



# Revenue through Energy Savings and Generation

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Energy Savings

Reducing Costs

Creating Revenue

Developing Revenue at a Facility



Location	Incentive Amount	Energy Efficiency Measures
Torrington, CT	\$300,000	<ul style="list-style-type: none"> <li>• VFDs and Controls on Pumps</li> <li>• Aeration Blower Upgrade</li> <li>• Lighting and HVAC</li> </ul>
Southington, CT	\$222,700	<ul style="list-style-type: none"> <li>• VFDs and Controls on Pumps</li> <li>• Aeration Controls Upgrade</li> <li>• Lighting and HVAC</li> </ul>
Marlborough, MA	\$179,000	<ul style="list-style-type: none"> <li>• Efficient Grit and Screening Systems</li> <li>• Aeration Upgrade</li> </ul>
Stamford, CT	\$43,400	<ul style="list-style-type: none"> <li>• High efficiency mixers</li> </ul>

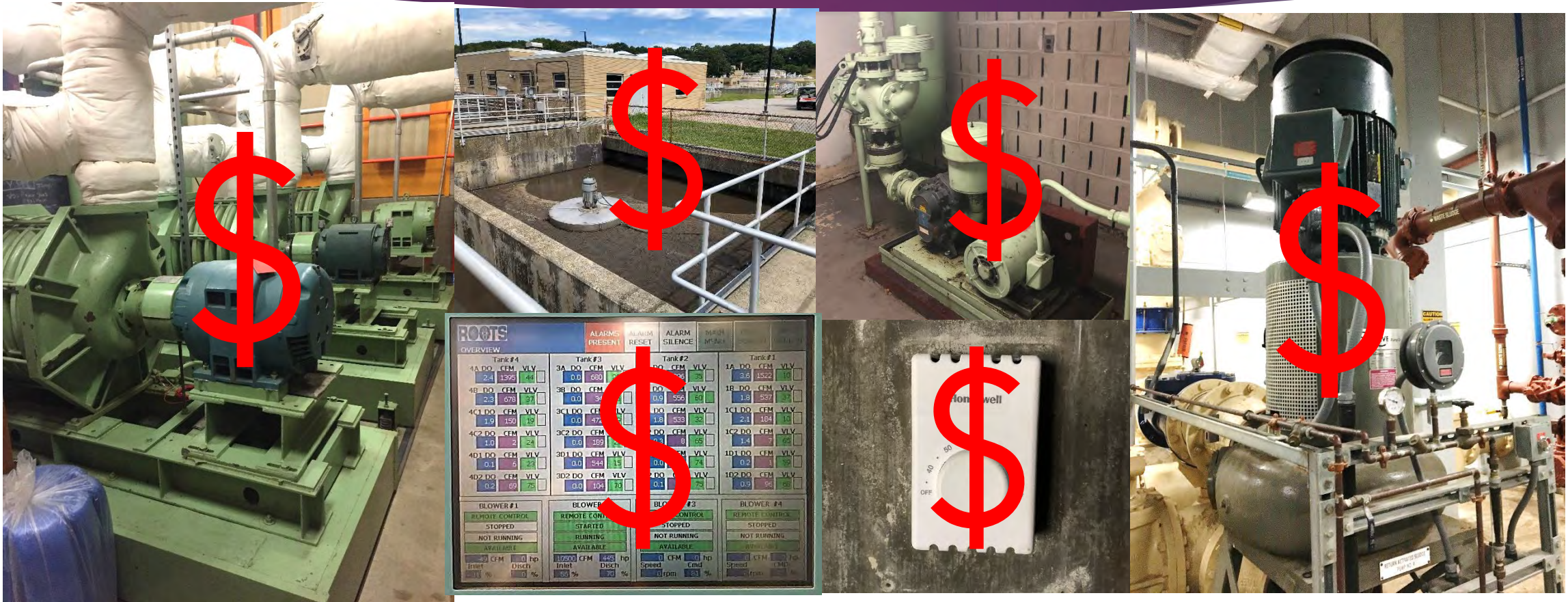
Get Paid  
to  
Upgrade

# Energy Savings

- ▶ Energy Auditing
- ▶ Equipment Testing
- ▶ Billing Structure Awareness



# What is an Energy Audit?



# Pump Testing

- ▶ Pumps are some of the biggest energy users at a WWTP
- ▶ Field testing using portable equipment
- ▶ Can identify pump wear, ragging, proper sizing, and operational adjustments





## How Important is Wet Well Level?

- ▶ Pump station with 5, 900HP pumps
- ▶ Potential Annual Savings:
  - ▶ 590,000 kWh
  - ▶ \$40,000/ft

# Case Study: Blower Operation

Blower	Blower Efficiency
1	58%
2	71%
3	66%

- ▶ Operate all 3 blowers year-round = 10,000,000 kWh/year
- ▶ Only operate blowers 2 and 3 = 9,500,000 kWh/year
- ▶ 500,000 kWh/year = \$90,000 in savings annually



# Understanding How You're Billed

## DETAIL OF CURRENT CHARGES

### Delivery Services

	Energy-kWh	Demand-kW	Demand-kVA
Metered Usage	406990 kWh		
Peak	141865 kWh	824.0 kW	860.0 kVA
Off Peak	265125 kWh	852.0 kW	
<b>Billed Usage</b>	<b>406990 kWh</b>	<b>824.0 kW</b>	<b>860.0 kVA</b>
Customer Charge			223.00
Dist Chg On Peak	0.01617199 x 141865 kWh		2,294.23
Dist Chg Off Peak	0.00864199 x 265125 kWh		2,291.22
Transition Charge	0.00034205 x 406990 kWh		139.21
Transmission Charge	0.02111136 x 406990 kWh		8,592.11
Distribution Demand Chg	5.76 x 824 kW/kVA		4,746.24
High Voltage Discount	-0.52 x 824 kW		-428.48
Energy Efficiency Chg	0.00957 x 406990 kWh		3,894.90
Renewable Energy Chg	0.0005 x 406990 kWh		203.50
High Voltage Metering	-1.0 % x \$ 22384.41		-223.84
<b>Total Delivery Services</b>			<b>\$ 21,732.09</b>

On Peak and Off Peak Hours  
Peak charge is 2X more expensive

Demand Charge  
Demand charge is 22% of the total cost

Usage per Month	Off Peak Cost	On Peak Cost
16,535 kWh	\$0.01181 / kWh	\$0.04661 / kWh
81.5 kW	\$0 / kW	\$16.96 / kW
Total per Month	\$195	\$2,153

Savings = \$1,958 per month or \$23,496 annually

Case Study:

Pump  
Station  
Operation  
Adjustment

# Revenue Generation

- ▶ Demand Response
  - ▶ Demand Response Programs
  - ▶ Battery Usage
- ▶ Renewable Energy Generation
  - ▶ Solar
  - ▶ CHP
  - ▶ Hydro



# ISO New England and Demand

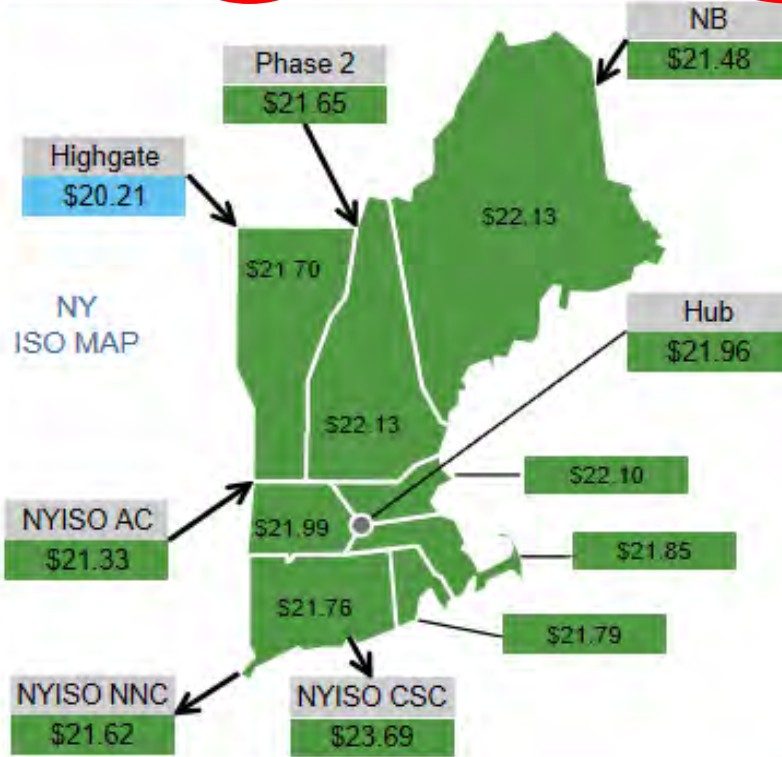
## LMP MAP: REAL-TIME

Day-Ahead

**Real-Time**

NE Energy: **\$21.95**

System Demand: **14878 MW**



January 2<sup>nd</sup>, 2019 at 9:10 AM

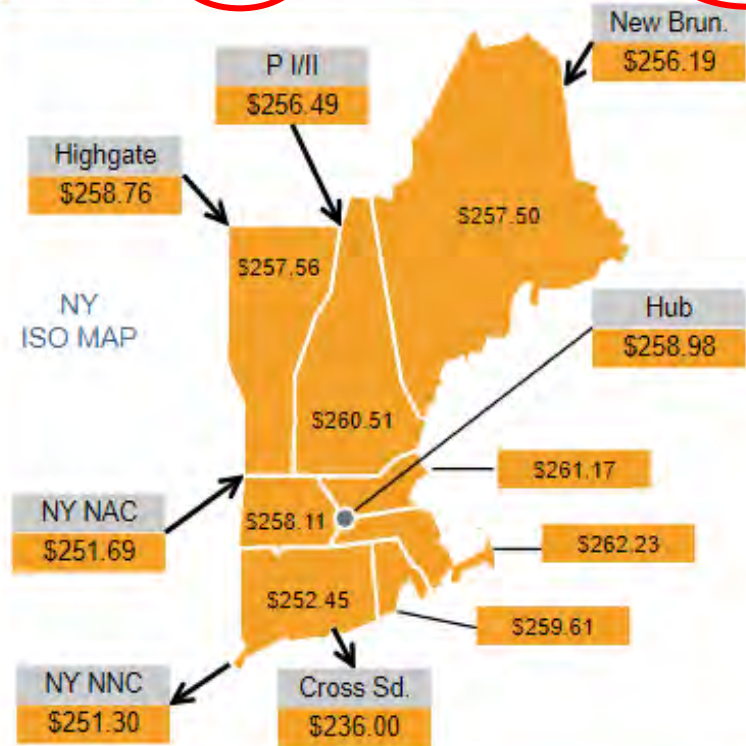
## LMP MAP: REAL-TIME

Day-Ahead

**Real-Time**

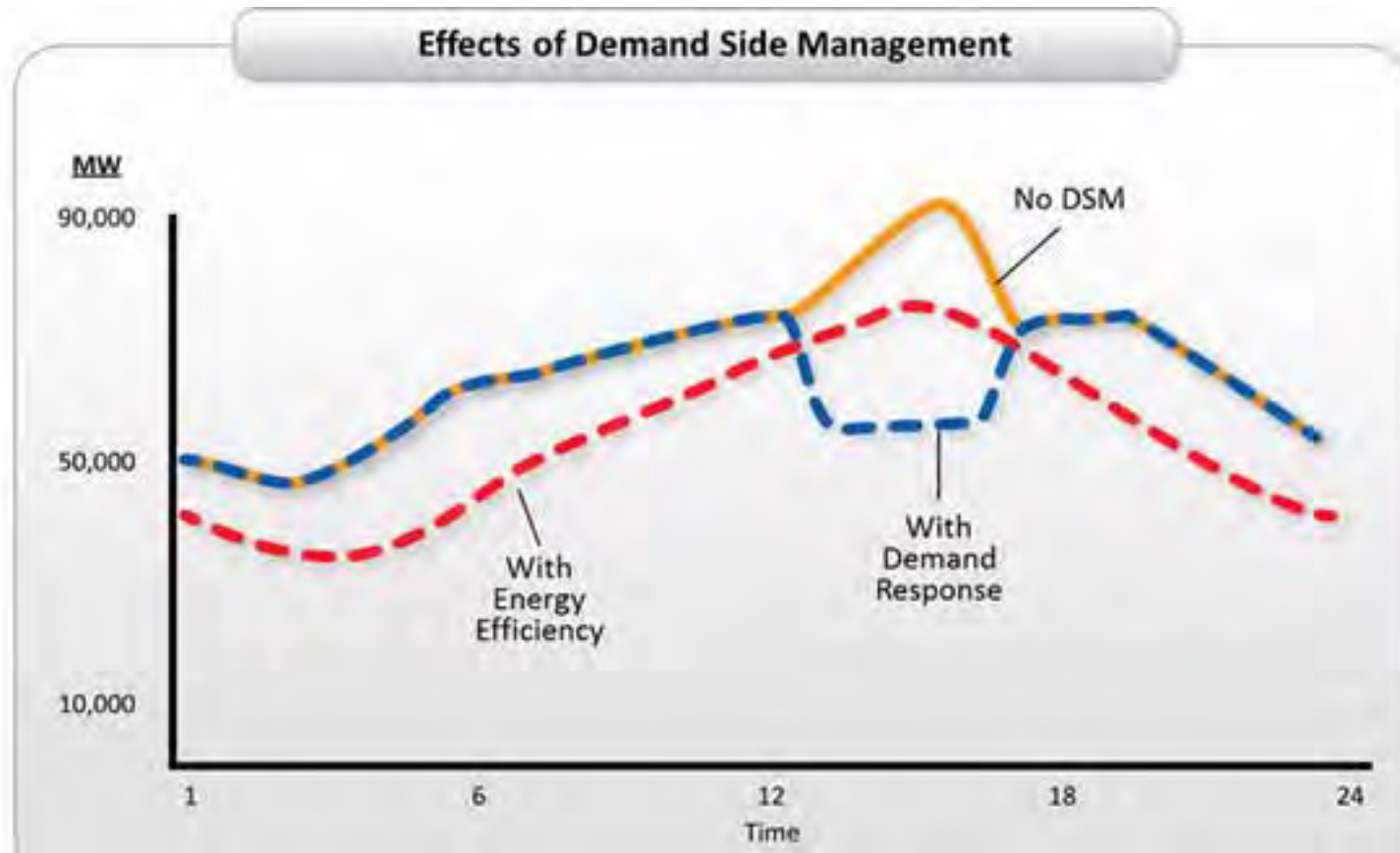
NE Energy: **\$258.03**

System Demand: **18658 MW**



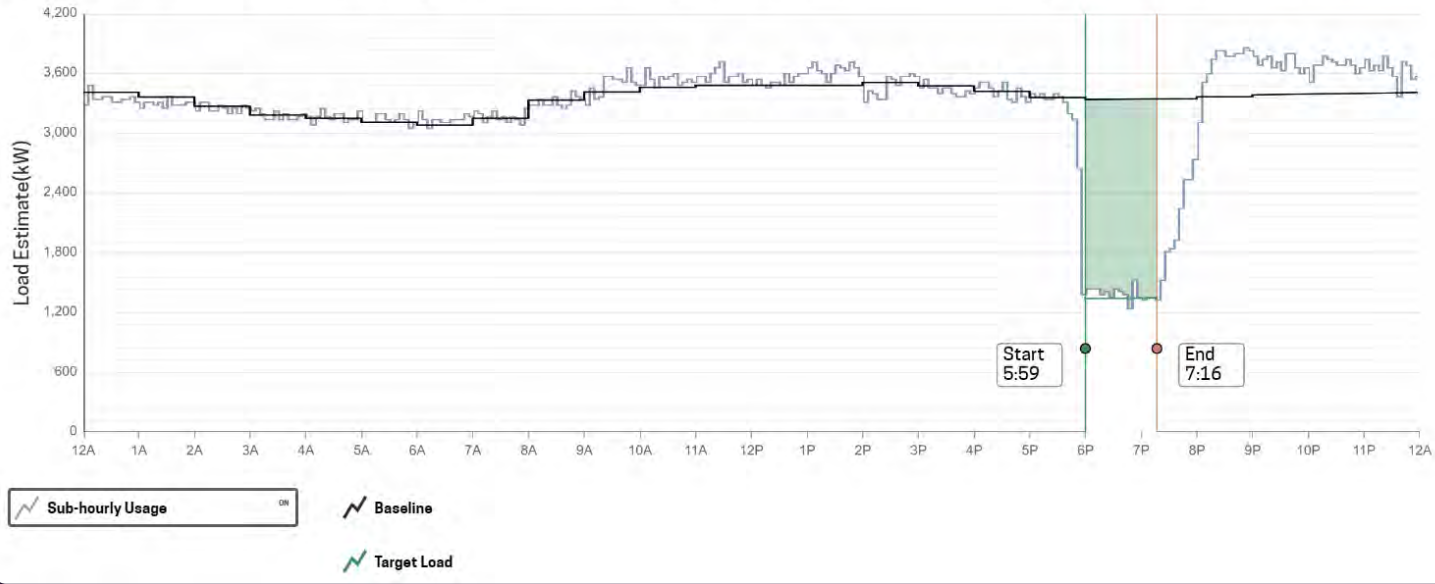
December 29<sup>th</sup>, 2017 at 10:50 AM

# Revenue through Demand Response



## Event Performance

Metropolitan District Hartford (ME) | ACDR | 2019-2020 | 06/27/2019



# Hartford MDC Demand Response

## Revenue

Summer 2018	1,325 kW	\$57,227
Winter 18/19	1,580 kW	\$45,382
<u>Summer 2019</u>	<u>1,941 kW</u>	<u>\$80,101</u>
<b>Total</b>		<b>\$182,711</b>



# Demand Response Case Study

## Program Revenues For Real-Time Demand Response (Assuming 8/1/18 Enrollment)

Forward Capacity Market Year	Demand Reduction Values		Price	Program	Customer Share	
	Summer kW (8 months)	Winter kW (4 months)	Published FCA Price (\$/kW- mth)	Gross Revenue	%	Annual \$
June 1, 2018 - May 31, 2019	425	425	\$ 9.55	\$ 24,271	75.0%	\$ 18,203
June 1, 2019 - May 31, 2020	425	425	\$ 7.03	\$ 35,853	75.0%	\$ 26,890
June 1, 2020 - May 31, 2021	425	425	\$ 5.30	\$ 27,030	75.0%	\$ 20,273
June 1, 2021 - May 31, 2022	425	425	\$ 4.63	\$ 23,613	75.0%	\$ 17,710
				<b>Customer Net Revenue</b>		<b>\$ 83,075</b>



# Batteries

- ▶ Battery technology is continuously improving and becoming less expensive
- ▶ Create a way to store energy onsite and use that energy to shed the peak load
- ▶ Stored energy can be utilized for demand response
- ▶ Programs are available for daily load shedding through battery storage
  - ▶ Certain utilities throughout New England provide incentives for these programs

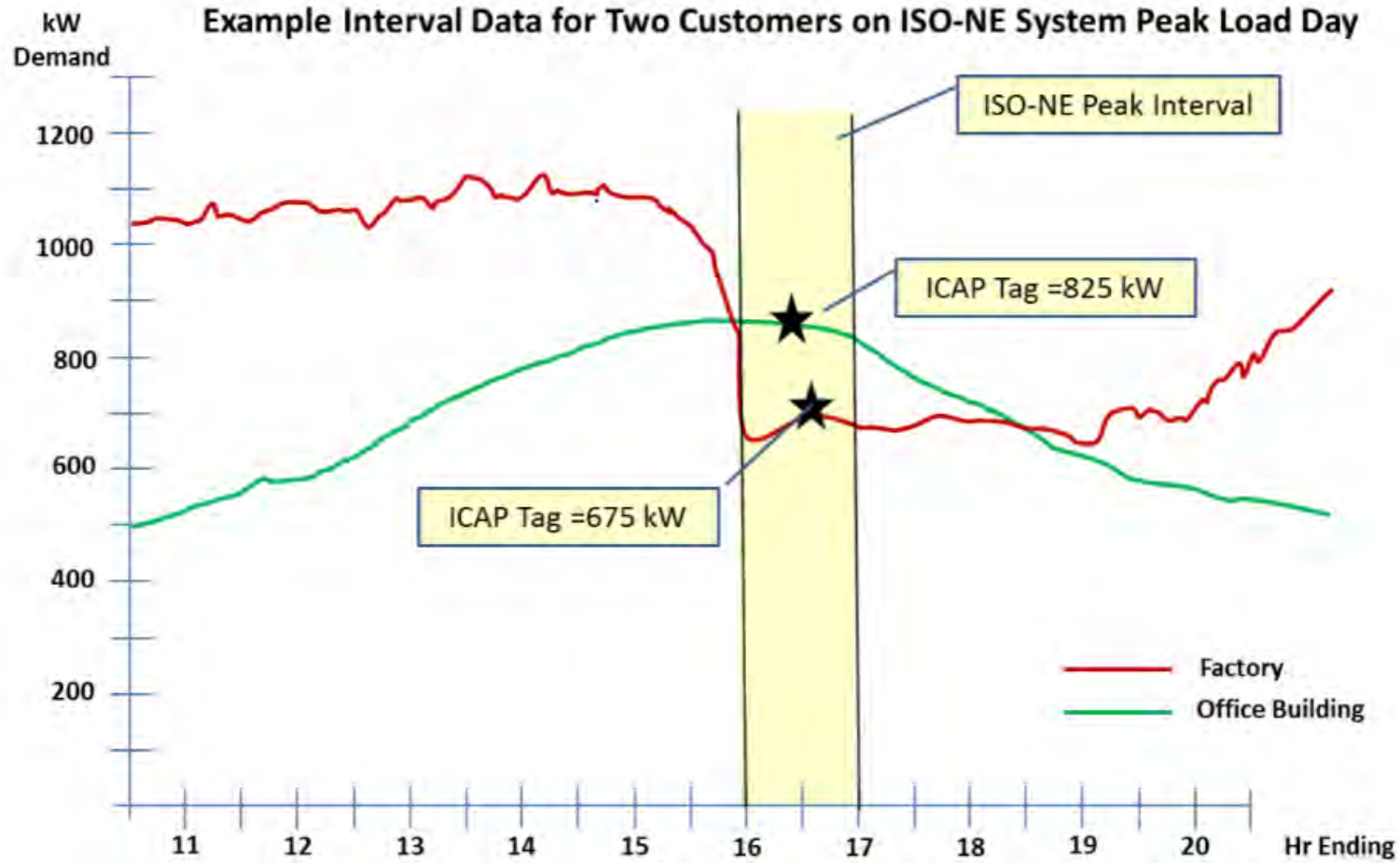


# Daily Load Shedding Using Battery Storage

Program	5 Year Net Revenue
ISO-NE	\$9,758
Eversource CT & MA	\$85,251
N.Grid MA	\$85,251
N.Grid RI	\$115,251

- ▶ 100 kW battery at a pump station
- ▶ Shedding 100 kW of load during on-peak hours year-round by utilizing battery power

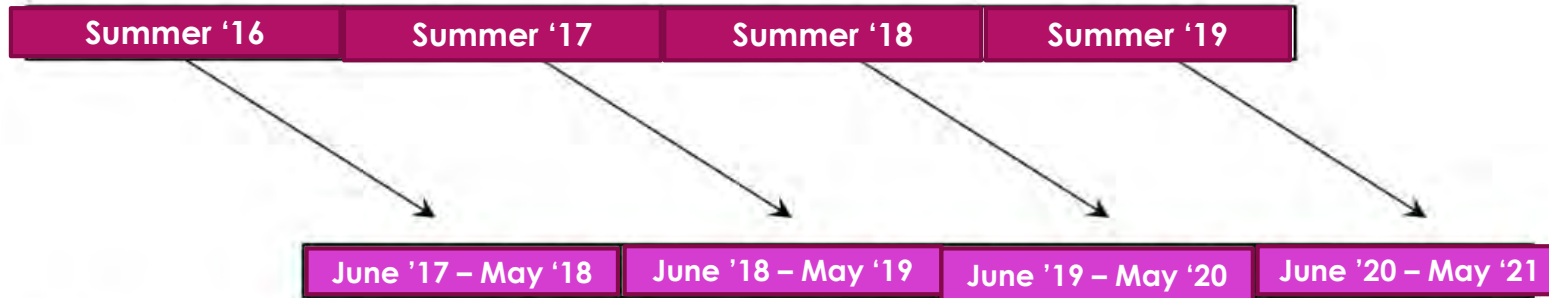
# Customer ICAP Tag Determination



Installed  
Capacity  
(ICAP)  
Tag

# ICAP Tags Take Effect With a One Year Lag

Customer ICAP Tag Set Per Interval Meter Data



Customer Payment Period  
for Associated ICAP Tag

# ICAP Tag

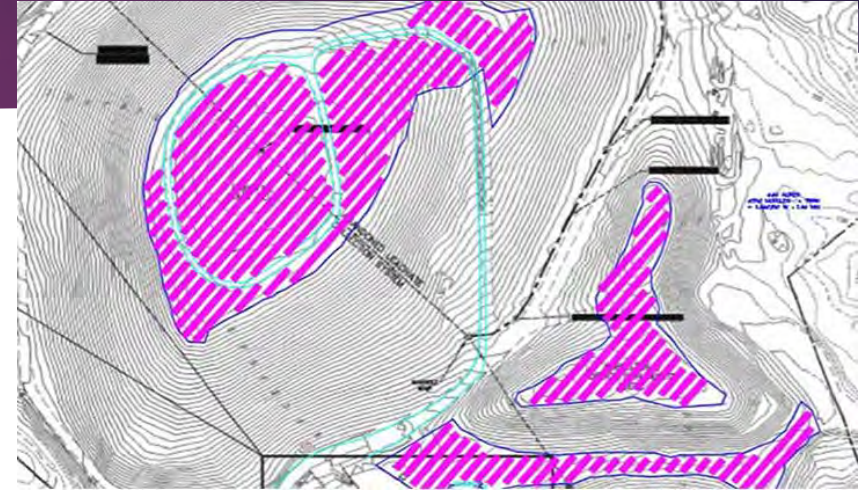
# Solar

- ▶ Offset the cost of treatment
- ▶ Provide capital for upgrade projects
- ▶ Incentives and payment programs available
  - ▶ Net metering programs throughout New England
  - ▶ SMART Incentive program in MA
  - ▶ Green Bank Power Purchase Agreement in CT

# Solar PV Array – Waterbury Landfill

## Project Overview

- ▶ RFP for Land Lease Agreement
- ▶ Solar Provider “Leases” the acreage from the City for a pre-negotiated annual fee
- ▶ Takes advantage of otherwise unusable plot of land on the closed City-owned landfill



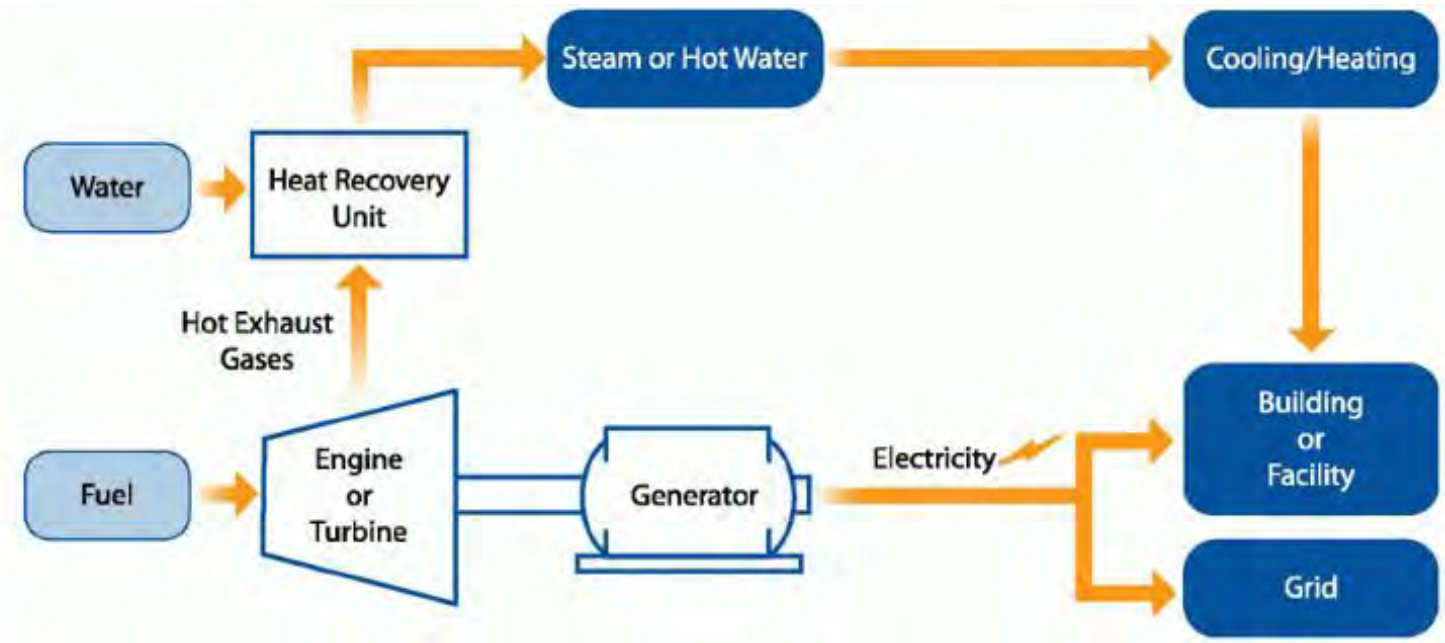
## Project Financials

- ▶ \$33,000/yr in annual “lease payments” back to the City
- ▶ 2.36 MW-AC Solar Array
- ▶ Solar Provider responsible for on-going maintenance and operation of system



## Combined Heat and Power (CHP)

- ▶ CHP at WWTPs is typically thought of with use of digesters
- ▶ Facilities can also utilize natural gas in a CHP system
  - ▶ Natural gas is typically available at WWTPs
- ▶ Incentive programs are available in MA and RI



# Hydro Power

- ▶ Largely untapped potential in wastewater systems
- ▶ Technology is improving
  - ▶ Becoming more cost effective
  - ▶ Becoming more applicable to smaller systems

Technology	Manufacturer	TDH (feet)	Required Flow (MGD)
Axial Flow Propeller Turbine	Energy Systems & Design LH 1000	10 (max)	0.7 (min)-1.4
In Stream Propeller Turbine	Power Pal MHG 1000LH	5 (min)	3.2 (min)
Submerged Channel Turbine	VLH Turbine 121-1	4.6 – 10.5	228 – 616
In Pipe or Channel Propeller Turbine	Voith StreamDiver	6.6 – 20	45 – 273



## NUStream – Mansfield CT

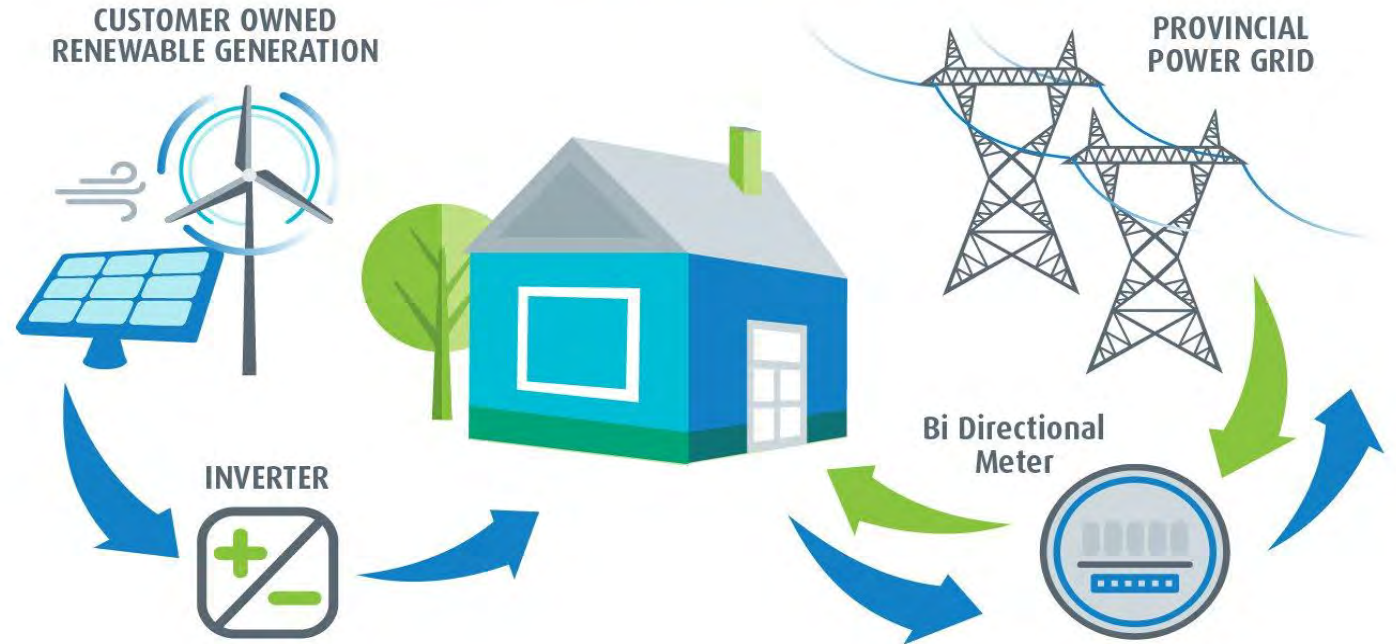
- ▶ Head of 8 – 40 ft
- ▶ Flow of 10 – 55 MGD
- ▶ Smaller units are being developed



# Net Metering

- ▶ Customer pays for the difference of the energy produced and energy used
- ▶ Can apply to all renewable energy
- ▶ Virtual net metering

## HOW NET METERING WORKS





## Summary

- ▶ There are a variety of ways to reduce costs and produce revenue at a WWTP
- ▶ Funding programs throughout New England can help reduce the cost of project implementation



Thank You

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# Understanding how you're billed

## Current Charges for Electricity

**Supply**  
**\$622.51**

Cost of electricity from  
CONSTELLATION NEWENERGY  
C&I

**Delivery**  
**\$651.09**

Cost to deliver electricity  
from Eversource



### Your electric supplier is

CONSTELLATION NEWENERGY C&I  
1221 LAMAR ST SUITE 750  
STE  
HOUSTON TX 77010-3038  
844-636-3749

## Total Charges for Electricity

### Supplier (CONSTELLATION NEWENERGY)

Generation Srvc Chrg**	8670.00kWh X \$0.07180	\$622.51
<b>Subtotal Supplier Services</b>		<b>\$622.51</b>

### Delivery (DISTRIBUTION RATE: 030)

Transmission Dmd Chrg	21.60KW X \$6.97000	\$150.55
Distr Cust Srvc Chrg		\$44.00
Distribution Dmd Chrg	21.60KW X \$13.30000	\$287.28
Electric Sys Improvements***	21.60KW X \$0.23000	\$4.97
Revenue Adj Mechanism	8670.00kWh X \$0.00201	\$17.43
CTA Demand Chrg	21.60KW X \$0.04000	\$0.86
FMCC Delivery Chrg	8670.00kWh X \$0.00939	\$81.41
Comb Public Benefit Chrg*	8670.00kWh X \$0.00745	\$64.59
<b>Subtotal Delivery Services</b>		<b>\$651.09</b>

**Total Cost of Electricity** **\$1,273.60**

**Total Current Charges** **\$1,273.60**

# Energy Conservation Measure Opportunities

Operational Adjustment	<ul style="list-style-type: none"><li>• Low cost</li><li>• Easily implemented</li><li>• Typically lower overall savings</li></ul>	<ul style="list-style-type: none"><li>• Cycle mixer operation</li><li>• Lower pump speed setpoint</li><li>• Reduce ventilation when rooms are unoccupied</li></ul>
Capital Improvement	<ul style="list-style-type: none"><li>• Larger, more expensive upgrades</li><li>• Requires more planning</li><li>• Typically higher overall savings</li></ul>	<ul style="list-style-type: none"><li>• Aeration control upgrade</li><li>• VFD Installation</li><li>• High efficiency pump replacement</li></ul>

# Daily Load Shedding Using Battery Power Storage

## South Central Regional Water Authority

### Program Revenues For On Peak Hours Resource

Commitment Period	ISO-NE kW Reduction		ISO-NE Payments		Customer Share	
	Summer (8 months)	Winter (4 months)	\$/kW-mth	Annual Gross	Rate	Annual Revenue
June 1, 2020 - May 31, 2021	100	100	\$1.59	\$1,907	60%	\$1,144
June 1, 2021 - May 31, 2022	100	100	\$2.08	\$2,500	60%	\$1,500
June 1, 2022 - May 31, 2023	100	100	\$2.28	\$2,736	60%	\$1,642
June 1, 2023 - May 31, 2024	100	100	\$3.80	\$4,560	60%	\$2,736
June 1, 2024 - May 31, 2025	100	100	\$3.80	\$4,560	60%	\$2,736
<b>Total Customer Benefit</b>						<b>\$9,758</b>

## 100 kW Battery in Eversource CT & MA or NGrid MA

### Projected Financial Benefits For New England Demand Response

Commitment Period	KW Reductions					Program Payments					Customer Economics						
	ISO-NE DR Program		Utility Program		Cap Tag	ISO-NE		Utility			Rate	Revenues		Cap Tag Savings	Total Annual Benefit	Metering Cost	Annual Net Benefit
	Summer (8 months)	Winter (4 months)	Summer	Winter		\$/kW-mth	Annual Gross	Summer \$/kW	Winter \$/kW	Annual Gross		ISO-NE	Utility				
June 1, 2020 - May 31, 2021	0	100	100	0	0	\$4.00	\$ 1,600	\$200	\$0	\$ 20,000	60%	\$ 960	\$ 12,000	\$ -	\$ 12,960	\$ (3,000)	\$ 9,960
June 1, 2021 - May 31, 2022	0	100	100	0	100	\$4.00	\$ 1,600	\$200	\$0	\$ 20,000	60%	\$ 960	\$ 12,000	\$ 8,202	\$ 21,162	\$ (3,000)	\$ 18,162
June 1, 2022 - May 31, 2023	0	100	100	0	100	\$3.80	\$ 1,520	\$200	\$0	\$ 20,000	60%	\$ 912	\$ 12,000	\$ 6,731	\$ 19,643	\$ (600)	\$ 19,043
June 1, 2023 - May 31, 2024	0	100	100	0	100	\$3.80	\$ 1,520	\$200	\$0	\$ 20,000	60%	\$ 912	\$ 12,000	\$ 6,731	\$ 19,643	\$ (600)	\$ 19,043
June 1, 2024 - May 31, 2025	0	100	100	0	100	\$3.80	\$ 1,520	\$200	\$0	\$ 20,000	60%	\$ 912	\$ 12,000	\$ 6,731	\$ 19,643	\$ (600)	\$ 19,043
<b>Total Customer Benefit</b>												<b>\$ 4,656</b>	<b>\$ 60,000</b>	<b>\$ 28,395</b>	<b>\$ 93,051</b>	<b>\$ (7,800)</b>	<b>\$ 85,251</b>

## 100 kW Battery in NGrid RI

### Projected Financial Benefits For New England Demand Response

Commitment Period	KW Reductions					Program Payments					Customer Economics						
	ISO-NE DR Program		Utility Program		Cap Tag	ISO-NE		Utility			Rate	Revenues		Cap Tag Savings	Total Annual Benefit	Metering Cost	Annual Net Benefit
	Summer (8 months)	Winter (4 months)	Summer	Winter		\$/kW-mth	Annual Gross	Summer \$/kW	Winter \$/kW	Annual Gross		ISO-NE	Utility				
June 1, 2020 - May 31, 2021	0	100	100	0	0	\$4.00	\$ 1,600	\$300	\$0	\$ 30,000	60%	\$ 960	\$ 18,000	\$ -	\$ 18,960	\$ (3,000)	\$ 15,960
June 1, 2021 - May 31, 2022	0	100	100	0	100	\$4.00	\$ 1,600	\$300	\$0	\$ 30,000	60%	\$ 960	\$ 18,000	\$ 8,202	\$ 27,162	\$ (3,000)	\$ 24,162
June 1, 2022 - May 31, 2023	0	100	100	0	100	\$3.80	\$ 1,520	\$300	\$0	\$ 30,000	60%	\$ 912	\$ 18,000	\$ 6,731	\$ 25,643	\$ (600)	\$ 25,043
June 1, 2023 - May 31, 2024	0	100	100	0	100	\$3.80	\$ 1,520	\$300	\$0	\$ 30,000	60%	\$ 912	\$ 18,000	\$ 6,731	\$ 25,643	\$ (600)	\$ 25,043
June 1, 2024 - May 31, 2025	0	100	100	0	100	\$3.80	\$ 1,520	\$300	\$0	\$ 30,000	60%	\$ 912	\$ 18,000	\$ 6,731	\$ 25,643	\$ (600)	\$ 25,043
<b>Total Customer Benefit</b>												<b>\$ 4,656</b>	<b>\$ 90,000</b>	<b>\$ 28,395</b>	<b>\$ 123,051</b>	<b>\$ (7,800)</b>	<b>\$ 115,251</b>

## SMART Solar Block Status Update

Last Update: 12/17/2019 8:45 AM

SMALL PROJECTS (<= 25 kW AC)	Accepting Applications for Block <sup>1</sup> :	Current Block Size (MW) <sup>2</sup>	Total Allocated Capacity (MW) <sup>3</sup>	Total Pending Capacity (MW) <sup>4</sup>	Total Remaining Capacity (MW) <sup>5</sup>	Waiting List (MW) <sup>6</sup>
Electric Distribution Company (EDC)						
Eversource MA East	3 of 8	18.401	33.776	9.668	102.991	0.000
Eversource MA West	6 of 8	3.147	13.473	2.324	9.353	0.000
National Grid (Massachusetts Electric)	4 of 8	18.442	56.781	11.353	75.902	0.000
National Grid (Nantucket)	1 of 2	0.604	0.094	0.114	1.000	0.000
Unitil	3 of 4	0.827	1.625	0.206	1.327	0.000
<b>Total</b>			<b>105.748</b>	<b>23.665</b>	<b>190.573</b>	<b>0.000</b>
LARGE PROJECTS (>25 kW AC)	Accepting Applications for Block <sup>1</sup> :	Current Block/Size (MW) <sup>2</sup>	Total Allocated Capacity (MW) <sup>3</sup>	Total Pending Capacity (MW) <sup>4</sup>	Total Remaining Capacity (MW) <sup>5</sup>	Waiting List (MW) <sup>6</sup>
Electric Distribution Company (EDC)						
Eversource MA East	3 of 8	73.445	174.783	14.772	396.133	0.000
Eversource MA West	Waitlist	TBD	100.208	57.136	0.000	56.637
National Grid (Massachusetts Electric)	Waitlist	TBD	559.206	57.360	0.000	40.423
National Grid (Nantucket)	1 of 2	2.417	1.000	0.000	3.833	0.000
Unitil	Waitlist	TBD	12.444	10.835	0.000	10.648
<b>Total</b>			<b>847.640</b>	<b>140.102</b>	<b>399.966</b>	<b>107.709</b>

# Hydro Power

Item	Value
Annual Energy Savings (kWh)	125,777
Annual Cost Savings (\$0.18/kWh)	\$22,514
Cost to rehab hydro system	\$37,274
Cost to replace with electric motor	\$7,274
Project Cost Differential	\$30,000
Payback (years)	1.33





# Solar Incentives Programs

ME	NH	VT	MA	RI	CT
<ul style="list-style-type: none"><li>• Mostly residential programs</li><li>• Net Metering</li></ul>	<ul style="list-style-type: none"><li>• Mostly residential programs</li><li>• Net Metering</li></ul>	<ul style="list-style-type: none"><li>• Mostly residential programs</li><li>• Net Metering</li></ul>	<ul style="list-style-type: none"><li>• SMART Program</li><li>• Net Metering</li><li>• MLP Solar Rebates</li><li>• Battery Incentives</li></ul>	<ul style="list-style-type: none"><li>• Small Scale Solar Grants</li><li>• Net Metering</li><li>• Battery Incentives</li></ul>	<ul style="list-style-type: none"><li>• Net metering</li><li>• LREC/ZREC program replacement in discussion</li><li>• Green Bank PPA</li></ul>

# Hydro Power



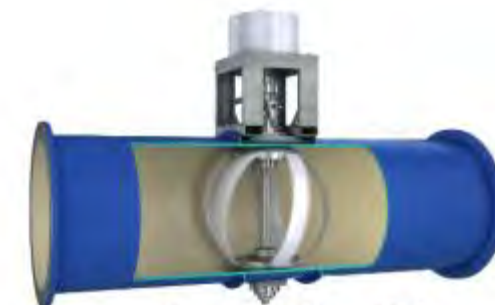
Vertical Axis Hydrokinetic Turbine



Amjet ATS-63

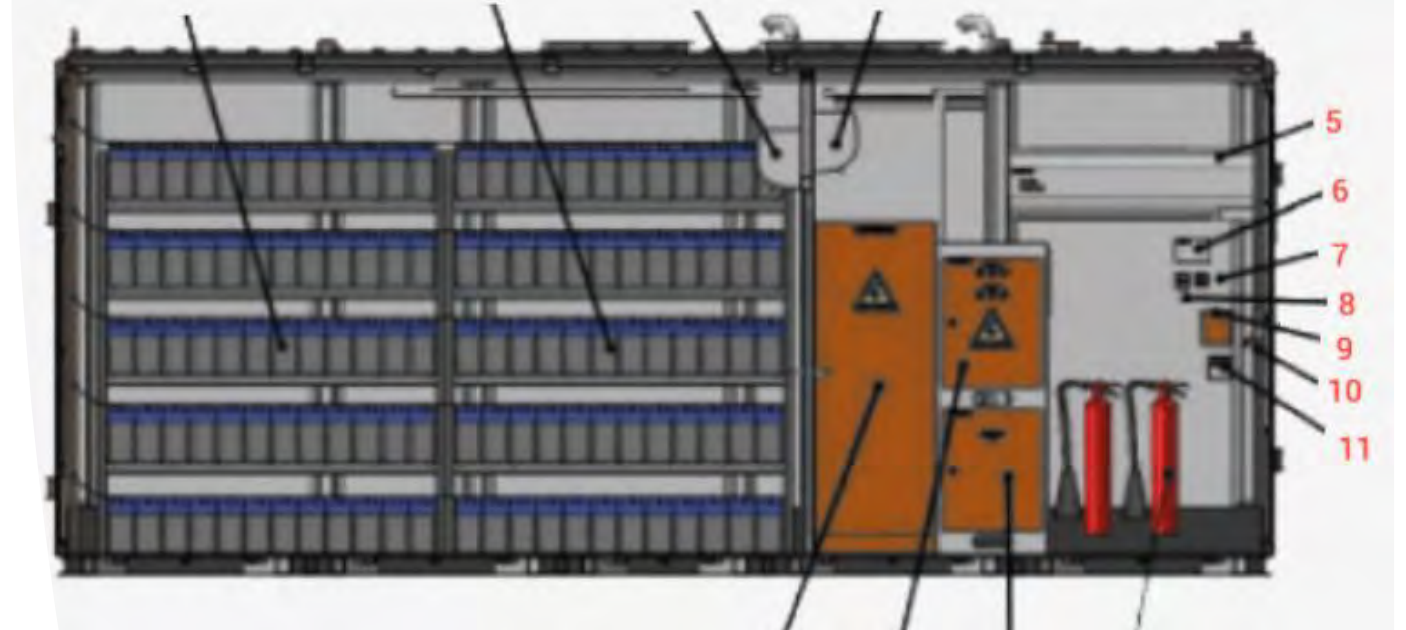


Inline Francis



LucidPipe™

Batteries –  
What kind  
of  
batteries?



## Combined Heat and Power (CHP)

- ▶ MA and RI – MassSave and National Grid RI have tier-based incentive programs for CHP systems
- ▶