Energy Management Basics for WWTFs

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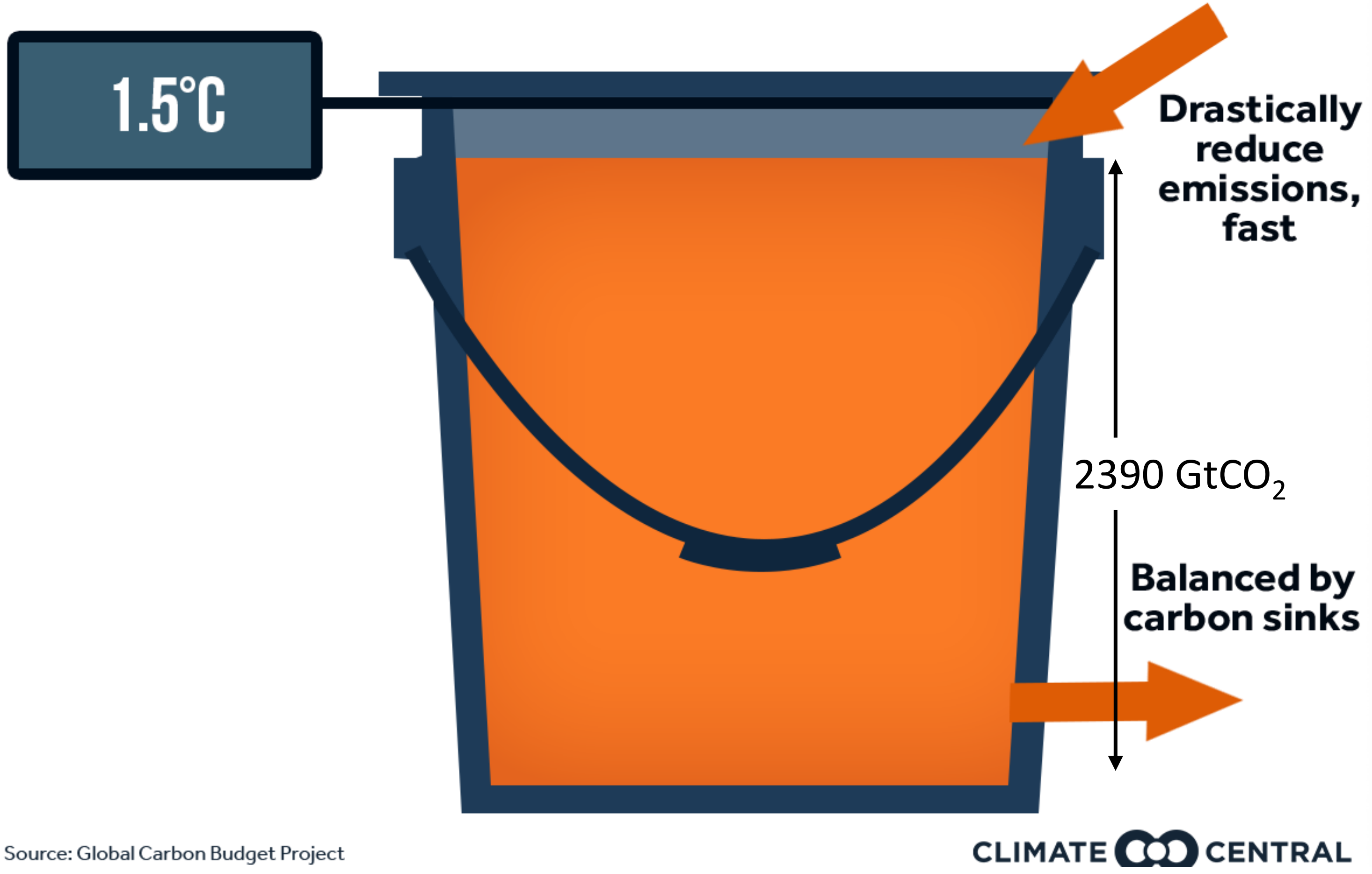
Agenda

- Drivers for energy and carbon reduction
- Strategic planning for energy management
- Tools for energy management implementation

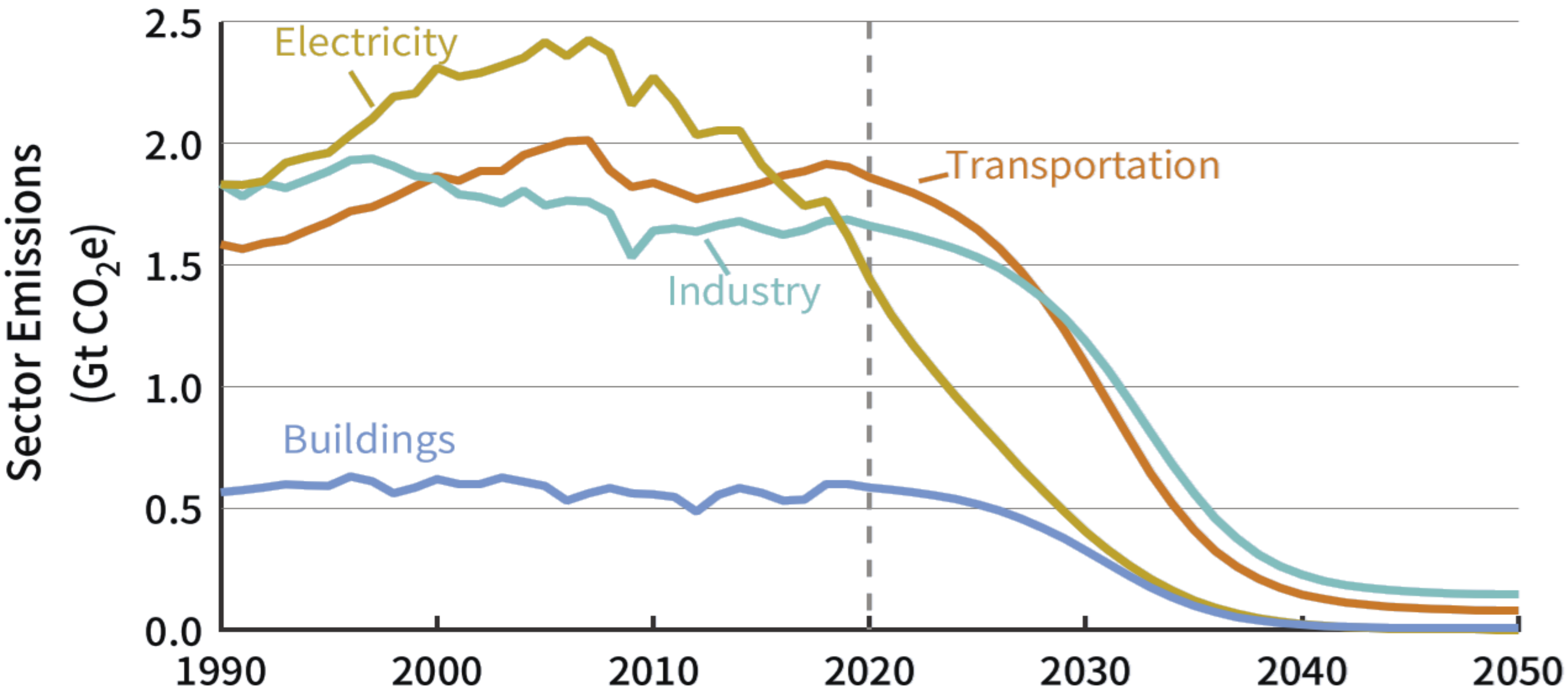
Need for Reduction in Carbon Emissions



- 1.5°C – Ideal limit for global temperature increase
- Most of budget already expended
- Drastic reduction in emissions necessary

Image Source: [Climate Central]

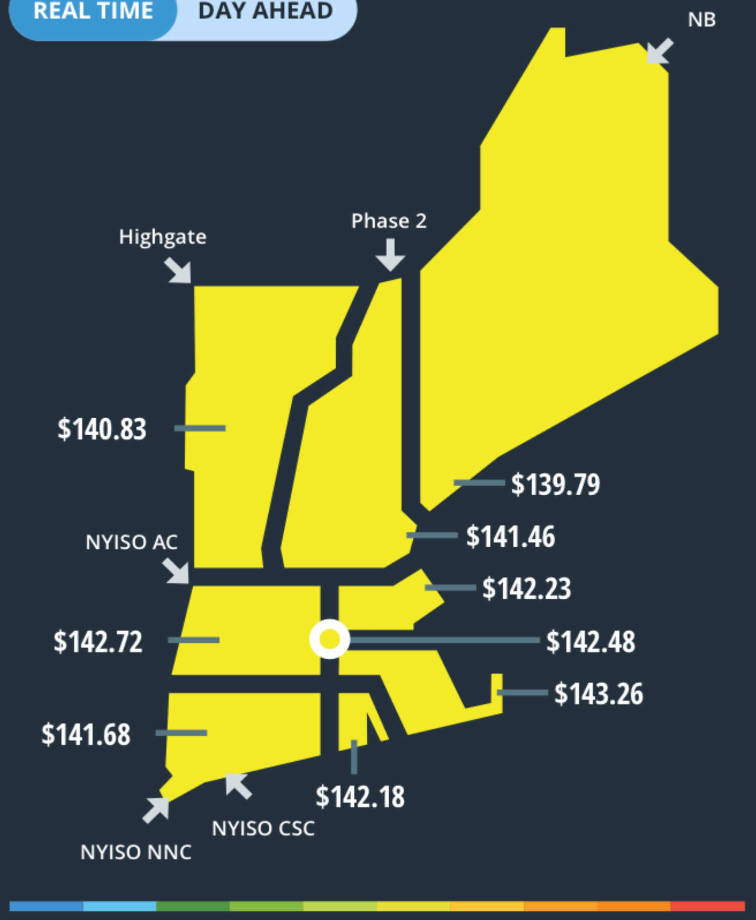
Urgency Around Decarbonization



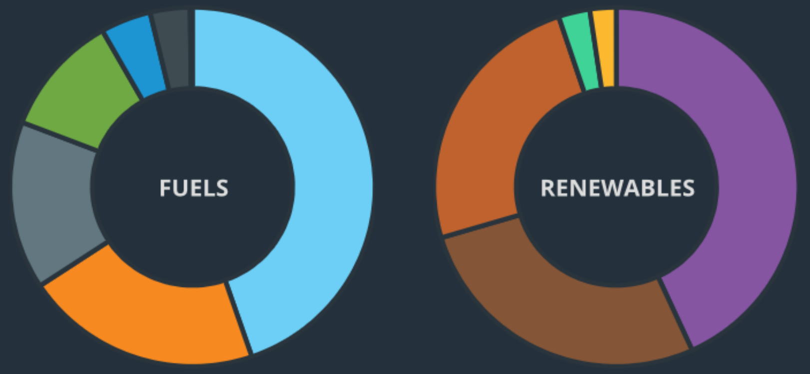
- Significant reduction in usage across all industries
- Electrical sector has the most progress to make
- Timeframe is short

Price Map

REAL TIME | DAY AHEAD



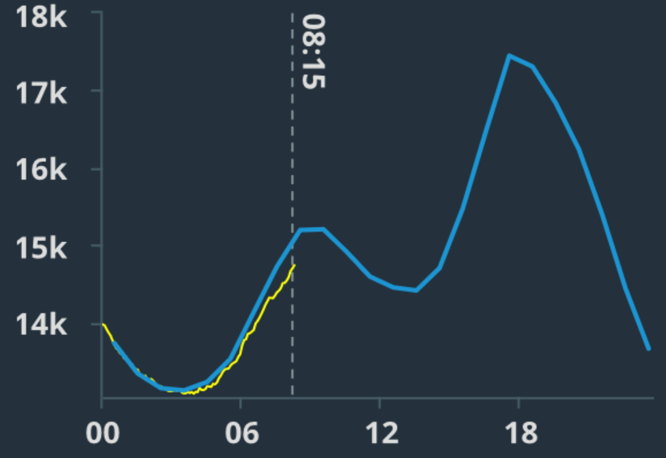
Fuel Mix



45% NATURAL GAS
21% NUCLEAR
15% OIL
11% RENEWABLES →
4% HYDRO
4% COAL
<1% OTHER

43% WIND
27% REFUSE
24% WOOD
3% LANDFILL GAS
2% SOLAR

System Demand



15200 FORECASTED (MW)
14745 ACTUAL (MW)

System Status

NORMAL

Today's Snapshot

AS OF 01/23/2022 07:50 AM

23,014 AVAILABLE CAPACITY (MW)

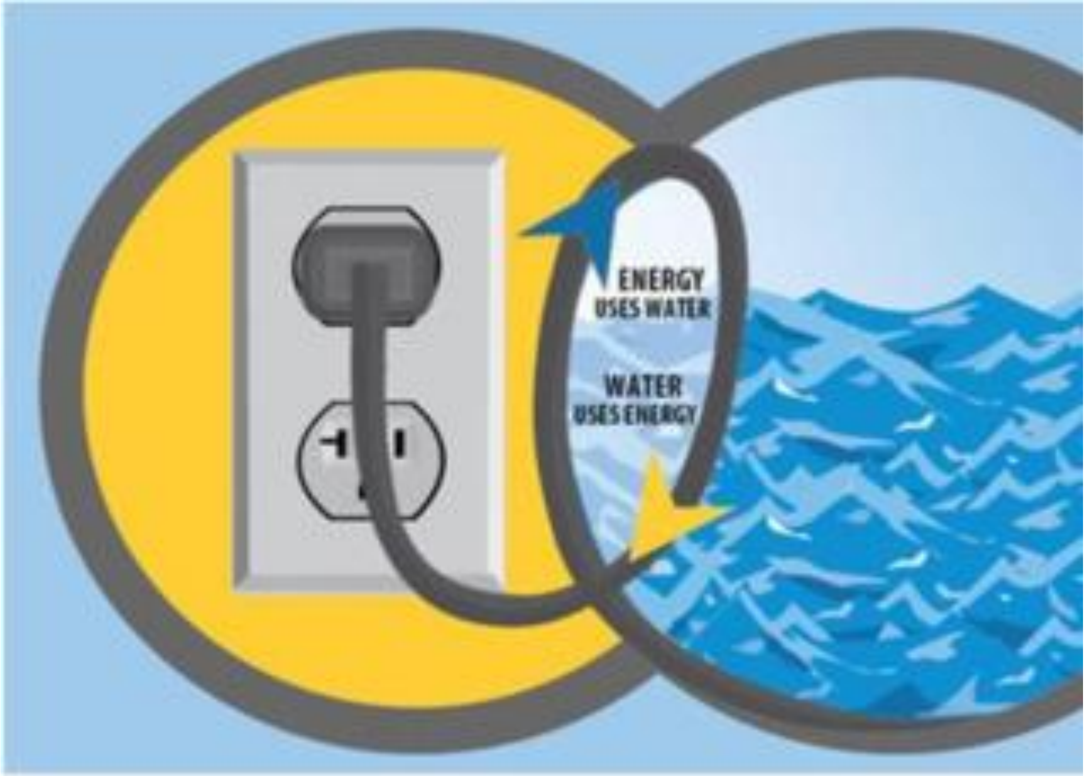
17,450 FORECASTED PEAK DEMAND (MW)

3,022 SURPLUS CAPACITY (MW)

17,590 YESTERDAY'S PEAK DEMAND (MW)

Our Responsibility: Energy Management is Carbon Management

3%	Water sector's share of global GHG emissions[1]
4%	Water sector's share of US energy use[2]
5 X	Ratio of energy potential in wastewater to energy required for treatment[3]



Sources: [1]IEA [2] EPRI [3]WERF

High Level Principles of Energy + Carbon Management

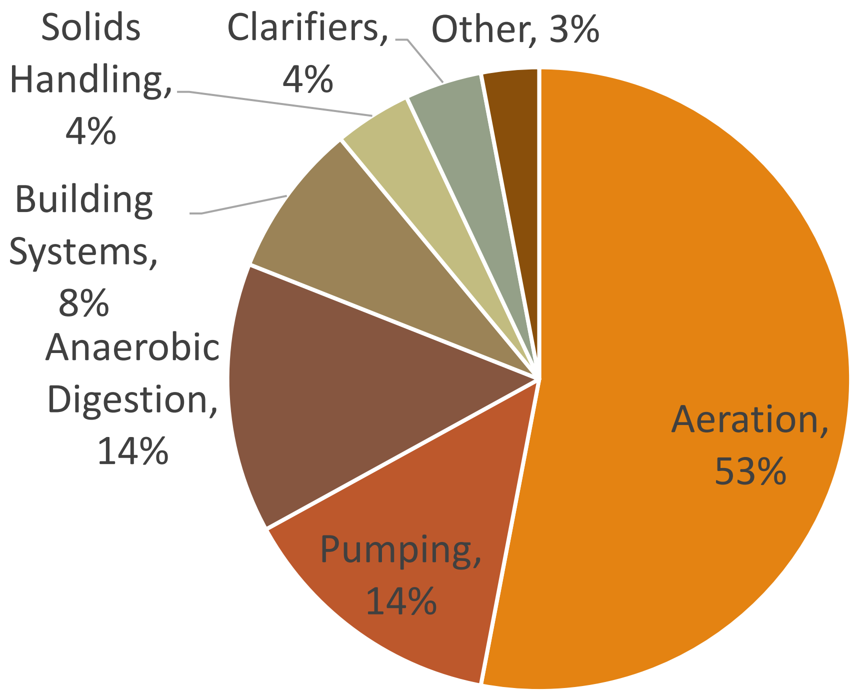
Understand Availabilty of Existing Data	Evaluate Energy Usage	Optimize Operations and Controls	Capital Planning	Long Term Goals and Strategies
➢Historic electric billing and SCADA Data	➢Identify and prioritize processes that use substantial amounts of energy	➢Identify low-cost operational adjustments that reduce energy usage and intensity	➢Categorize energy saving measures by projected savings ➢Integrate energy efficiency into equipment upgrades	➢Effective management is ongoing management

Using Data to Inform Energy Management Decisions

- Energy management is only as good as the data we have
- Submetering – Real time power data
  - Trend process performance data against real time energy usage data to pinpoint energy intensive equipment
- Assess current energy usage against previous energy usage
- Spot readings from field testing

Reducing Energy Needs in Water Utilities

- Typical WRRFs can reduce energy use by 15-30%[1]
- Focus on energy intensive processes/equipment
- Turn it off (or turn it down)
- Implement automated process controls
- Properly sized equipment
- Monitor equipment performance to maintain efficiency
- Onsite generation
- Demand response/battery storage



Sources: [1] US EPA; Energy use distribution: US DOE

What is an Energy Evaluation?

Steps	Actionable Items
Understand typical operations	➢ Understand billing and rates ➢ Evaluate equipment and process efficiency
Identify ways to save energy	➢ Identify energy conservation measures/operational changes
Plan for implementation	➢ Explore energy efficiency funding ➢ Integrate energy management into capital improvement plans
Integrate into culture	➢ Involve staff ➢ Prioritize energy efficient design

JK MUIR

Implement Energy Conservation Programs

Formalize a Plan	Create Accountability	Evaluate Energy Usage Before + After Project Implementation	Integrate Plant Staff
➢ Implement low-cost operational adjustments ➢ Develop a schedule for improvement upgrades	➢ Designate an energy manager/energy team	➢ Energy monitoring system or field verification ➢ Follow up with utility/site manager	➢ Report findings to staff to ensure inclusion and participation in energy management programs

Understanding How You're Billed

On Peak and Off Peak Hours

Peak charge is 2X more expensive

Demand Charge

Demand charge is 22% of the total cost

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	
Billed Usage	406990 kWh	824.0 kW	860.0 kVA

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
			Total Delivery Services	**$ 21,732.09**

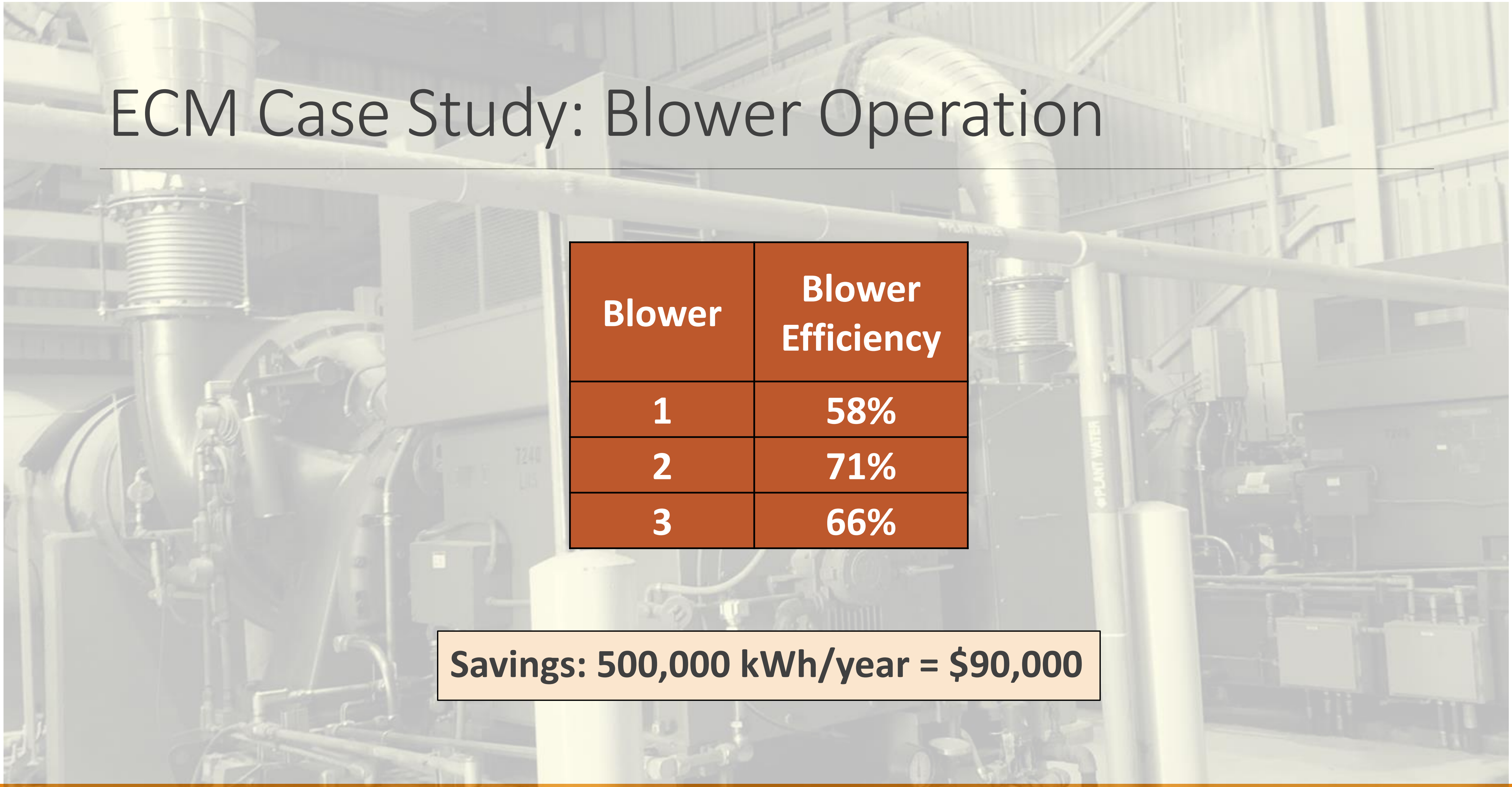
Energy Conservation Measure Opportunities

Operational Measures (OM) – Setpoint Adjustments

Energy Conservation Measures (ECMs/EEMs) – Capital Improvement

	ENERGY CONSERVATION MEASURES	Annual Energy Savings (kWh)	Annual GHG Emissions Reduction ($MTCO_2e$)	First Year Annual Dollars Saved ($)	Initial Budgetary Project Cost ($)	Simple Payback (years)
OM 1	Reduce Cell #1 Anaerobic Mixer Operation	27,173	9.6	$4,348	-	Immediate
OM 2	Optimize Cell #3 Aerobic Mixer Operation	97,216	34.4	$15,555	-	Immediate
OM 3	Optimize Primary Sludge Pump Operation	223,161	79.0	$35,706	-	Immediate
ECM 1	Replace Cell #3 Aerobic Mixers and Optimize Operation	165,364	58.5	$26,458	$308,220	11.6
ECM 2	RAS Pump Replacement	101,101	35.7	$16,176	$267,800	16.6
ECM 3	Plant Water Replacement	281,999	99.8	$45,120	$658,125	14.6
ECM 4	WAS Pump Replacement	48,734	17.2	$7,797	$200,200	17.2
ECM 5	Aeration Diffuser Replacement	342,312	121.2	$54,770	$450,000	8.2
Potential Energy Program Cost and Savings		**1,189,844**	**421.0**	**$190,375**	**$1,884,345**	**9.9**

Notes:
1. OM 2 not included in total savings to avoid double counting the savings associated with ECM 1



ECM Case Study: Blower Operation

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

Savings: 500,000 kWh/year = $90,000

Energy Efficiency Incentive Programs

Funding available for high efficiency equipment and controls for process, HVAC, and lighting equipment

Pittsfield, MA Nutrient Removal Upgrade: $200,000

- Mixing equipment, aeration blowers, aeration controls, boilers

South Street Ridgefield, CT Upgrade: $410,000

- UV controls, process blowers, process pump and blower VFDs, lighting, HVAC

Enfield, CT Upgrades: $500,000

- Aeration blowers, process pump VFDs, mixing equipment, mixer VFDs

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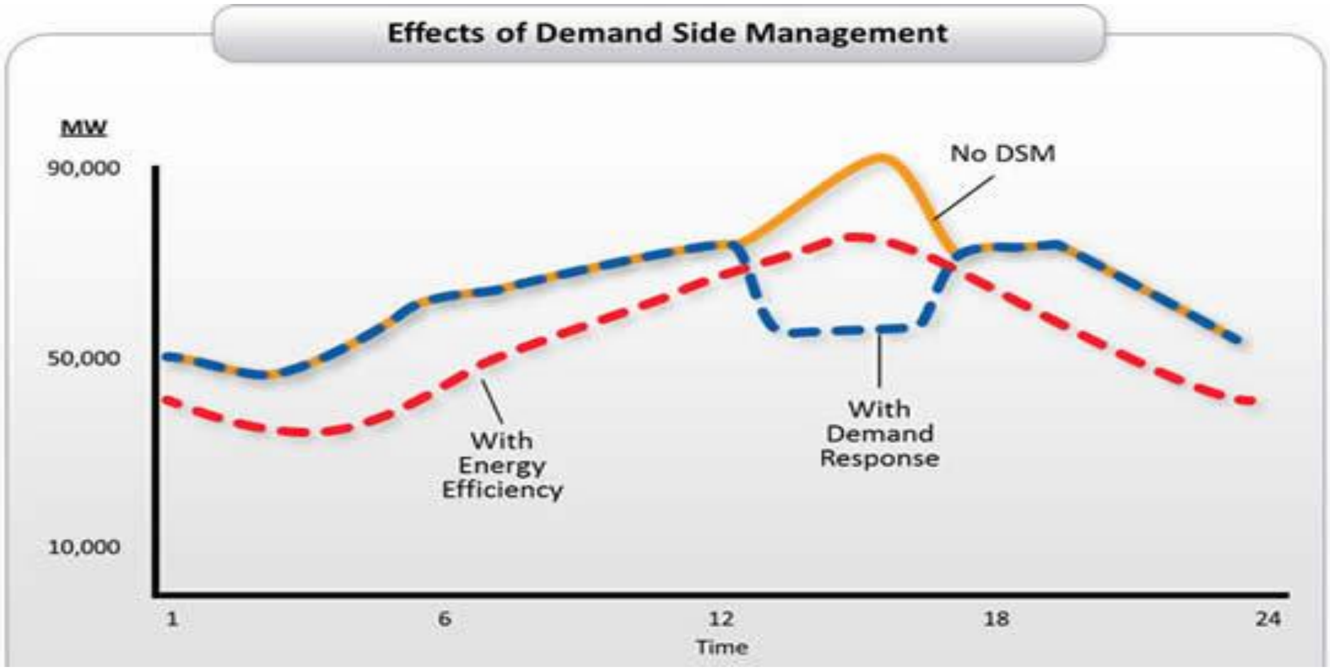
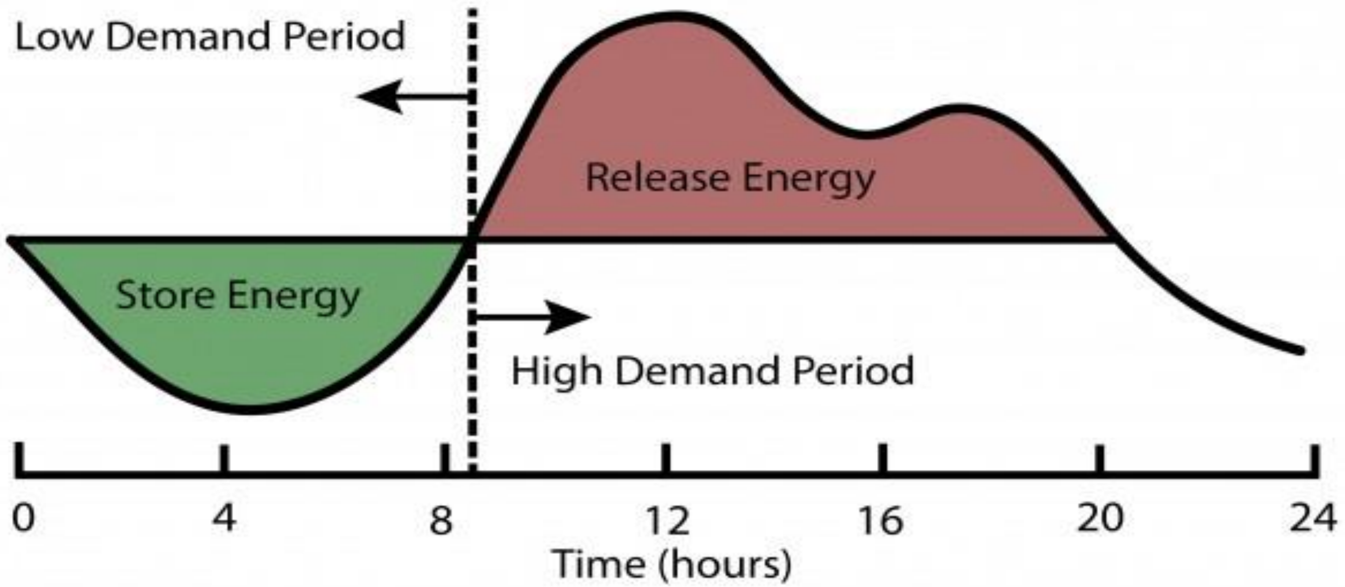
Revenue Through Demand Response and Battery Storage

- Clip load during high-cost kWh times and charge from the grid during low-cost kWh times
- Participate in previous demand response programs + additional with more frequent events
- New England Utilities Daily Dispatch Program: $200 - $300/kW; up to 60 summer events
- NYSERDA offers upfront commercial storage incentives paired with renewables

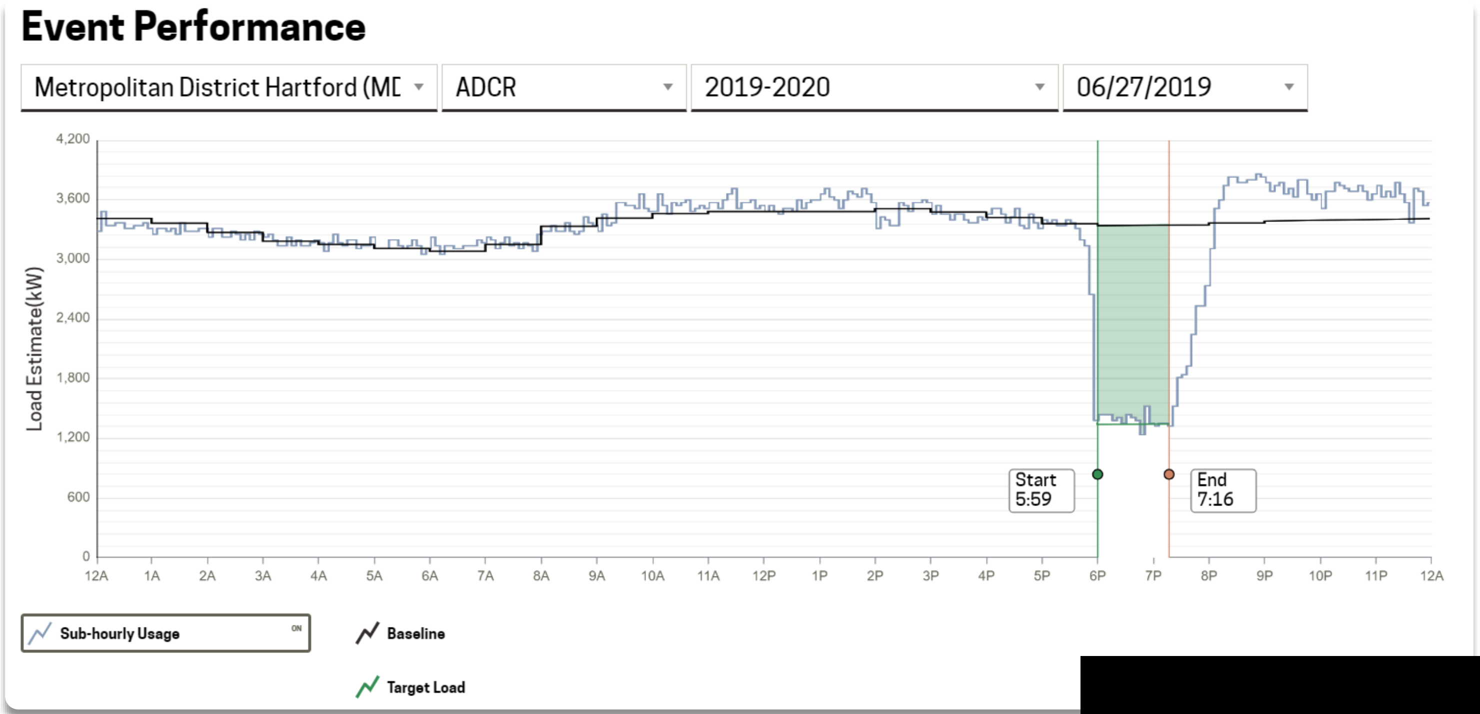




Daily Load Shedding Using Battery Storage

Program	Incentive Opportunity
ISO-NE	$55/kW/year
EnergizeCT	$200/kW/summer
Connected Solutions	$200/kW/summer
RI Energy	$400/kW/summer

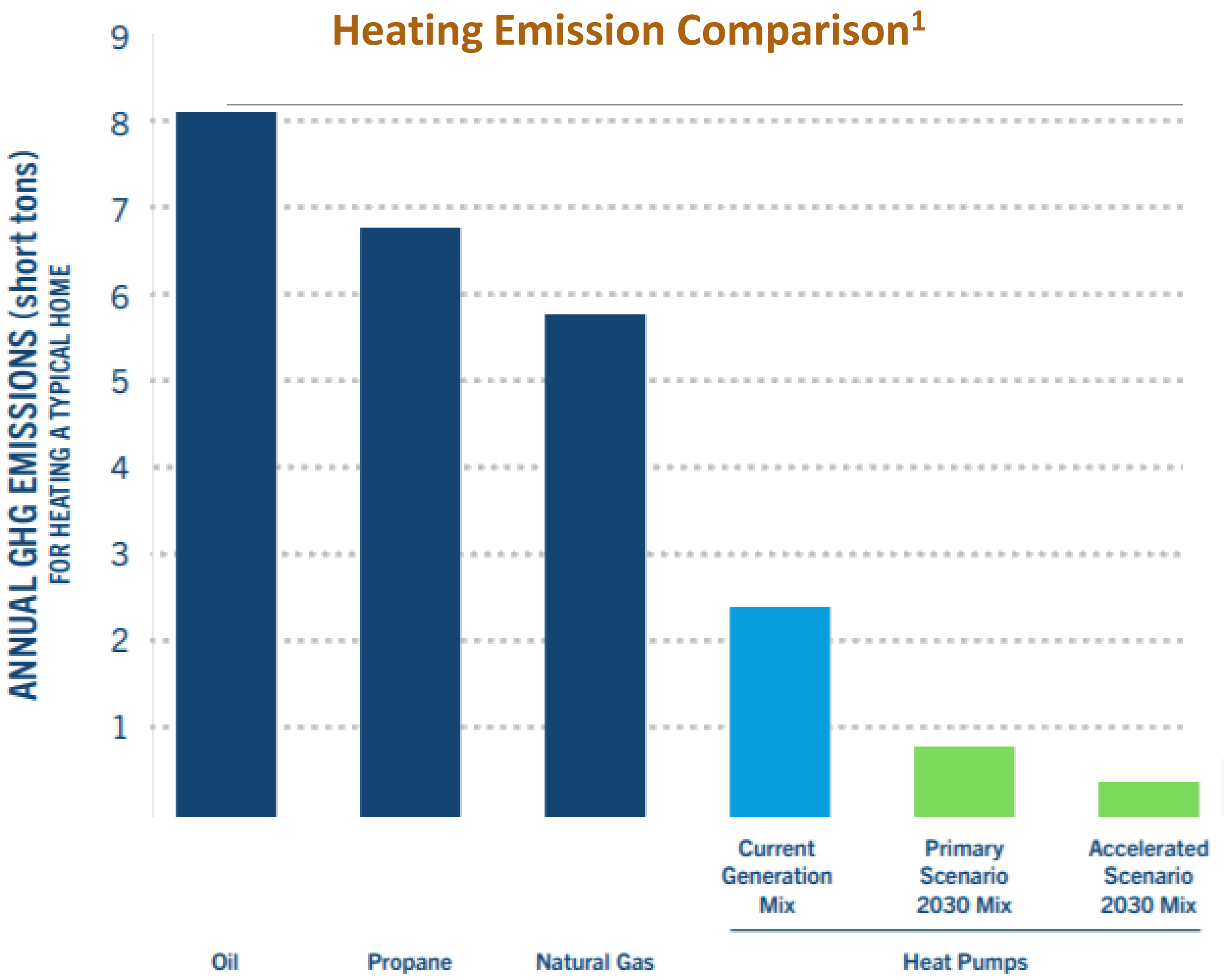
Hartford MDC Demand Response



Revenue		
Summer 2018	1,325 kW	$57,227
Winter 18/19	1,580 kW	$45,382
Summer 2019	1,941 kW	$80,101
Total		**$182,711**

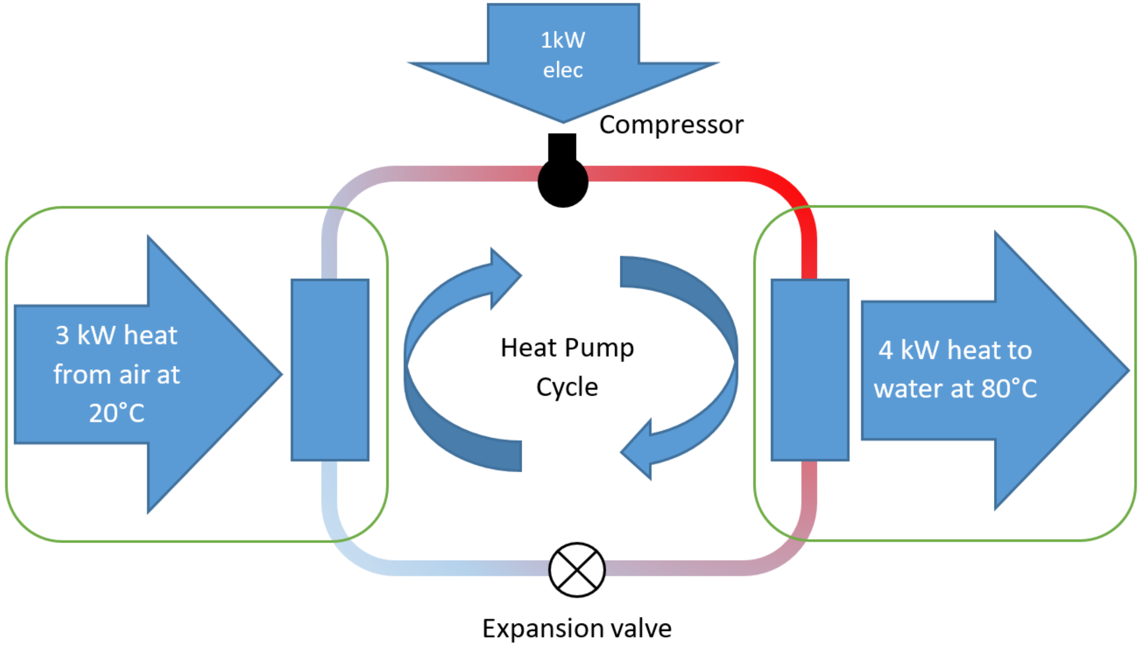
CPower

Electrification at Water Utilities: lower carbon emissions + drastically increase efficiency (without increasing costs)



[1]From Acadia Center's EnergyVision2030

Heat Pumps achieve efficiencies of over 400%



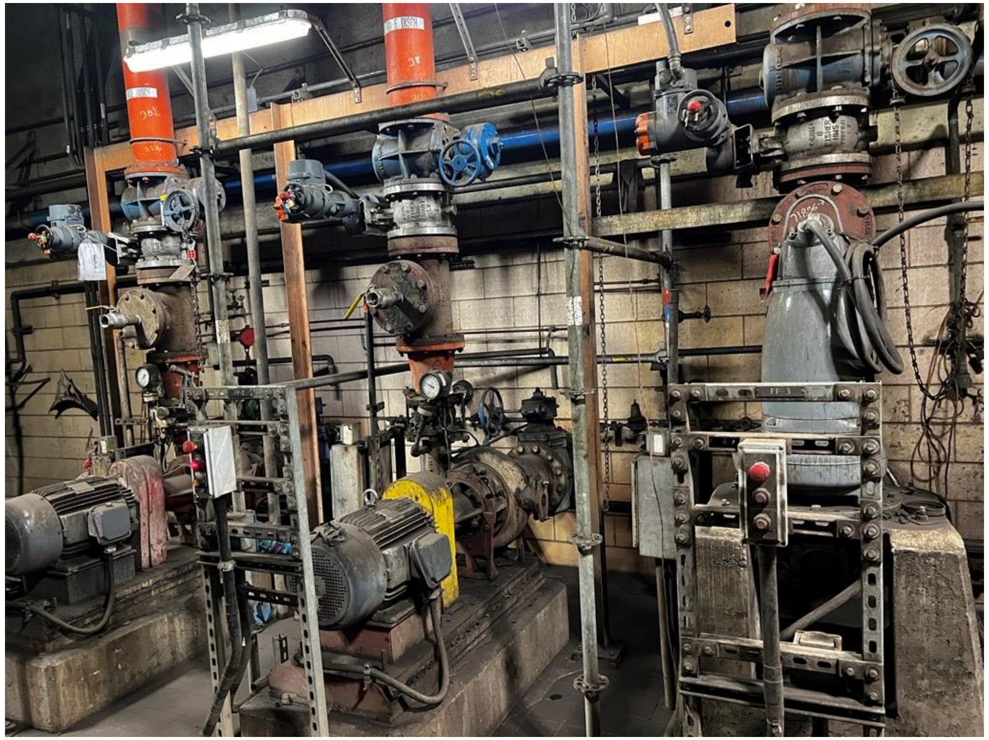
- Water source heat pumps can be used to recover/dump heat from/into process stream for heating/cooling spaces
- Air source heat pumps use the heat within outdoor air and can operate down to temperatures of -17°F
- Ground source heat pumps use the heat from underground to heat spaces

Summary

Energy Savings

Reduce Costs

Create Revenue



Thank You

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