

Opportunities: Electrification & Battery Storage



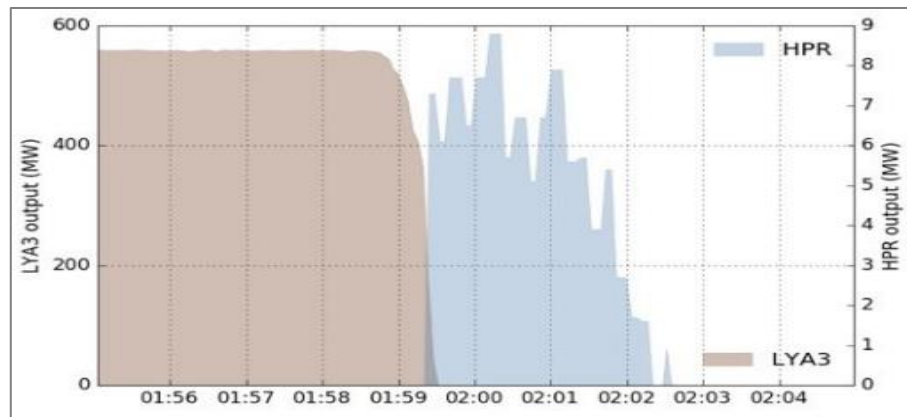
Kate Crosby, Energy Manager
Acton-Boxborough Regional School District

December 21, 2017

Tesla big battery outsmarts lumbering coal units after Loy Yang trips

“Last Thursday, one of the biggest coal units in Australia, Loy Yang A 3, tripped without warning...with the sudden loss of 560MW and causing a slump in frequency on the network.

“What happened next has stunned electricity industry insiders....Even before the Loy Yang A unit had finished tripping, the [Tesla battery] had responded...



“Data...shows that the Tesla big battery responded four seconds ahead of the generator contracted to provide FCAS (frequency control and ancillary services)...pretty much instantaneous.

“Tesla weren’t officially playing in that market, but just wanted to show what they could do. And they did.”

<https://reneweconomy.com.au/tesla-big-battery-outsmarts-lumbering-coal-units-after-loy-yang-trips-70003/>

March 29, 2019

Florida utility to close natural gas plants, build massive solar-powered battery

“The plan calls for the construction of a **409 MW/ 900 MWh** battery installation...

“For context, the largest battery installation in the world was built by Tesla...in South Australia [with] a capacity and power rating of **100 MW / 129 MWh.**”



New Solar + Battery Price Crushes Fossil Fuels, Buries Nuclear

“The Los Angeles Board of Water & Power Commissioners is expected to approve a 25-year contract that will serve 7 % of the city's electricity demand at **1.997¢/kwh** for solar energy and **1.3¢/kwh** for power from batteries.

“...the lowest solar-photovoltaic price in the US...the largest and lowest-cost solar + storage project in the US and we believe in the world today,’ said the agency's manager for strategic initiatives.

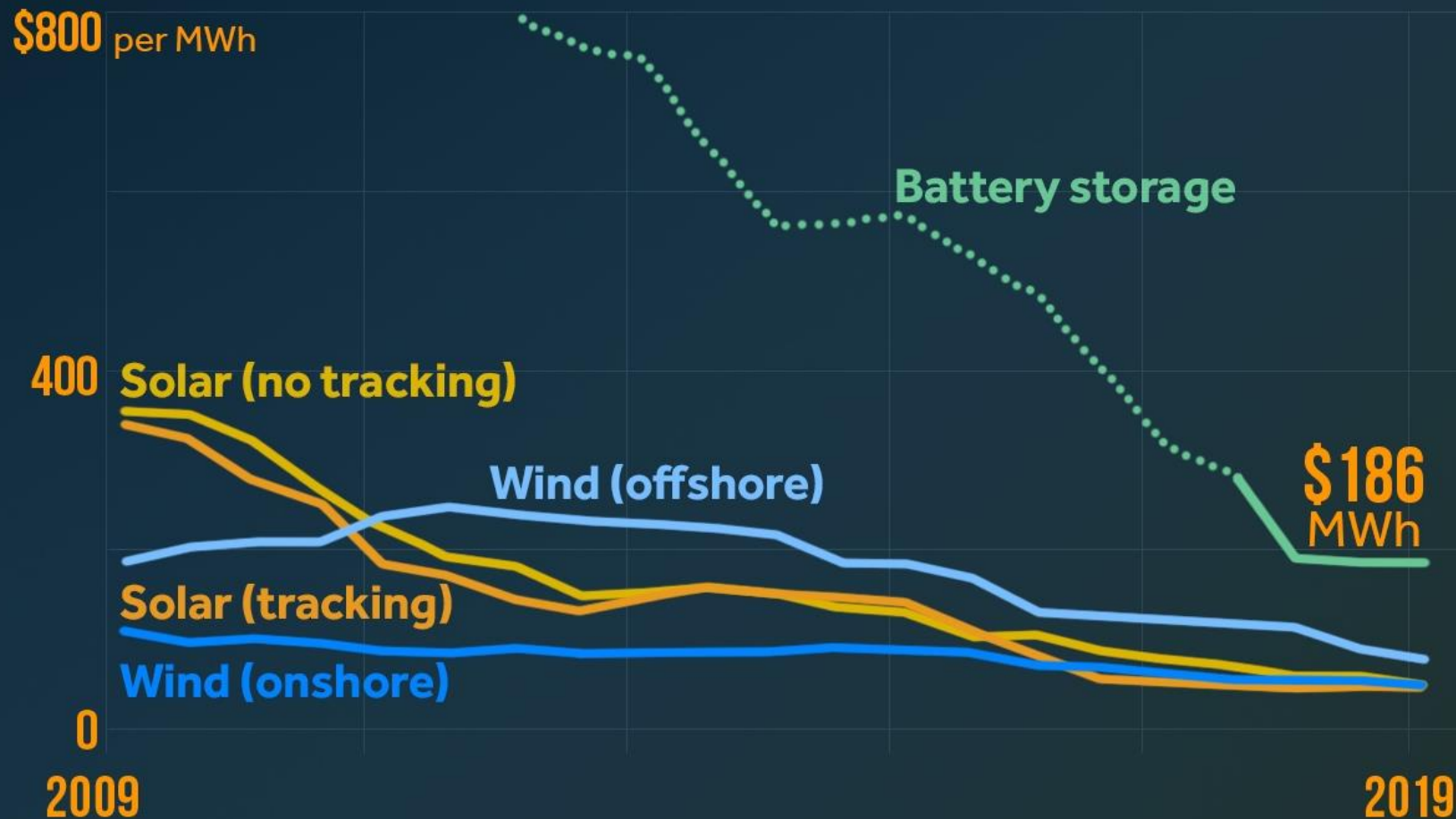


“...half the estimated cost of power from a new natural gas plant.”

<https://www.forbes.com/sites/jeffmcmahon/2019/07/01/new-solar--battery-price-crushes-fossil-fuels-buries-nuclear/#7c38b1985971>

SOLAR, WIND AND BATTERY PRICES FALLING

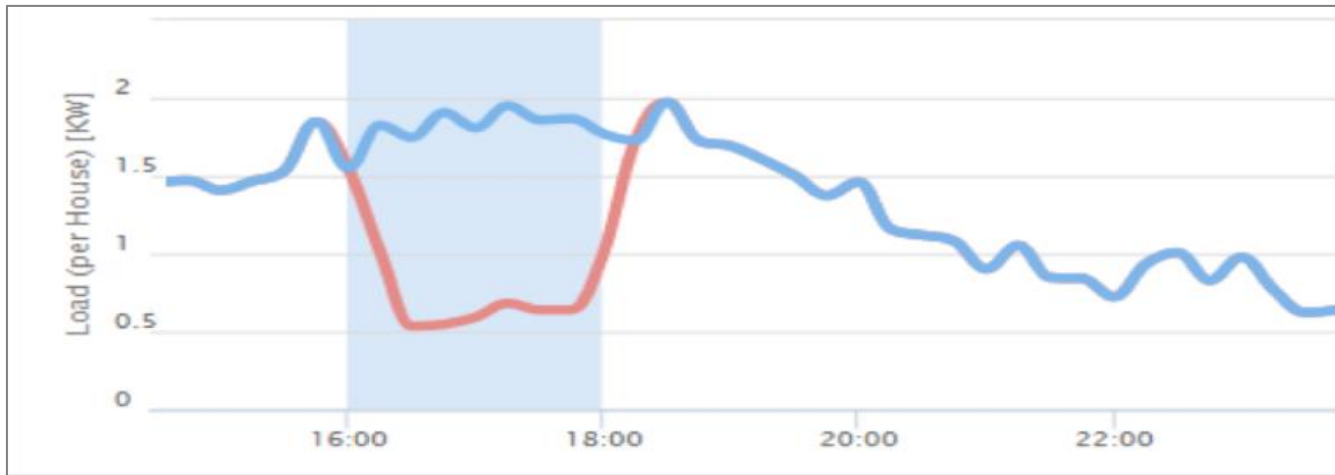
BloombergNEF Levelized Cost of Energy



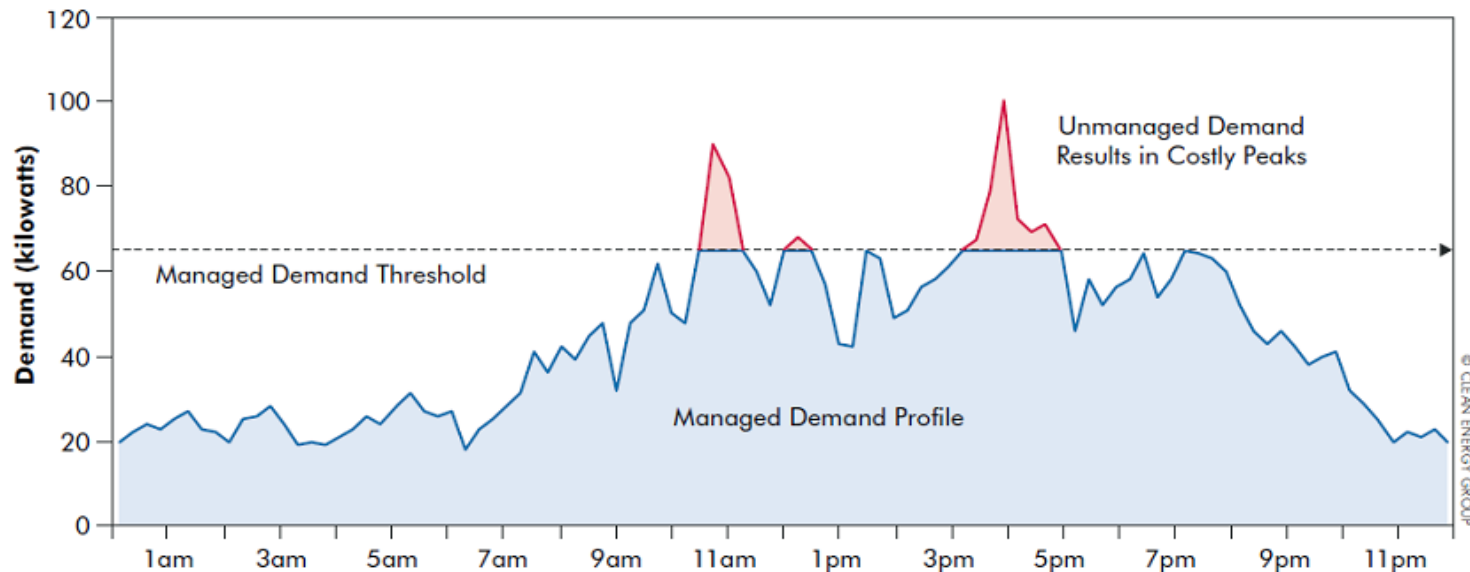
Source: BloombergNEF Note: The global benchmark is a country weighted-average using the latest annual capacity additions. The storage LCOE is reflective of a utility-scale Li-ion battery storage system with four-hour duration running at a daily cycle and includes charging costs assumed to be 60% of wholesale average power price. Data as of October 22, 2019.

High demand costs → opportunities

- Participate in Demand Response programs to generate revenue

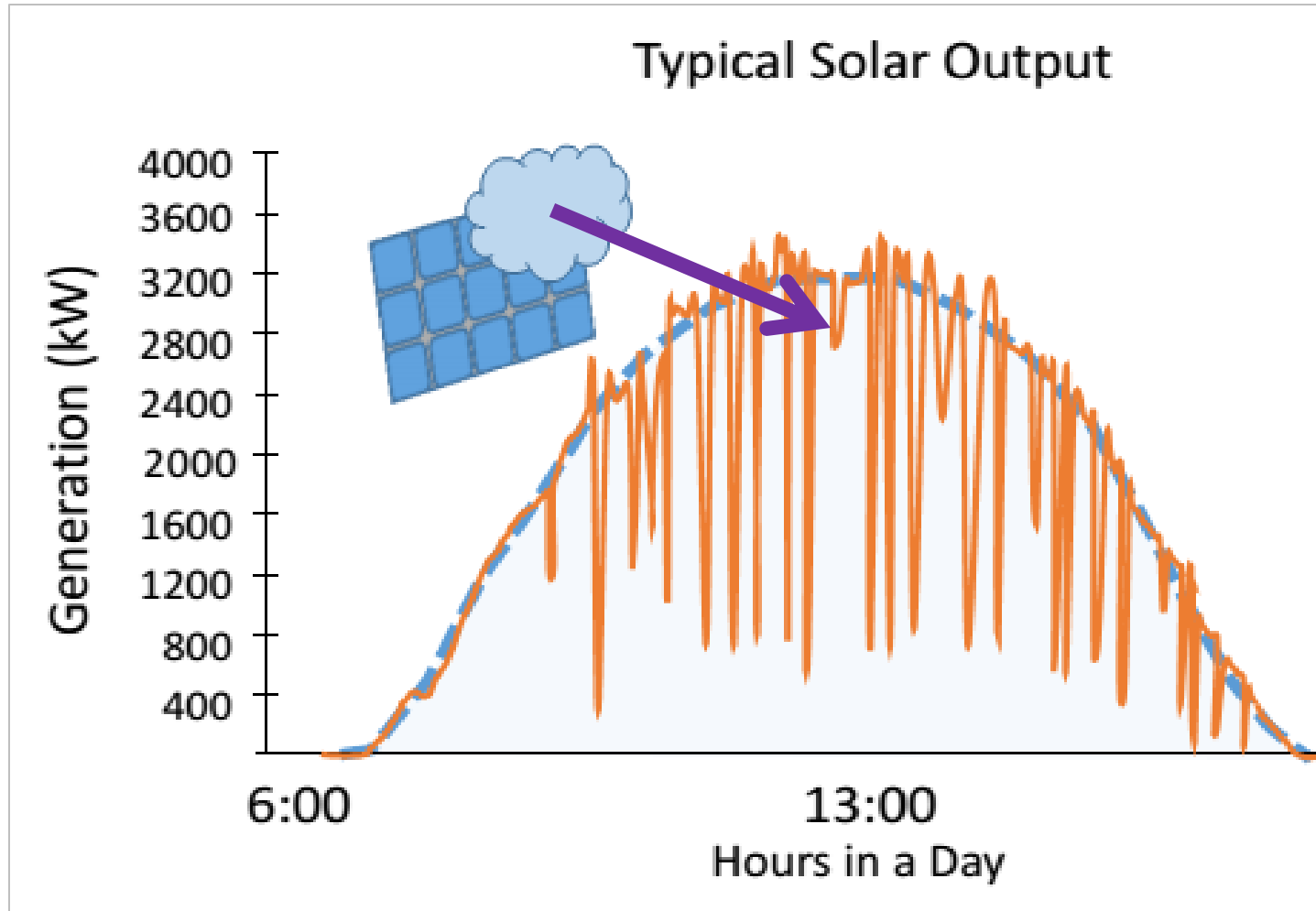


- Reduce demand charges by “snipping peaks” on your electricity account(s)



Source An Introduction to Demand Charges (Clean Energy Group/NREL)

Solar arrays do ***not*** provide steady protection from 15-minute demand charges because generation is variable.

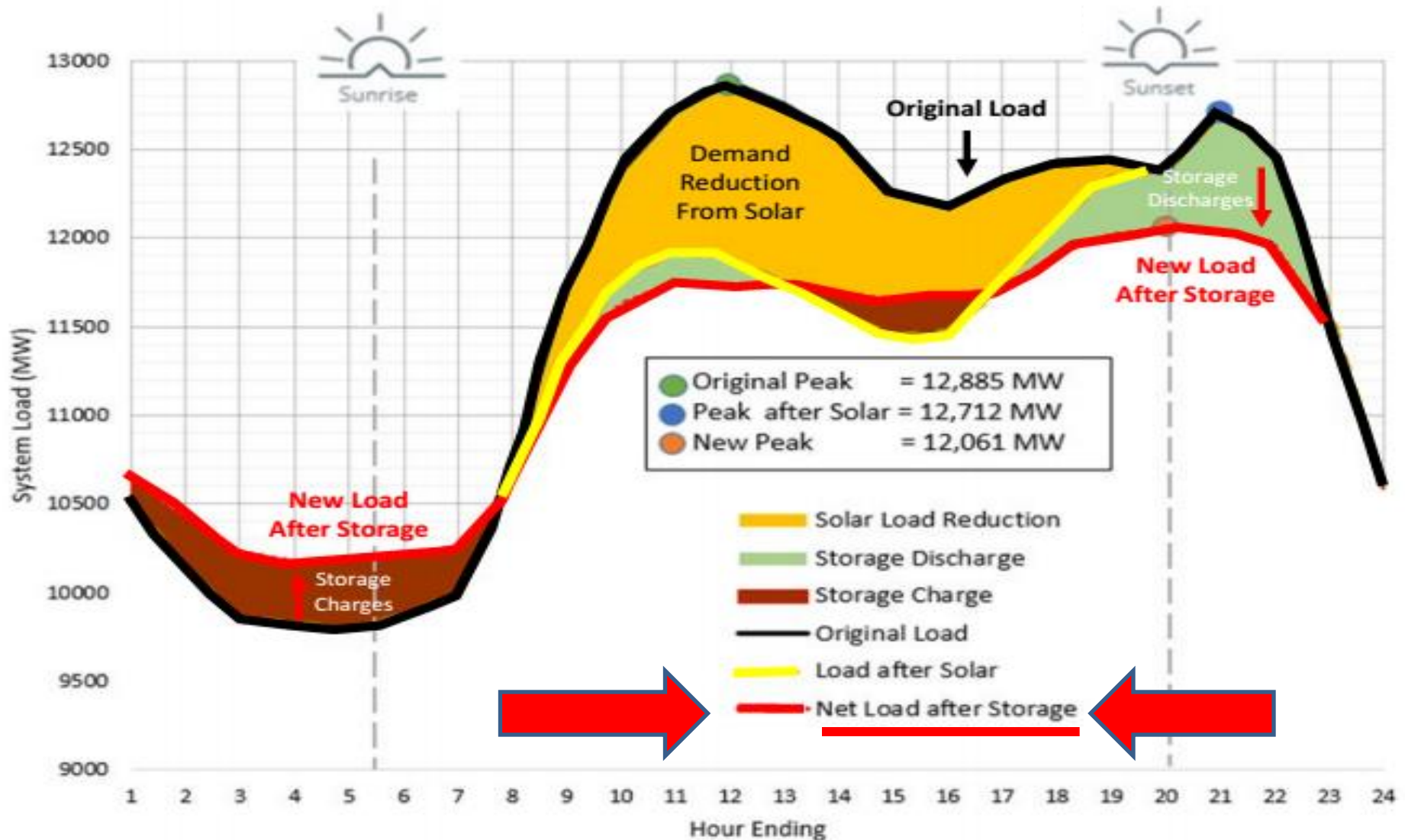


Source How to Estimate Demand Charge Savings from PV on Commercial Buildings (NREL)

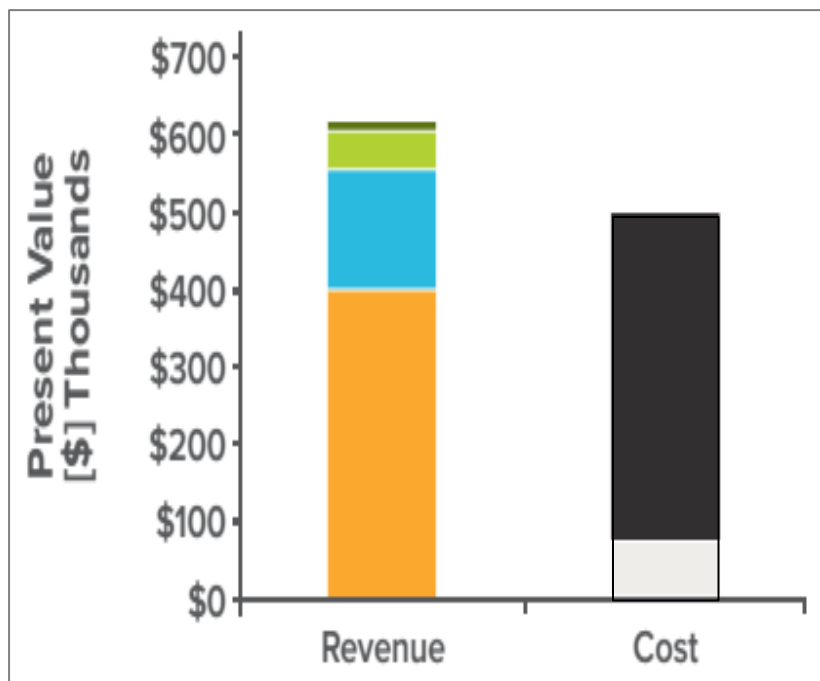
Source Massachusetts Energy Storage Initiative: State of Charge (MA DOER, MA CEC)

Solar + Storage:

“Time Shift” of Renewables & Peak Load Reduction



“Value Stack” – Battery Economics



REVENUE:

- Demand Charge Reduction
- Resource Adequacy (Forward Reserve Market = reserve capacity)
- Frequency Regulation
- Load Following/Arbitrage

COSTS:

- Capital
- O&M & Charging

Key

ISO/RTO SERVICES: ■ Load Following ■ Frequency Regulation ■ Spin Reserve ■ Non-Spin Reserve

UTILITY SERVICES: ■ Resource Adequacy ■ Dist Deferral

CUSTOMER SERVICES: ■ TOU ■ Self-Consumption ■ Demand Charge Reduction

COSTS/TAX: ■ Capital Cost ■ O&M & Charging ■ Tax Cost ■ Tax Benefits



ACES (Advancing Commonwealth Energy Storage)

2MW/4MWh battery storage array (on central school campus)

Dec. 2017 = grant award

Dec. 2020 = commissioning



ABRSD Central Campus Storage Project

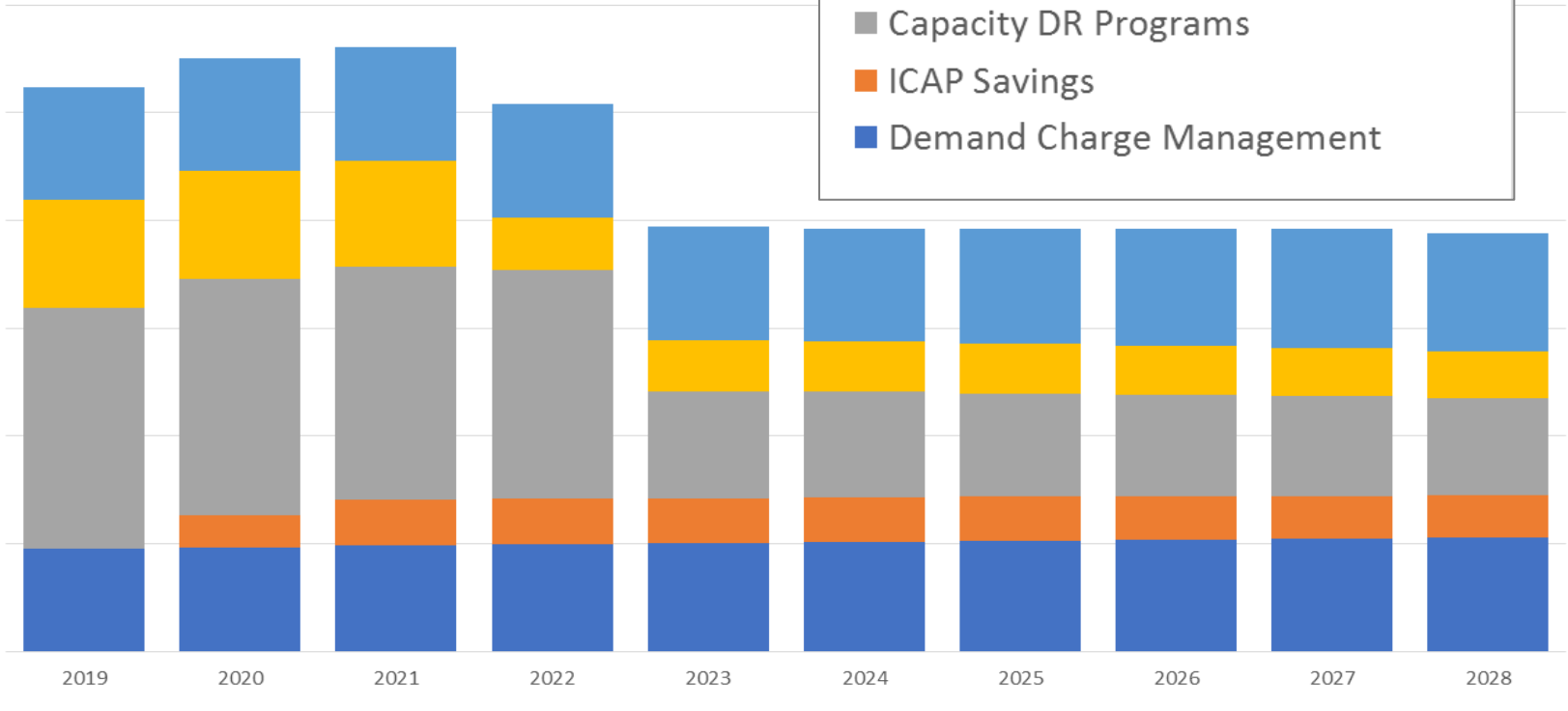
Revenue Projection

Plus new Clean Peak Standard

Sources of Battery Revenue and Savings over Time

\$\$ (revenue & cost savings)

- ISO-NE Frequency Regulation (ATRR)
- ISO-NE Reserves
- Capacity DR Programs
- ICAP Savings
- Demand Charge Management



Demand Charge Management ICAP Savings Capacity DR Programs ISO-NE Reserves ISO-NE Frequency Regulation (ATRR)

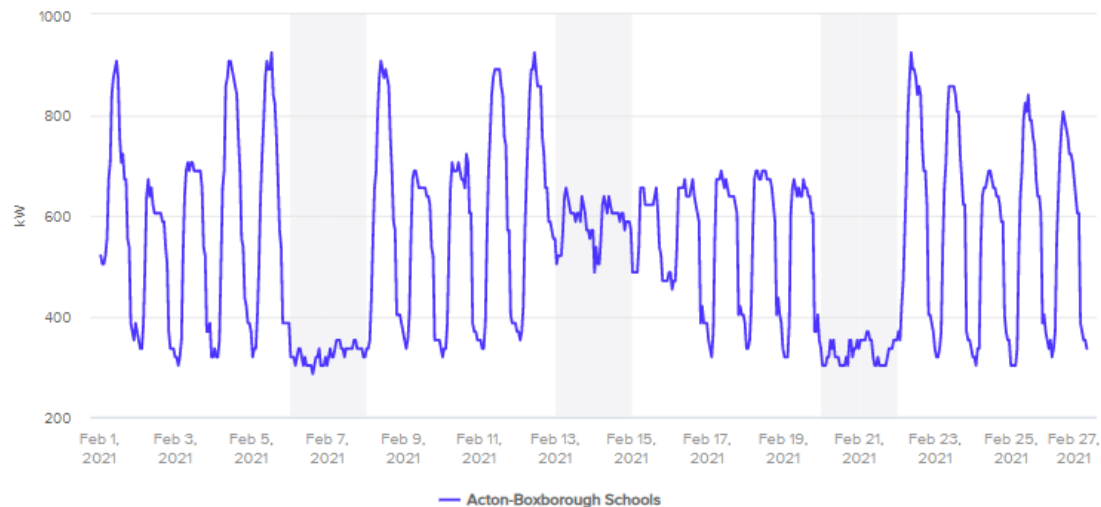
Compare Trends

Compare To Past

Current date range

2/1/21 - 2/26/21

Interval 1 hour



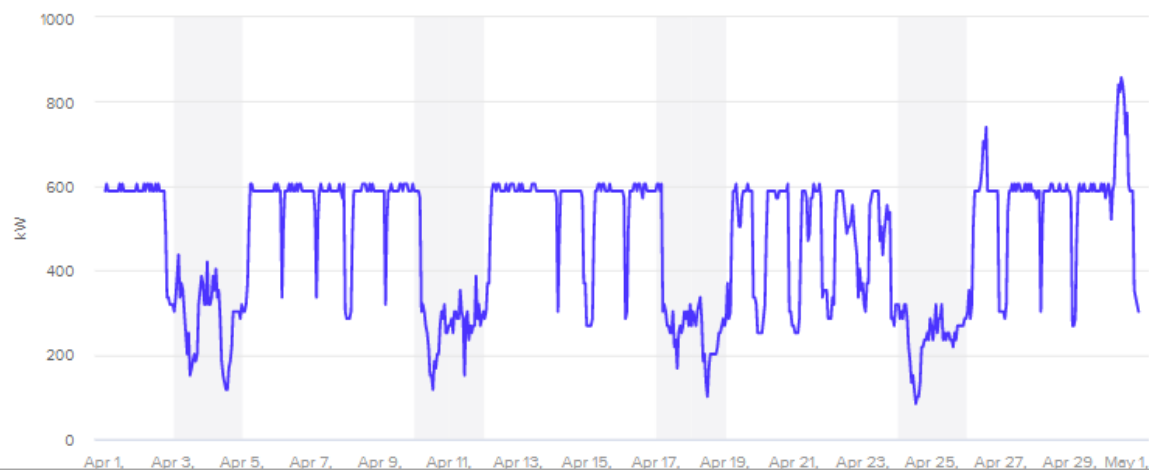
Compare Trends

Compare To Past

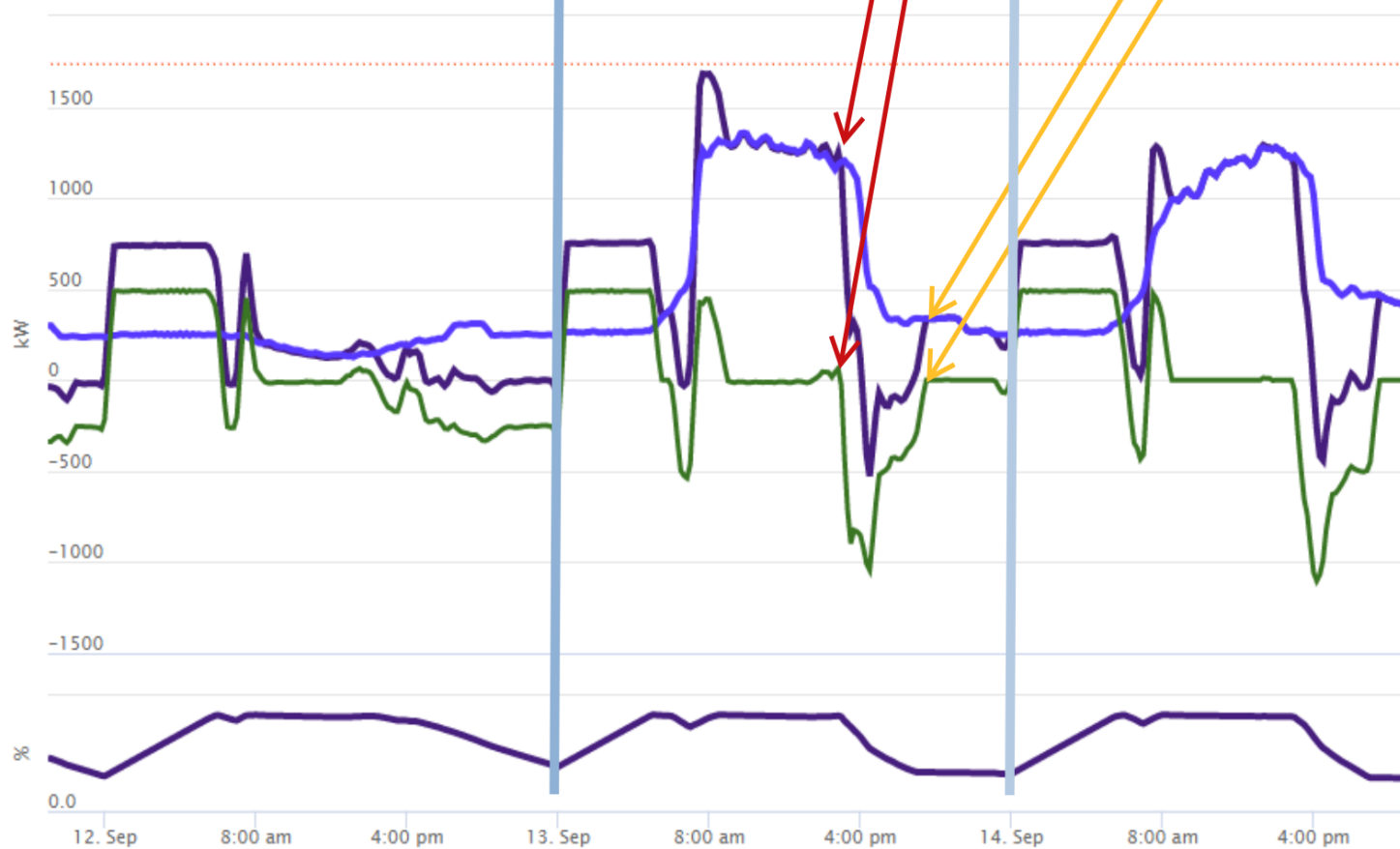
Current date range

4/1/21 - 4/30/21

Interval 1 hour



Last 3 days ▾



Data Interval (minutes):

30 5 1

- ☒ Site Meter
- ☒ Building Demand
- ☒ Storage
- ☐ Solar
- ☐ Fuel Cell
- ☐ Load Before Bat...
- ☒ Committed De...
- ☒ Upper Bound

- ☒ Average SOC
- ☒ Individual SOC's

2021-08-16 to 2021-08-21



Data Interval
(minutes):

30

5

1



☒ Site Meter

☒ Building ...

☒ Storage

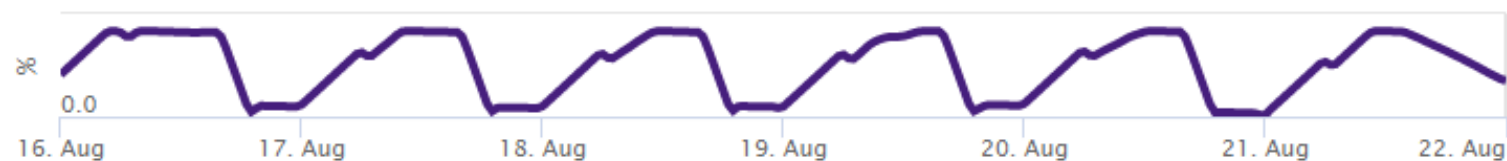
Solar

Fuel Cell

Load Befo...

☒ Committe...

☒ Upper Bo...



☒ Average S...

☒ Individual
SOCs

ABRSD Douglas & Gates School Building Project

Douglas & Gates Elementary Schools

Acton-Boxborough Regional School District
Acton, Massachusetts

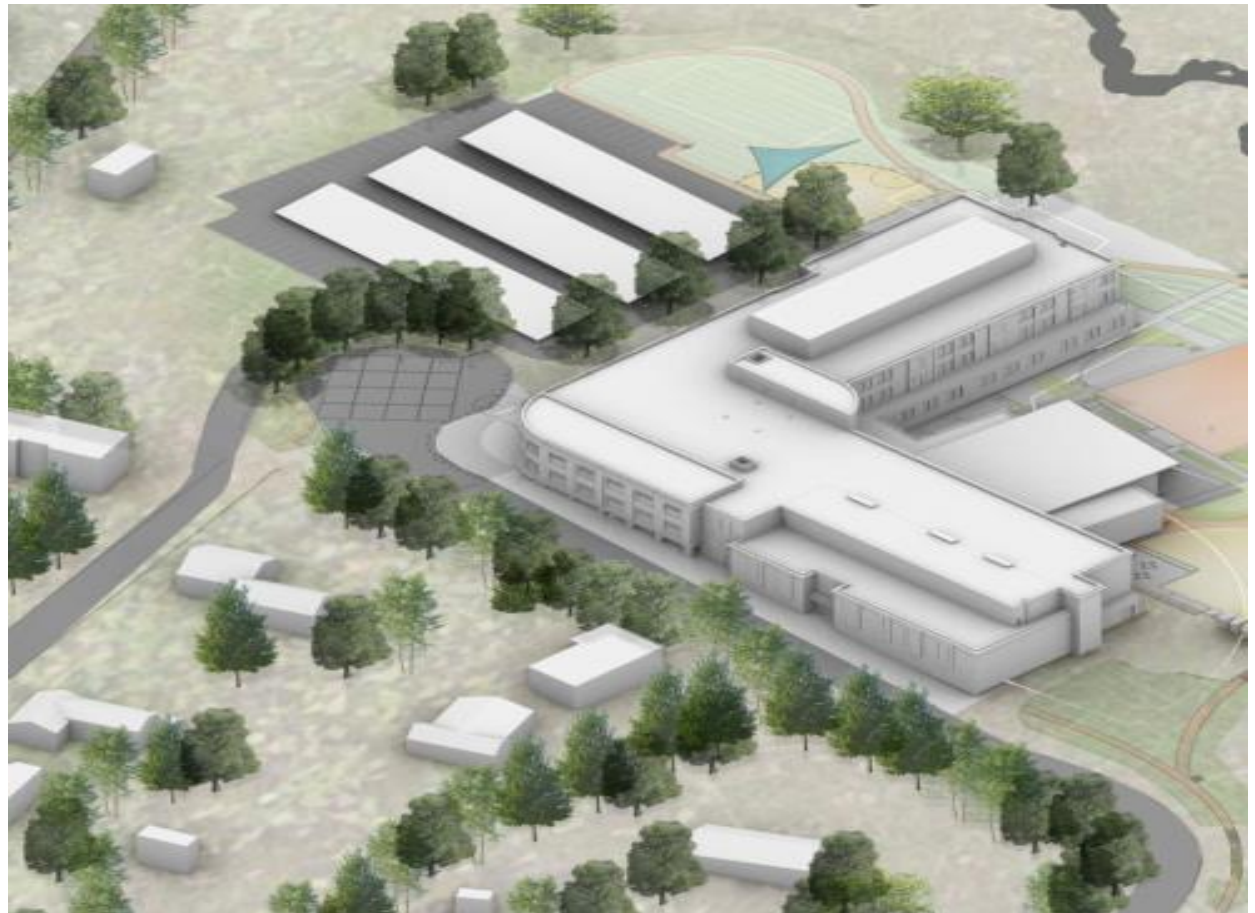


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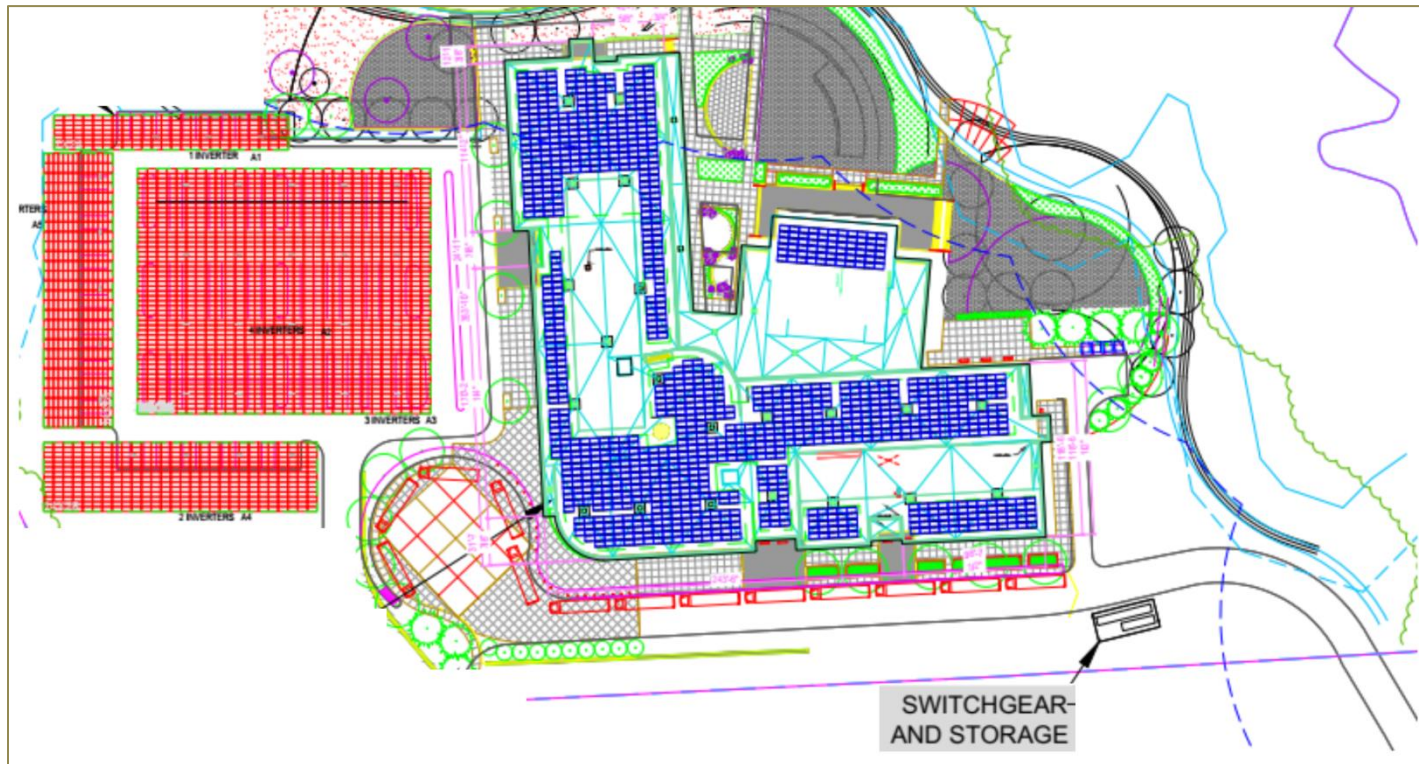
SKANSKA

101 SEAPORT BOULEVARD
SUITE 200
BOSTON, MA 02210
617.574.1400
www.skanska.com



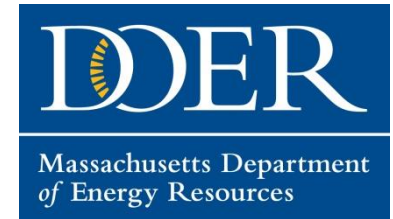
ABRSD Douglas & Gates School Building Project

- 177,000 s.f.
- EUI target 28 kBtu/sf – currently modeling at 23.6 kBtu/sf
- Zero Net Energy
- Geothermal heating/cooling + backup electric boiler
- All-electric (diesel emergency backup generator)
- Solar+Storage (1MW/2MWh battery array)
- Rainwater collection to greywater system



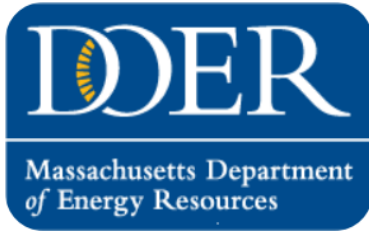
STRATEGIC ELECTRIFICATION

- ❖ \$70,000 “Electrification Roadmap” grant (MA MVP)
 - 10 responses to RFP – now underway
- ❖ \$15,000 Municipal Energy Technical Assistance grant (MA DOER)



“Ithaca, New York votes to decarbonize every building in climate change fight”

Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth



***Alternative Energy Portfolio Standard
Straw Proposal***

July 20, 2021

APS = Alternative Energy Portfolio Standard (similar to RPS)

AEC's = Alternative Energy Credit (similar mechanism to REC's)

Intermediate and Large Renewable Thermal

- DOER is soliciting feedback from stakeholders on potential metering schemes for intermediate and large Generation Units
- Metering schemes must calculate Useful Thermal Energy and include the ability to net out:
 - Parasitic load and grid electricity
 - All cooling energy
 - Any heating energy from heat recovery

Useful Thermal Energy

1. Meter the heat energy coming off the heat pumps. For geothermal: meter the inlet and outlet water temp and it shows as BTUs...temp differential tells you how much heat was created thru GSHP. Calculate as BTU, and then convert to kWh (MWh).
2. Then subtract the electricity input into the GSHP system (kWh) to run the pumps, etc.
3. That calculation = net thermal energy from the system (in kWh) >>> you receive AECs.