$4,541,588	$4,541,588	$4,541,588	$4,541,588
ITC	$1,750,156	$1,750,156	$1,750,156	$1,816,635
Capital Cost after ITC	$2,791,432	$2,791,432	$2,791,432	$2,724,953
IRR	-2.2%	-1.2%	0.7%	4.4%
NPV @6%, 20 years	($1,407,458)	($1,241,188)	($1,045,895)	($371,671)
Simple Payback (years)	~24	~22	19	14
First-year cash flow	$162,003	$162,003	$162,003	$197,369
20-year cash flow	($478,588)	($199,099)	$300,912	$1,632,269

Quantitative Comparison



Choosing Your Path

FTM is for entities that:

- Seek higher internal rate of return (IRR) and strong long-term cash flow.
- Have access to large, utility-interconnected sites.
- Prefer a single, centralized project over multiple smaller installations.
- Are comfortable negotiating with utilities.
- Can tolerate longer permitting and interconnection timelines.
- Aim to optimize portfolio-level financial performance rather than site-level resilience.
- View resilience as non-critical or already addressed by other assets.
- Are willing to manage environmental review and community outreach for large infrastructure projects.

BTM is for entities that:

- Operate critical municipal or community facilities (e.g., town halls, DPWs, emergency services)
- Prefer direct control over their own energy assets.
- Have rooftop solar or plan to expand on-site renewables.
- Face limited interconnection capacity or long interconnection timelines.
- Can phase projects over time using internal or grant funding.
- Value on-bill savings.
- Prioritize sustainability goals.
- Want to minimize regulatory risk and complexity.
- Have sufficient site space and local electrical capacity to host systems.

Thank you for the opportunity to present our work!

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