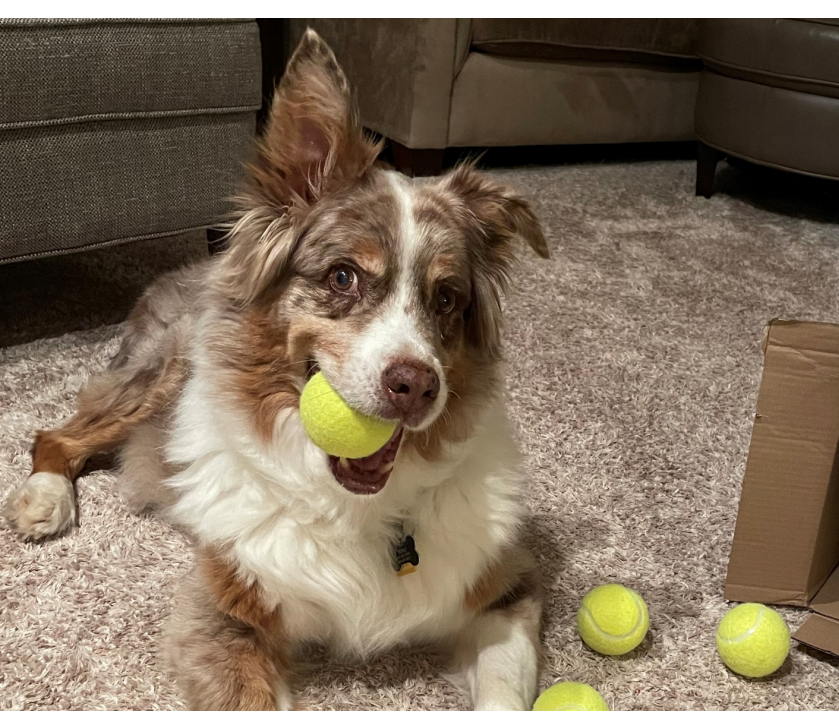


# Energy Management and Emerging Trends

Jen Muir, P.E.

JKMuir, LLC

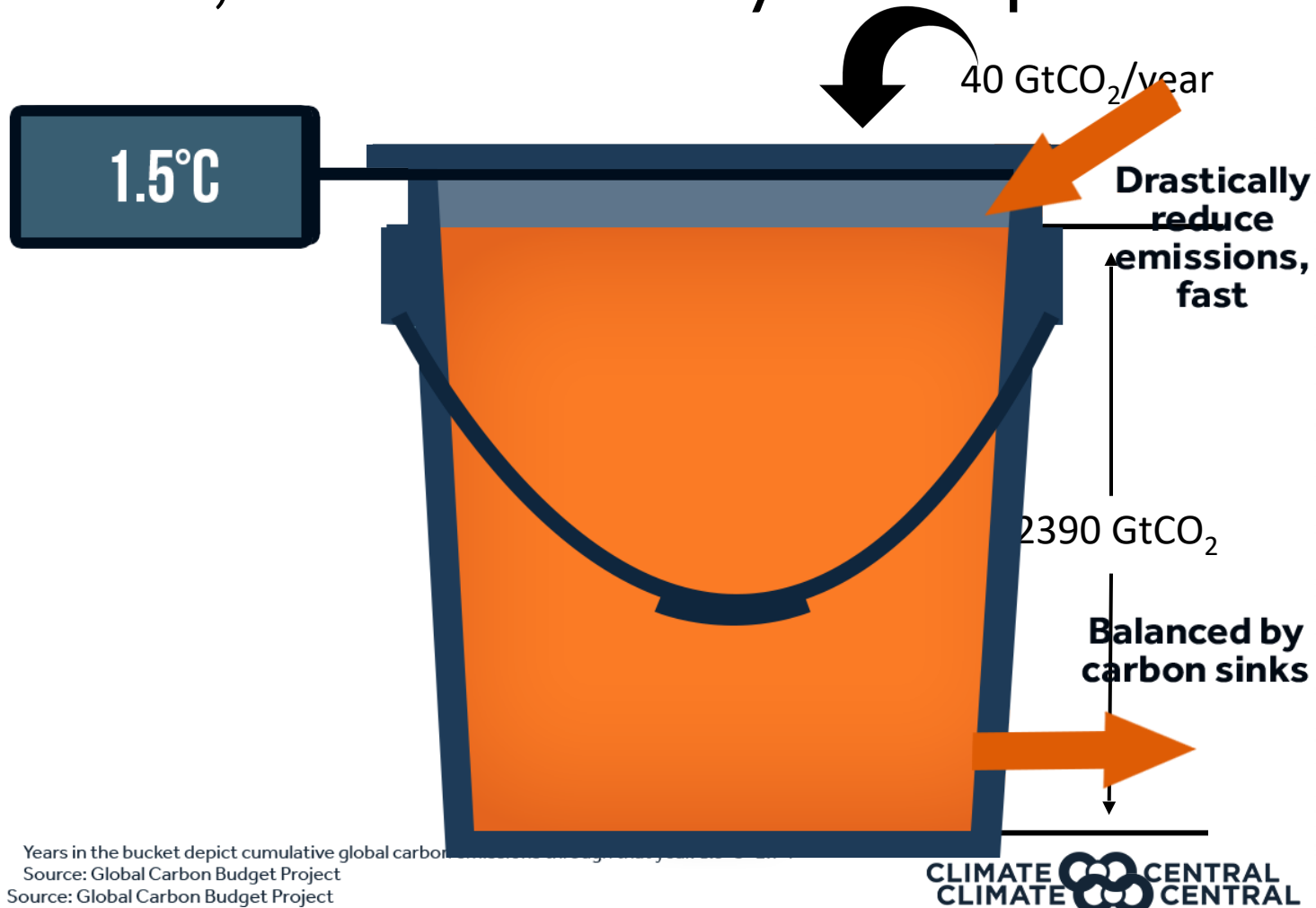






- Founded in 2008
- Engineering Consulting
  - Energy & Sustainability
  - Water/Energy Nexus
  - Public Infrastructure
- 15 Person Team:
  - Civil & Environmental Engineers
  - Chemical & Mechanical Engineers
  - Construction Managers
- Clients:
  - Engineering/Consulting Firms
  - Municipalities
  - Contractors
  - Utilities
    - Power / Energy
    - Private Water / Wastewater
  - ESCOs
  - Manufacturers Sales Representatives
- Women Owned Business

# There is a global carbon budget for limiting warming to 1.5°C, and it's already 80% spent



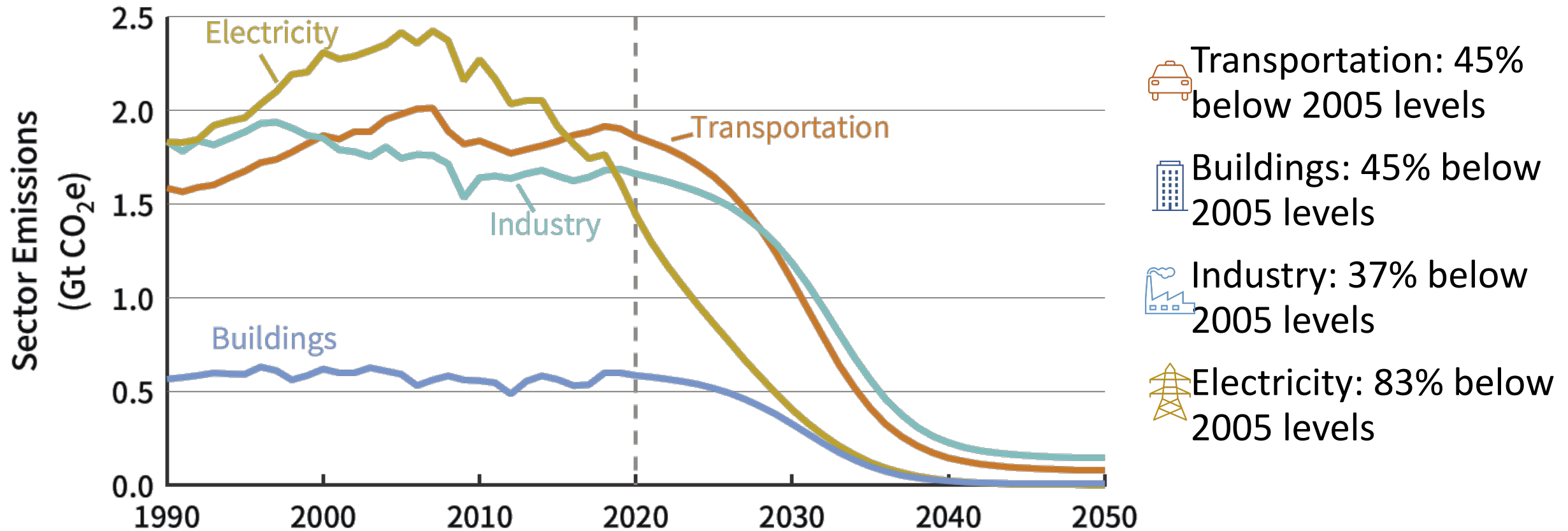
500 Gt CO<sub>2</sub> global carbon budget remaining

~7% is US' 'fair share' of the budget, or 37 Gt CO<sub>2</sub>

Less than 10 years at current emissions level (~4.4 Gt CO<sub>2</sub>/year)

Years in the bucket depict cumulative global carbon emissions.  
Source: Global Carbon Budget Project  
Source: Global Carbon Budget Project

# Keeping cumulative US emissions within the carbon budget requires significant reductions by 2030



# High Level Principles of Decarbonization

A review of decarbonization studies show us there are a few near term key strategies to limit warming to 1.5°C

## Increase Efficiency

- Reduce energy needs in buildings, transport and industry

## Build Renewables

- Deploy solar, wind, and battery storage on a massive scale

## Electrify Things

- Rapidly adopt heat pumps and electric vehicles

## Decarbonize other sectors

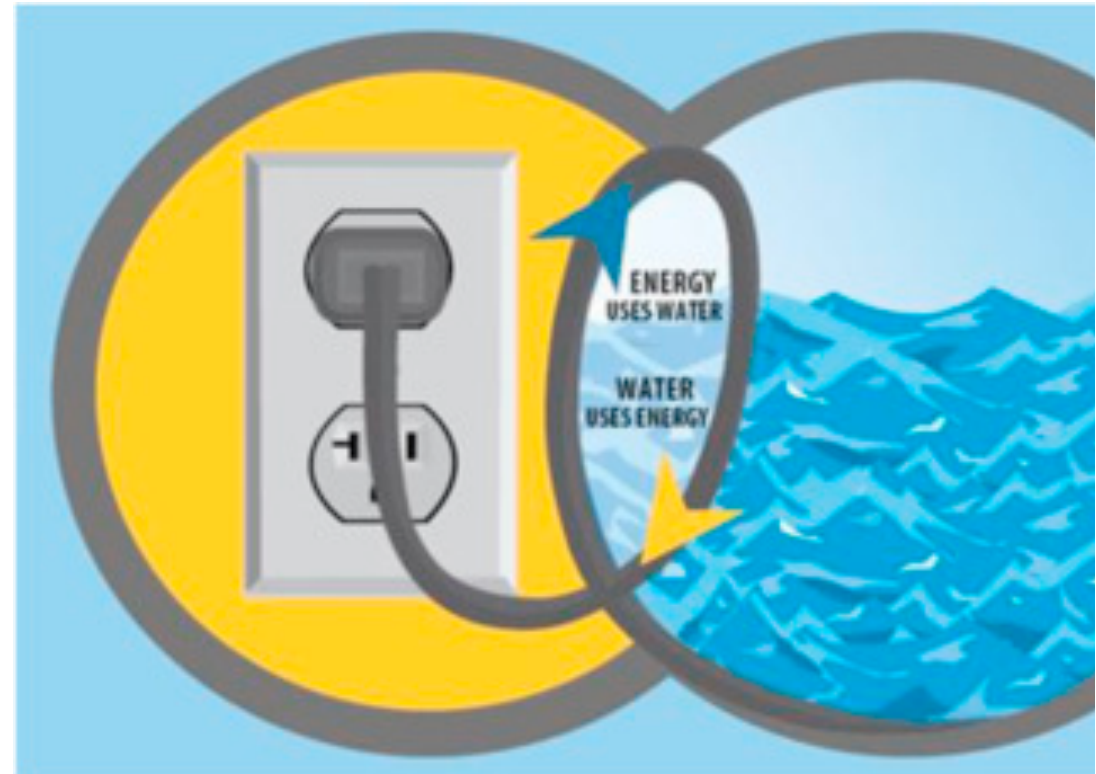
- Develop clean, low carbon fuels
- Build out carbon sinks

# The water sector: part of the problem, but also a solution

**3%** Water sector's share of global GHG emissions<sup>1</sup>

**4%** Water sector's share of US energy use<sup>2</sup>

**5 X** Ratio of energy potential in wastewater to energy required for treatment<sup>3</sup>



# Sources of GHG Emissions



CO<sub>2</sub>



Methane  
(~25x)

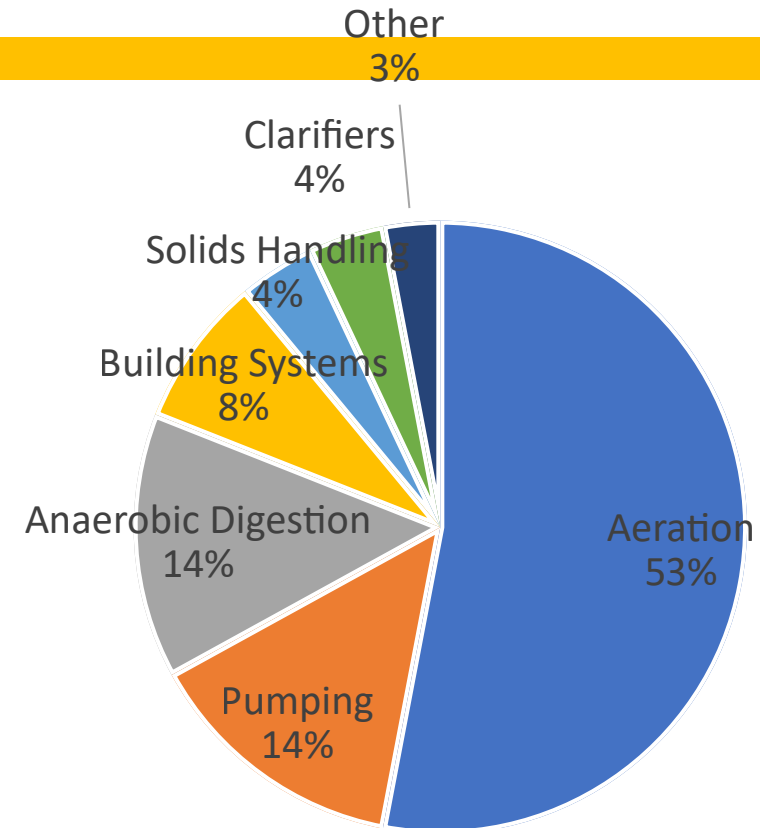


N<sub>2</sub>O  
(~298x)

# Reducing Energy Needs in Water Utilities

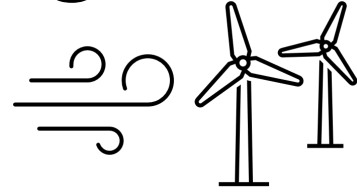
Typical WRRFs can reduce energy use by 15-30%<sup>1</sup>

- Benchmark energy use
- Focus on energy intensive processes/equipment
- Turn it off (or turn it down)
- Implement automated process controls
- Right-size equipment
- Monitor equipment performance to maintain efficiency

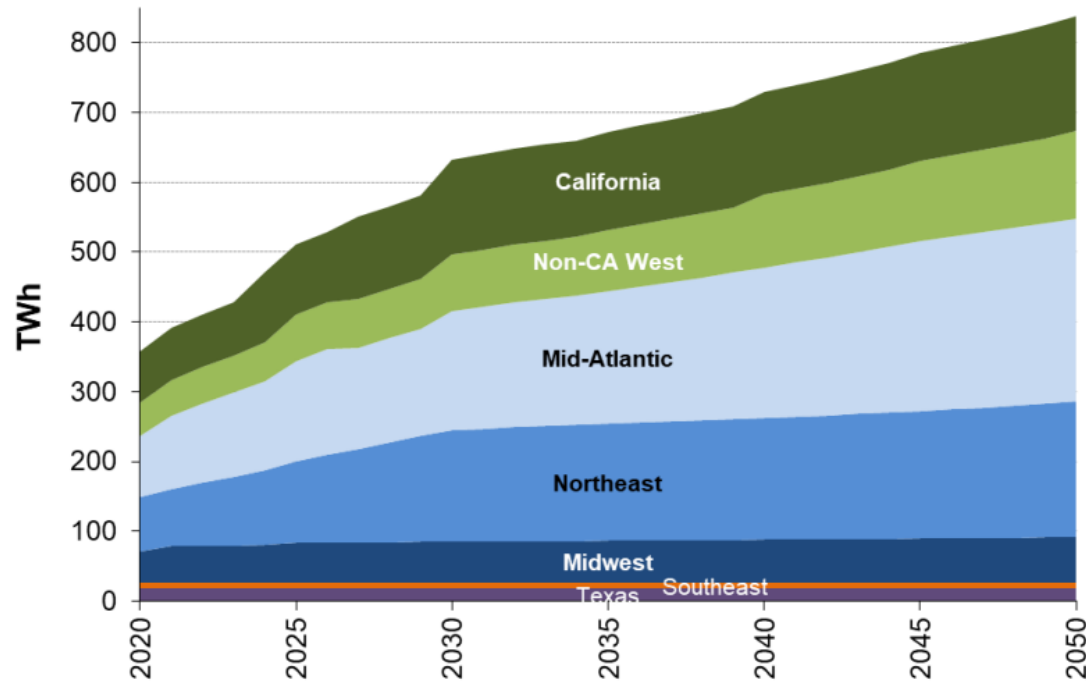




# Decarbonizing the electric grid



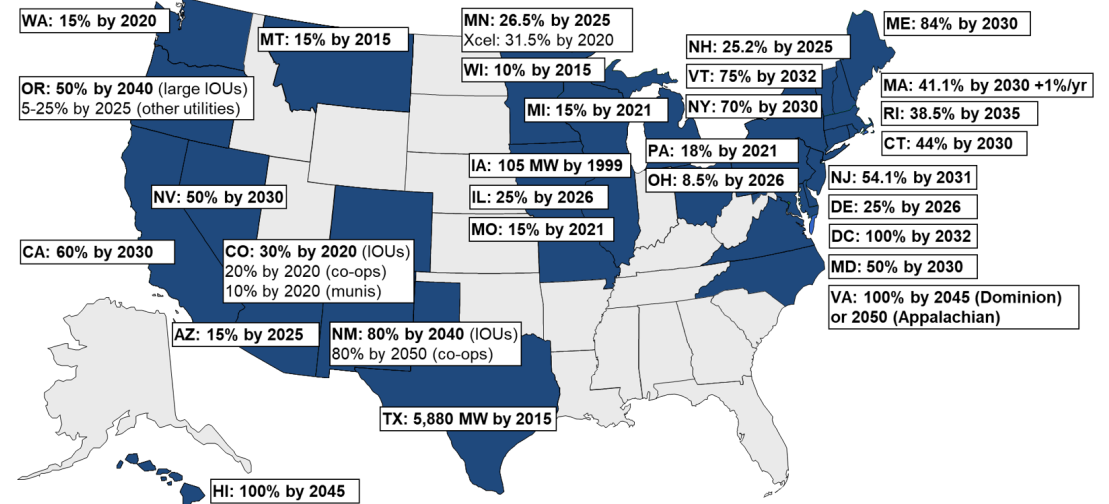
Projected demand from State Renewable Portfolio Standards to more than double over the next 30 years



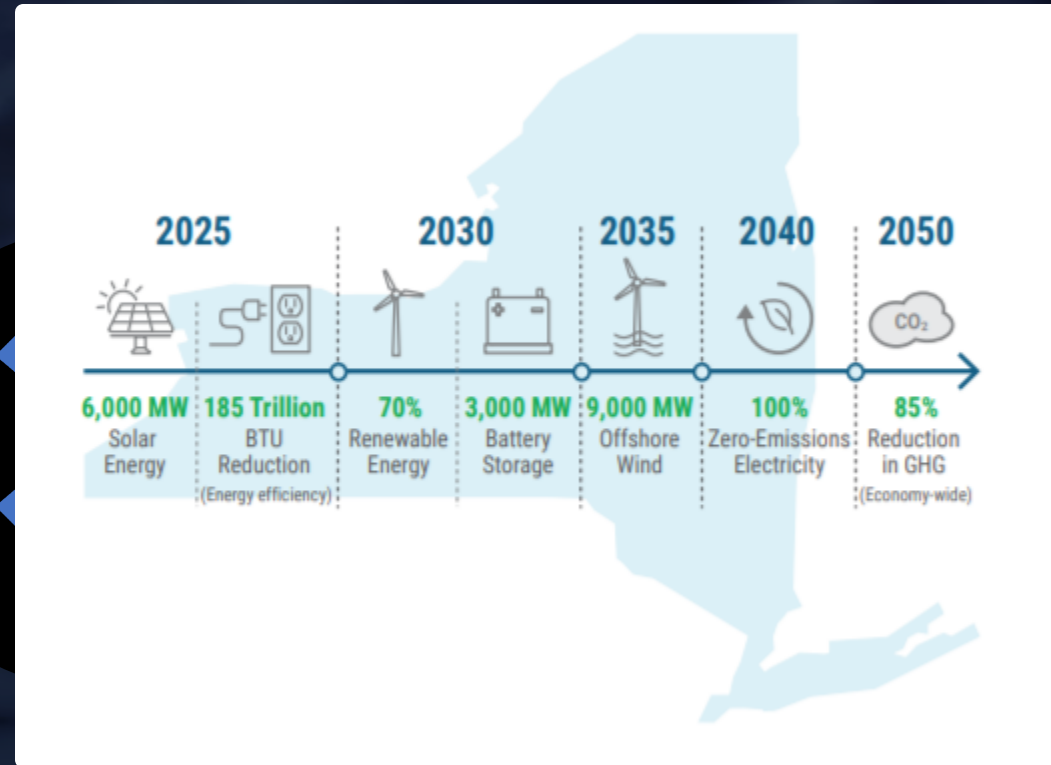
Source: [Berkeley Lab](#)

*Many states mandate electric utilities to supply a certain percentage of their load from renewable / clean energy within a certain timeframe, which often is accompanied by a tradeable REC market*

State by state RPS: variation from no ambition to massive increases by 2030



# Spotlight: NY State – Aggressive Carbon Goals



REACH ZERO EMISSION GRID BY 2040

STRICT RENEWABLE CAPACITY INCREASES  
WITHIN THE NEXT 5-15 YEARS

# NYISO

Rea

Re

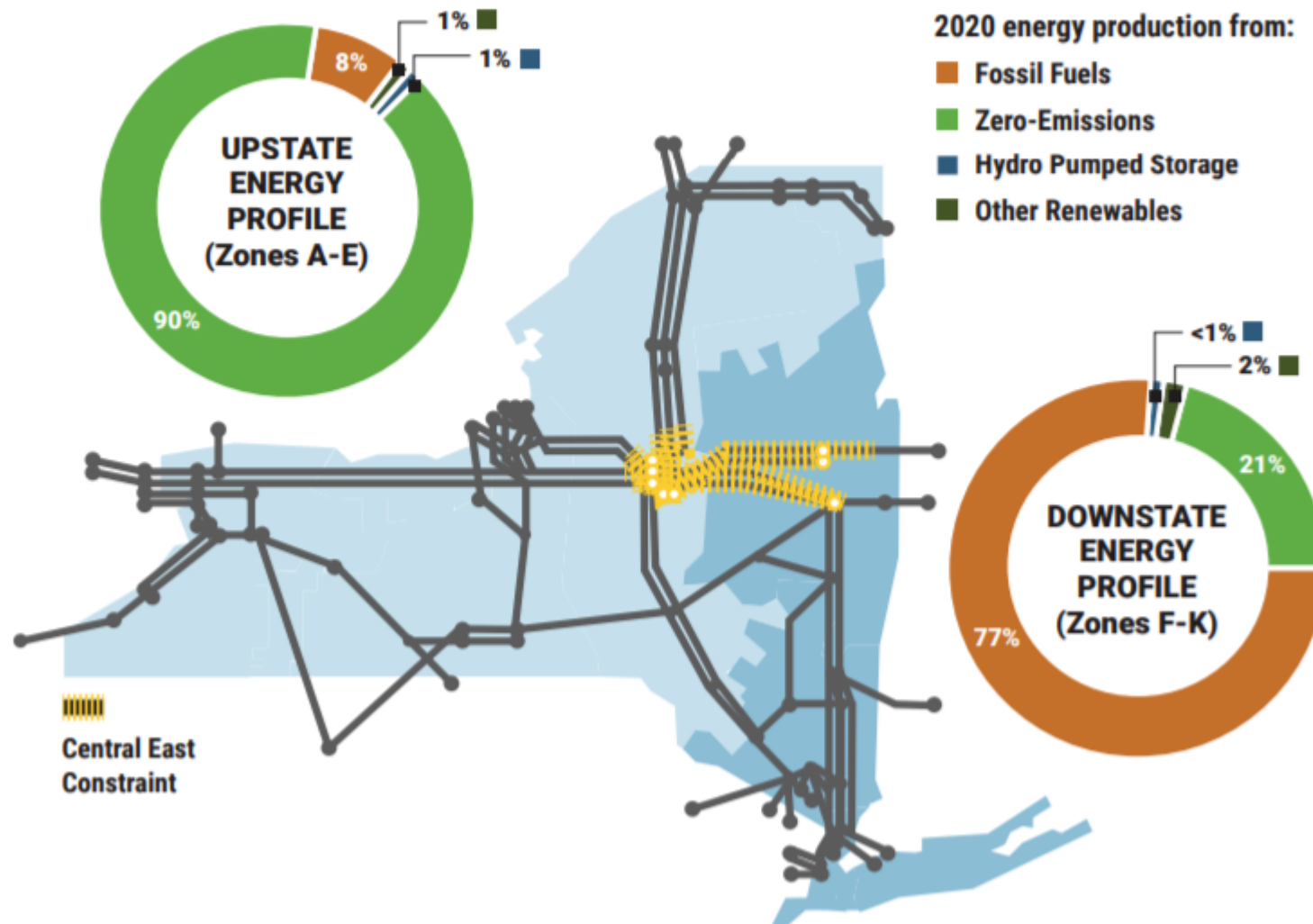
02

Clic

\$

\$

## ► Tale of Two Grids



21.00

30.82%



## Key findings

**1.** The variability of output from wind and solar resources presents a fundamental challenge to meeting electricity demand.



**2.** Battery storage resources help to fill in voids in renewable resources output, but extended periods rapidly deplete storage capabilities.



**3.** Dispatchable, emission-free resources are needed to balance renewable intermittency on the system.



**4.** It will also be necessary to expand transmission throughout the state in order to maximize the access to renewable resources.



**5.** Overall, the key reliability challenges identified in this study relate to how the resource mix evolves in compliance with the CLCPA.



**6.** Climate change will impact meteorological conditions and events that introduce additional reliability risks.



# ISONE

New England



Price Map

Demand Chart

Zones

15,629 MW  
SYSTEM DEMAND

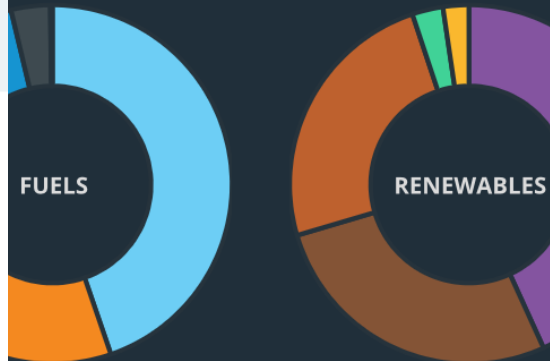
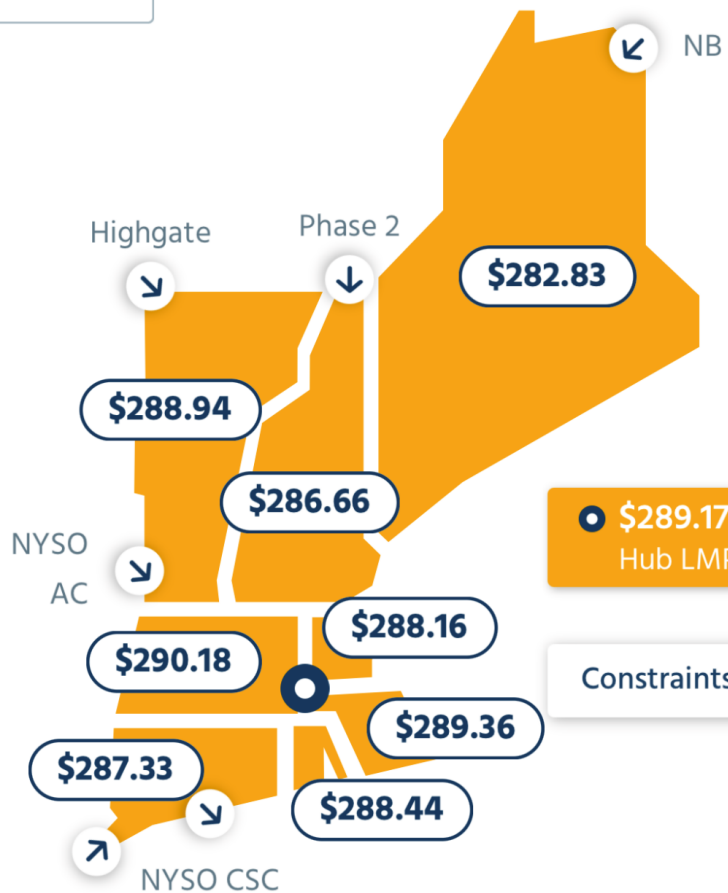
\$287.74  
NE ENERGY

Normal  
SYSTEM STATUS

REAL TIME

Real-Time

Day-Ahead



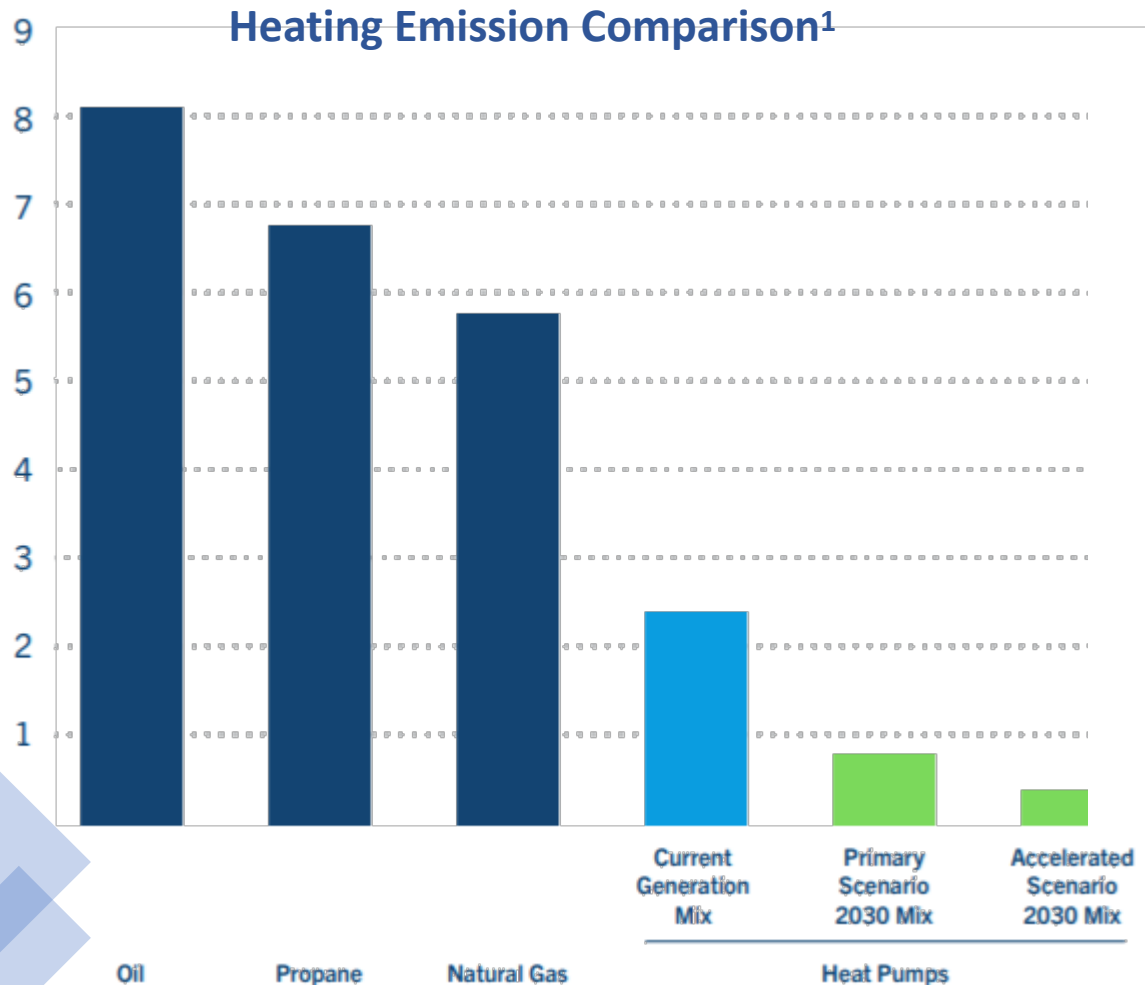
- 43% WIND
- 27% REFUSE
- 24% WOOD
- 3% LANDFILL
- 2% SOLAR

23,014  
AVAILABLE CAPACITY (MW)

## Fast Stats

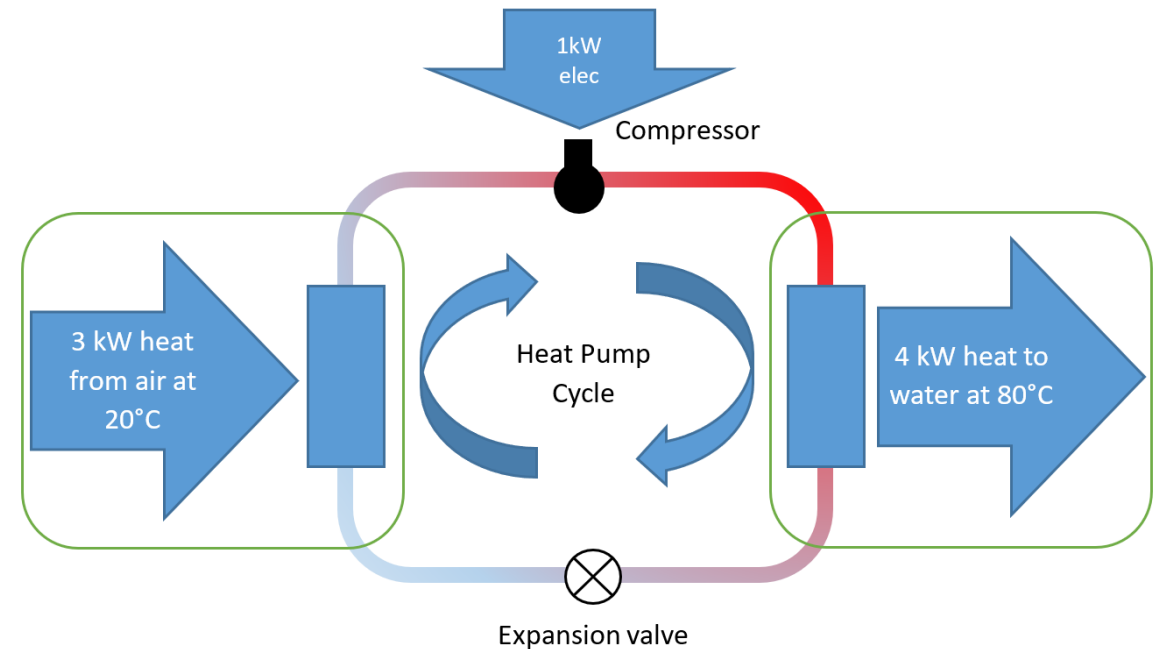
- 99%, 78%, and 42% decrease in annual regional emissions between 2001 and 2019 for sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), and carbon dioxide (CO<sub>2</sub>), respectively
- 60% decrease in coal-fired generation, between 2018 and 2019
- 69% decline in oil-fired generation from 2018 to 2019
- 13% increase in production from solar and wind resources, combined, between 2018 and 2019

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



<sup>1</sup>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

# The push towards strategic electrification

*“powering end uses with electricity instead of fossil fuels in a way that **increases energy efficiency** and **reduces pollution**, while **lowering costs** to customers and society”*  
*-NEEP*

In 2020 alone...

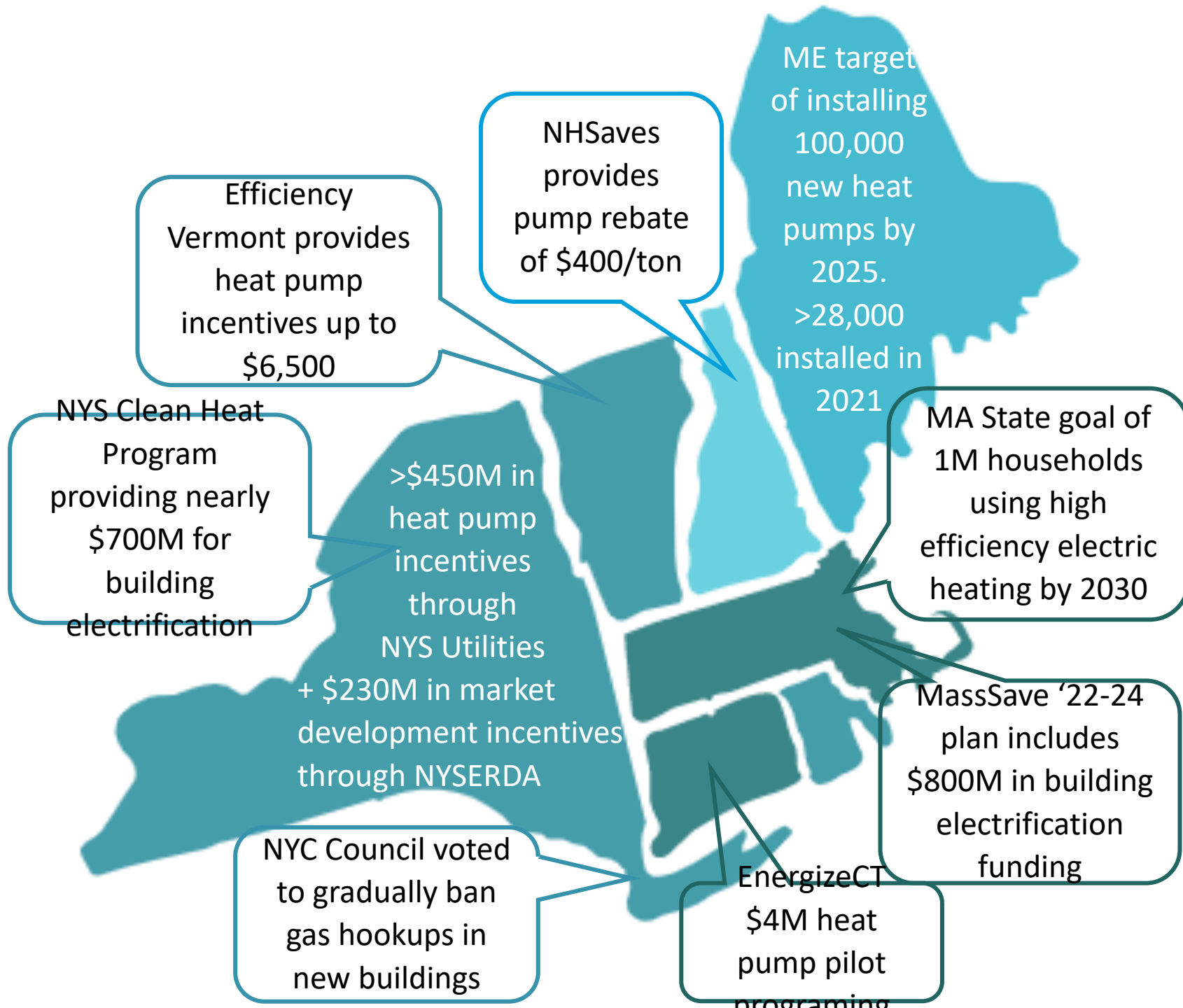
Seattle's mayor announced, Maine's state climate action plan called for installation of at least 45,000 heat pumps by 2025

Two MA municipalities called for widespread electrification of residential heating sales by 2030 to meet the state's goals

**2020 Building Electrification**

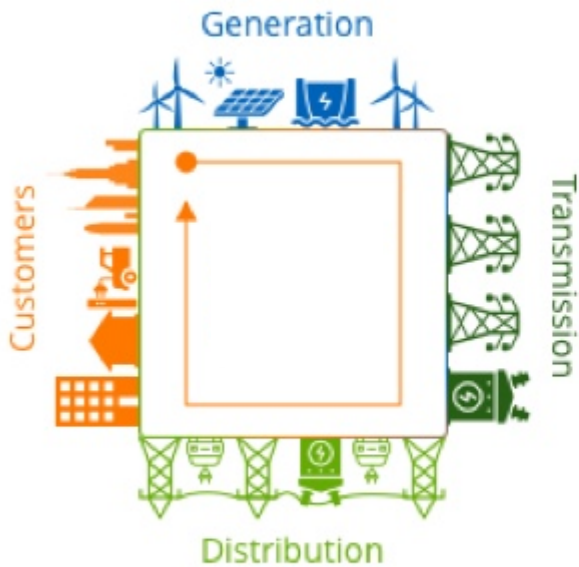
Most noteworthy state actions on building electrification this year.  
**AND MORE!**

Electrification funding and ambition in the Northeast is only one regional example of the national opportunity to ride the electrification wave



# Part of the Grid: water utilities as a distributed energy resource

The grid of the future is *decentralized*, and water utilities are well-positioned to *respond to grid needs* by developing and deploying a variety of resources



Renewables



Batteries



Demand response



Cogeneration

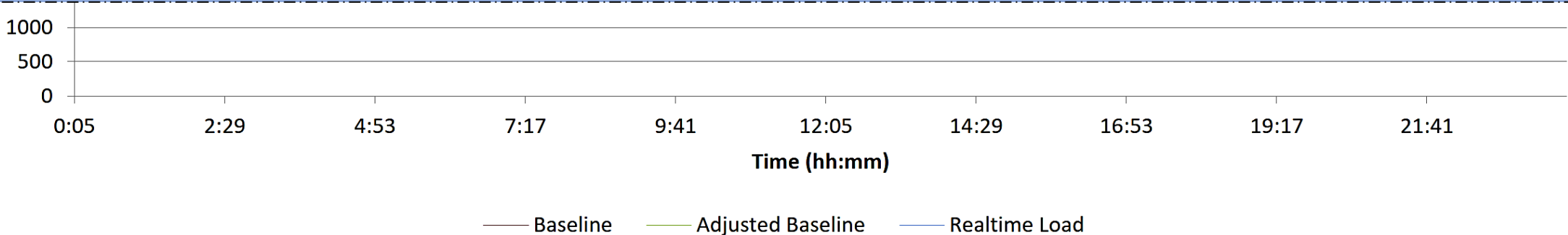
# Demand Response Programs



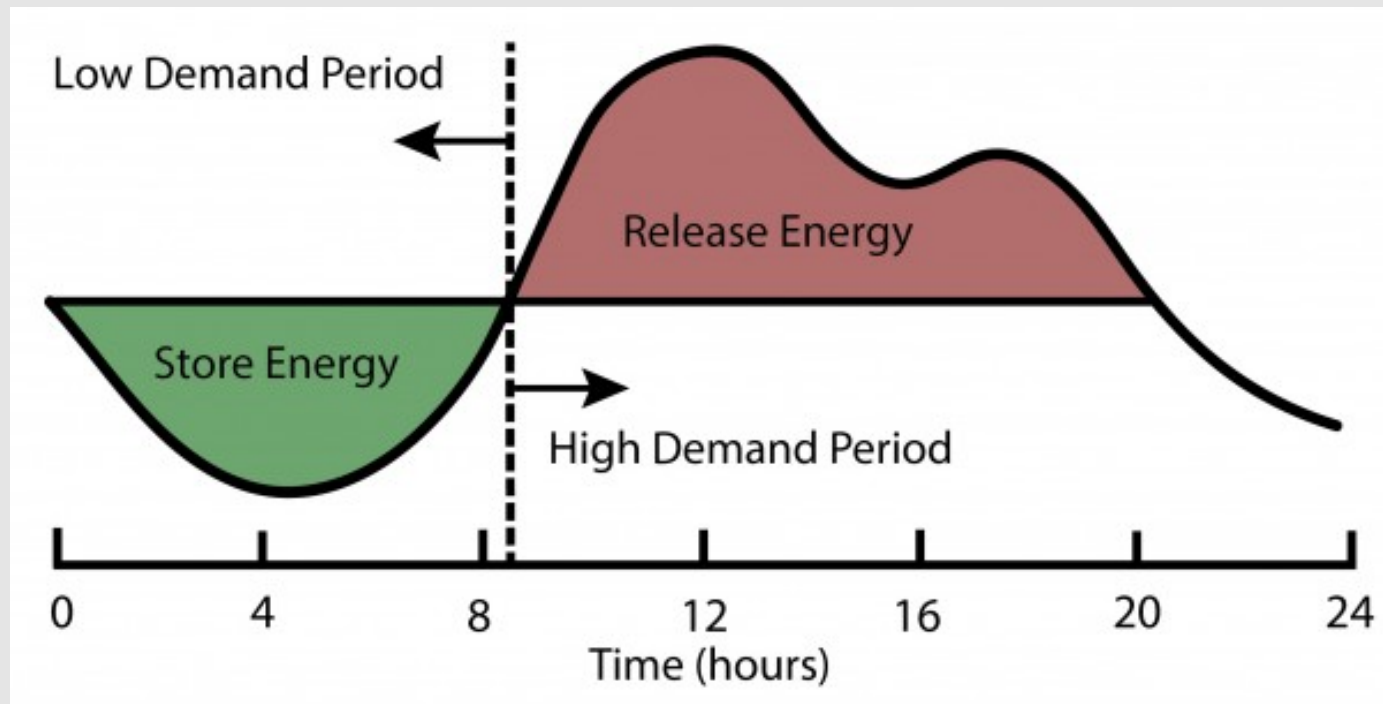
Option to also claim carbon offsets associated with reduced grid emissions due to load curtailment

Average Baseline (kW)	Average Realtime (kW)	DR Performance (kW)
3301	1732	1569

"TOU rate designs are being developed that give customers price signals to adopt new technologies that serve changing system demand"

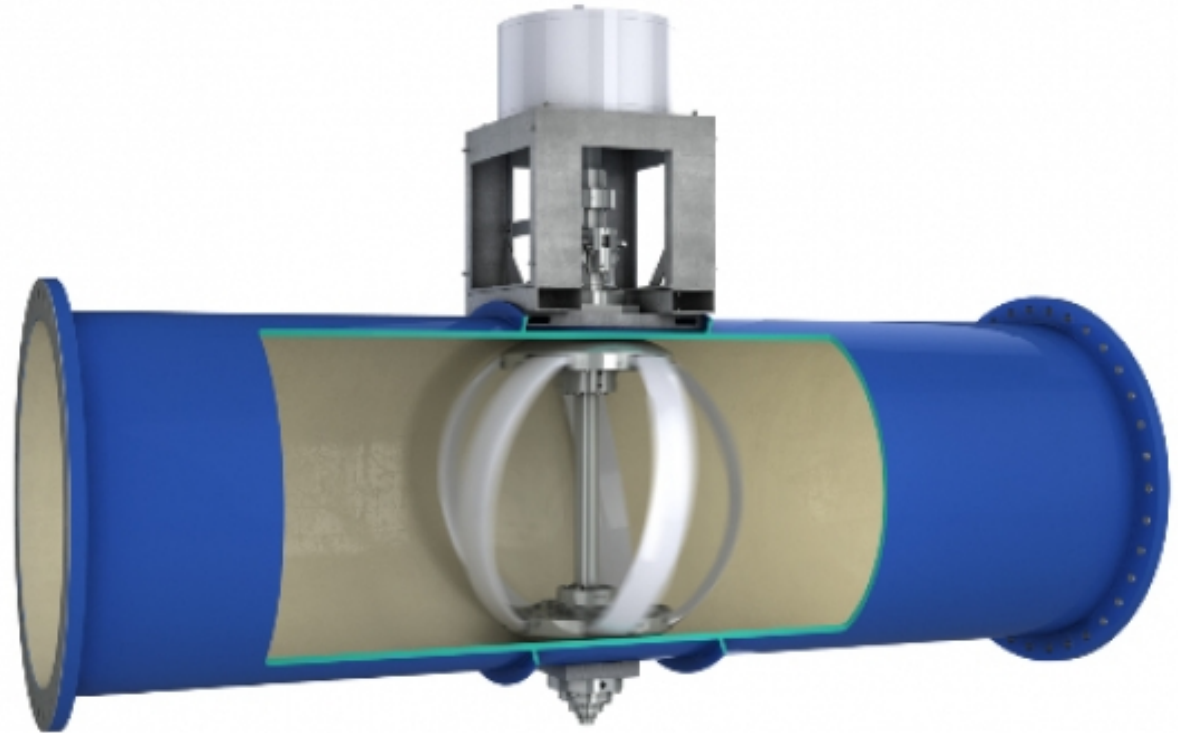


# Battery Storage



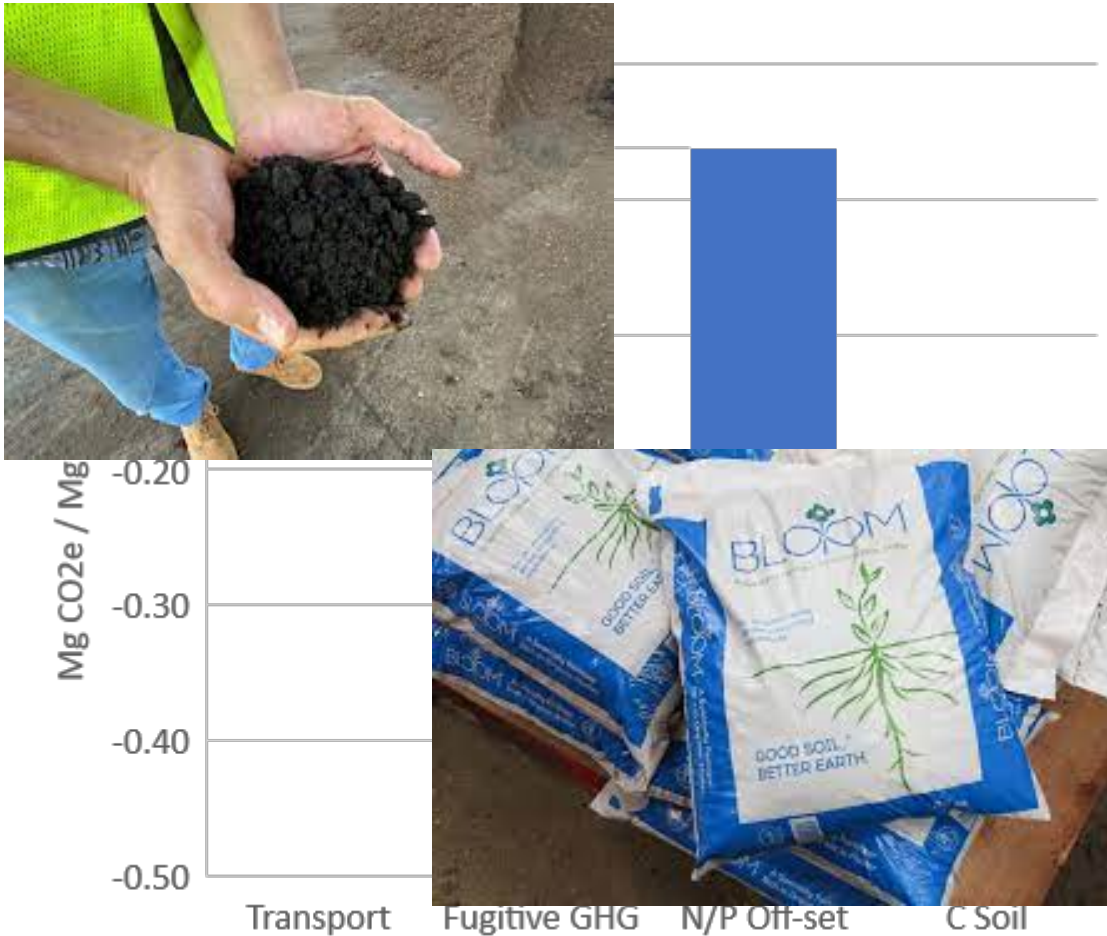
- Clip load during high-cost kWh times and charge from the grid during low-cost kWh times
- Participate in previous demand response programs + additional with more frequent events
- New England Utilities Daily Dispatch Program: \$200 - \$300/kWh; up to 60 summer events
- NYSEERDA offers upfront commercial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

# Water Facilities: The Untapped Potential of Hydropower



# WRRFs: The unique opportunity in biosolids

## Disposal: Enhancing Carbon Sinks



## Resource Recovery: Low Carbon Fuels



Source: BEAM model

**OneNYC 2050**  
BUILDING A STRONG AND FAIR CITY

# A LIVABLE CLIMATE

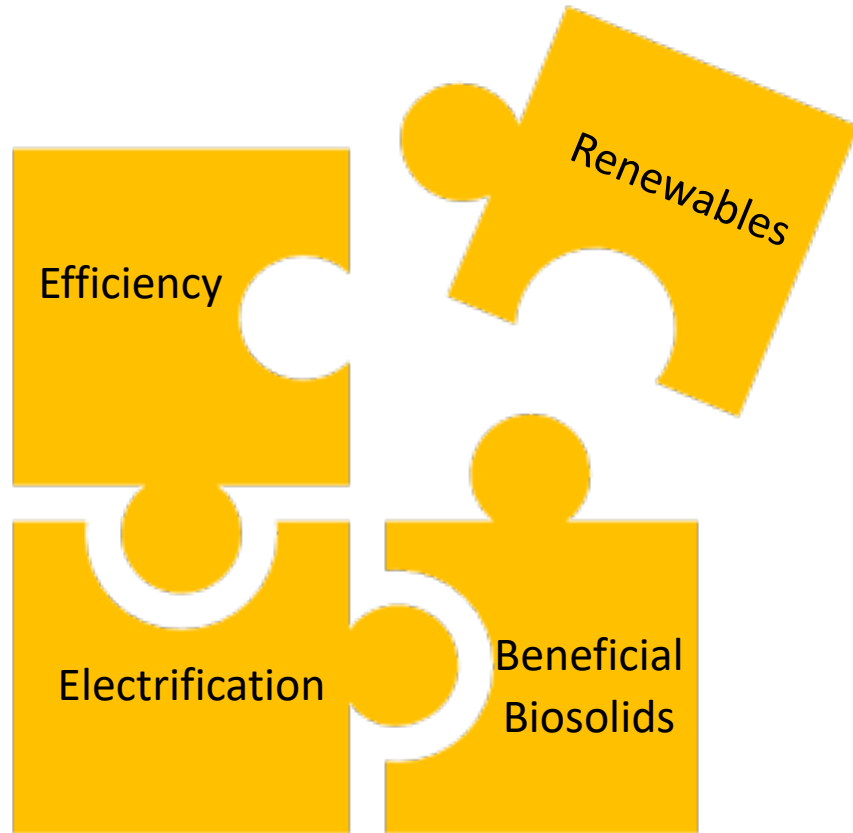
VOLUME 7 OF 9

New York City will lead a just transition to achieve carbon neutrality and adapt the city to withstand and emerge stronger from the impacts of climate change.

**NYC**



# Our Role in the Climate Challenge



Educate

Educate others on this issue



Advocate

Vouch for these opportunities



Implement

Make these projects happen; Make the business case



Share

Share successes to inspire others

**Part of the Change**

**&**

**Part of the Grid**

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