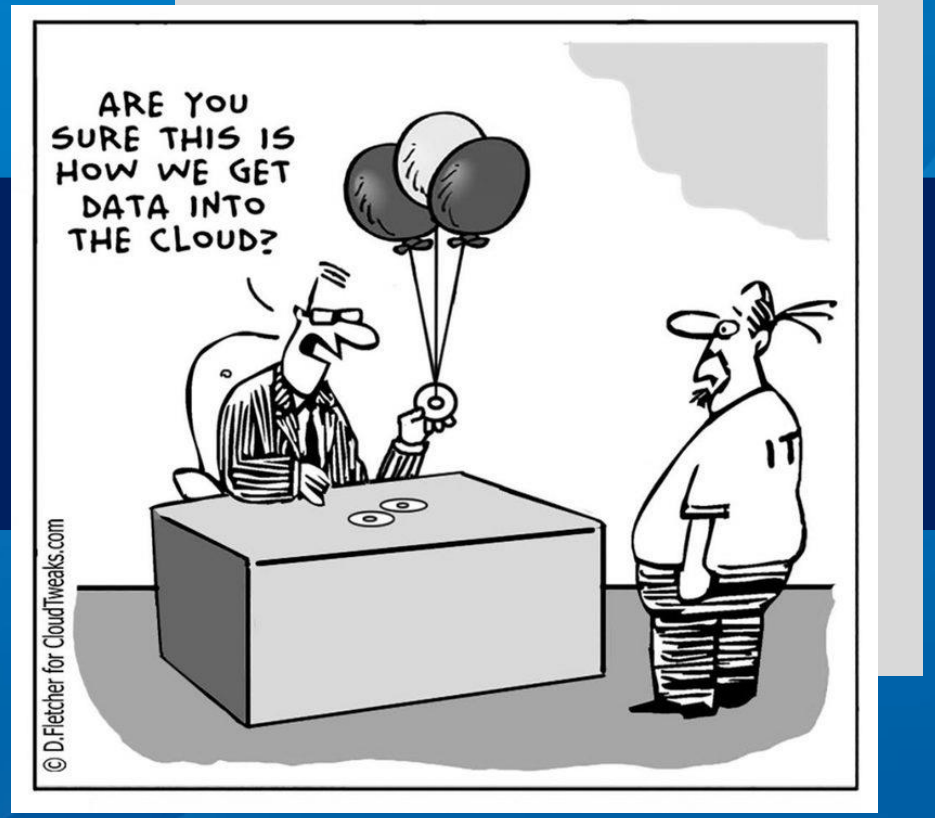
Leveraging Cloud-Based Technologies to Understand, Report, & Reduce Emissions

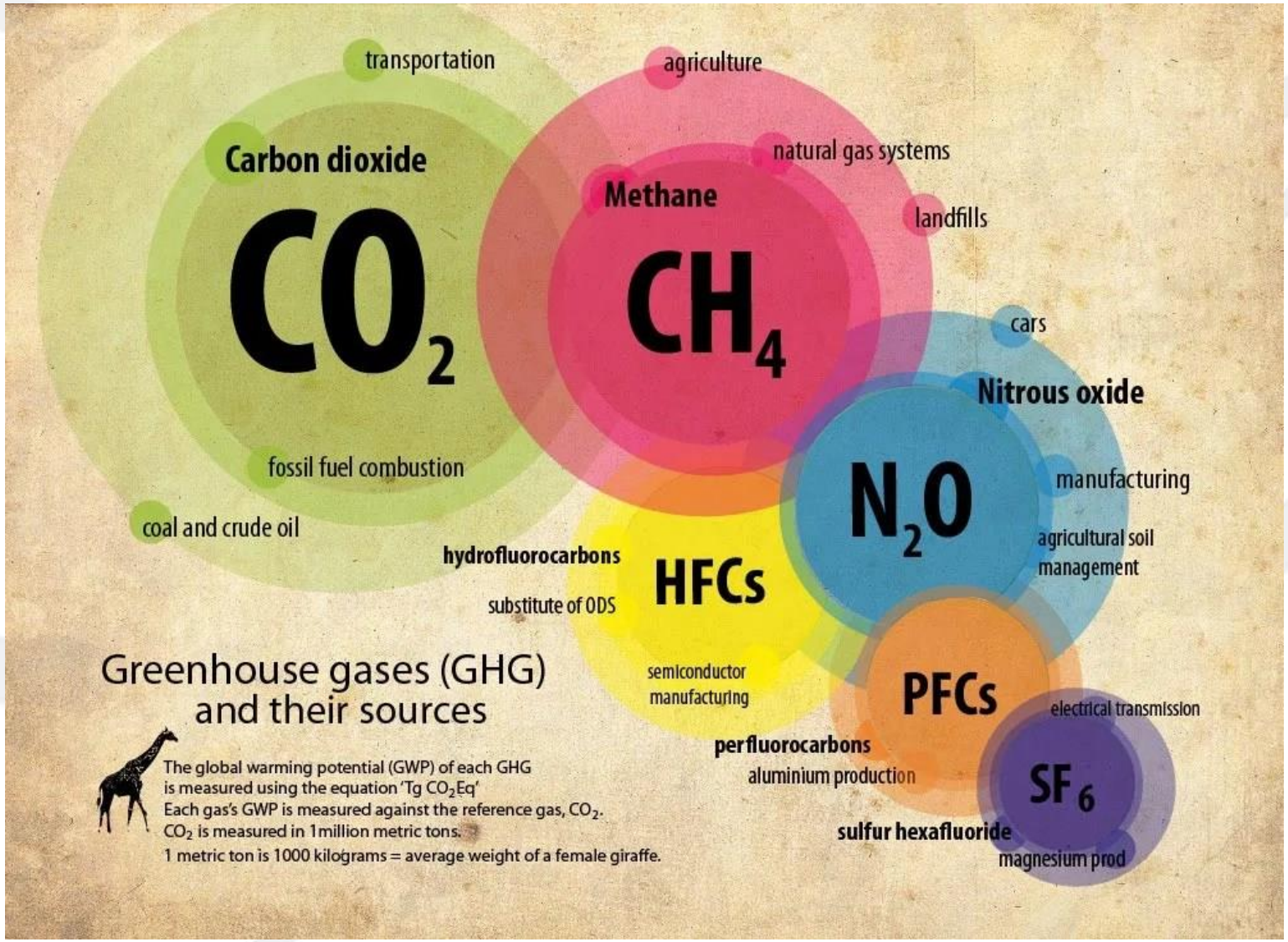


Ariana Axelrod, PE, CEM, VP Preconstruction
ariana.axelrod@controltechinc.com

BUILDINGENERGY BOSTON
PRE-CONFERENCE WEBINAR

HTS® DXS CONTROL TECHNOLOGIES

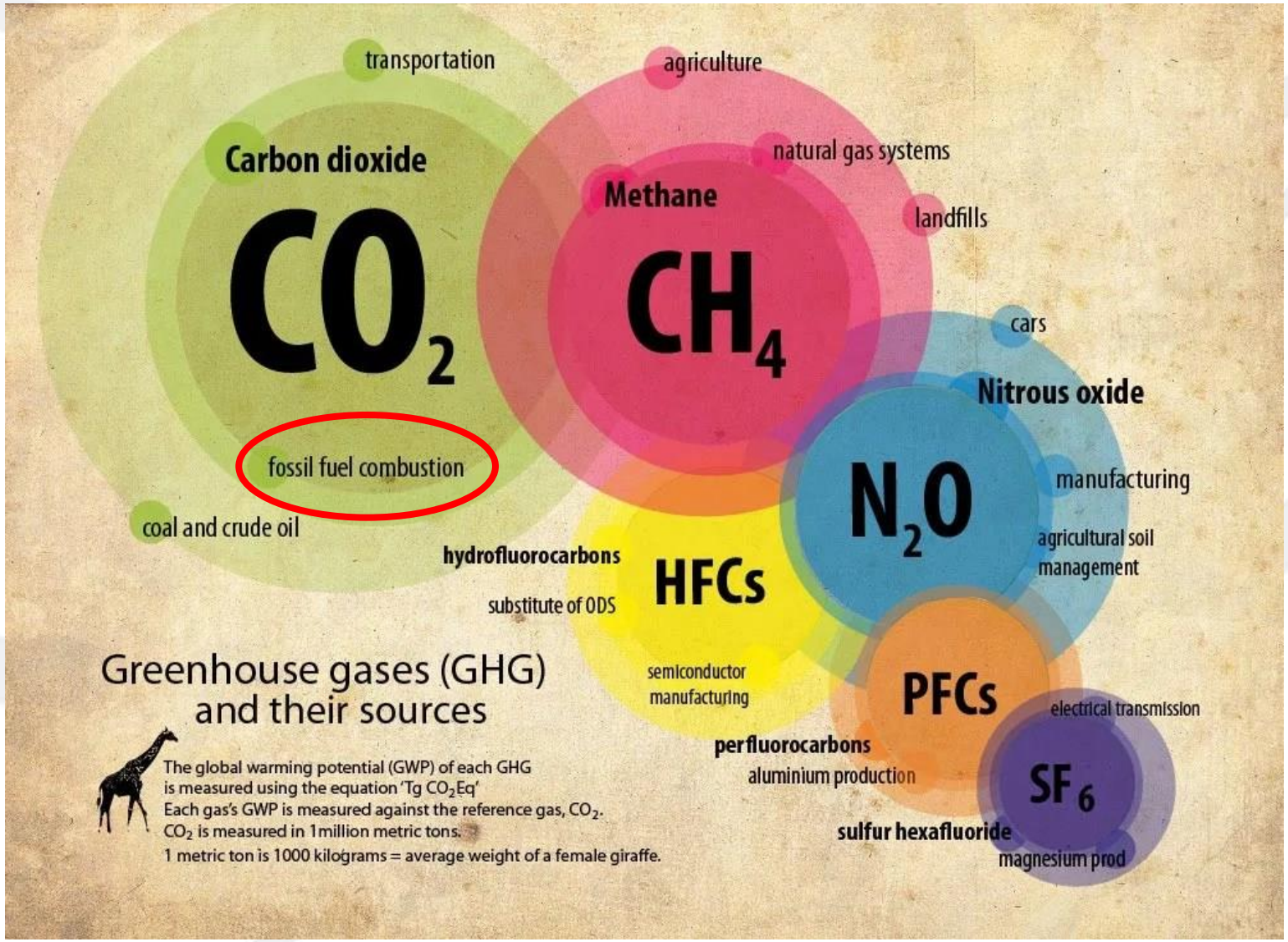
Greenhouse Gases (GHGs)

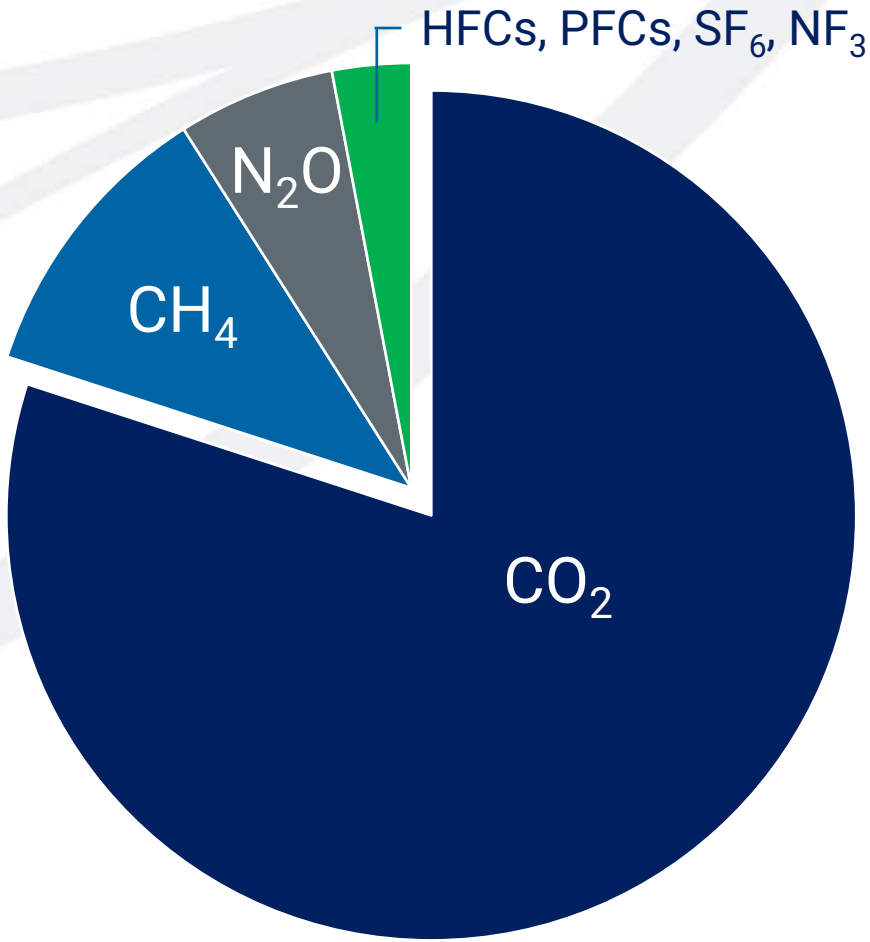


Gases within the atmosphere that trap heat

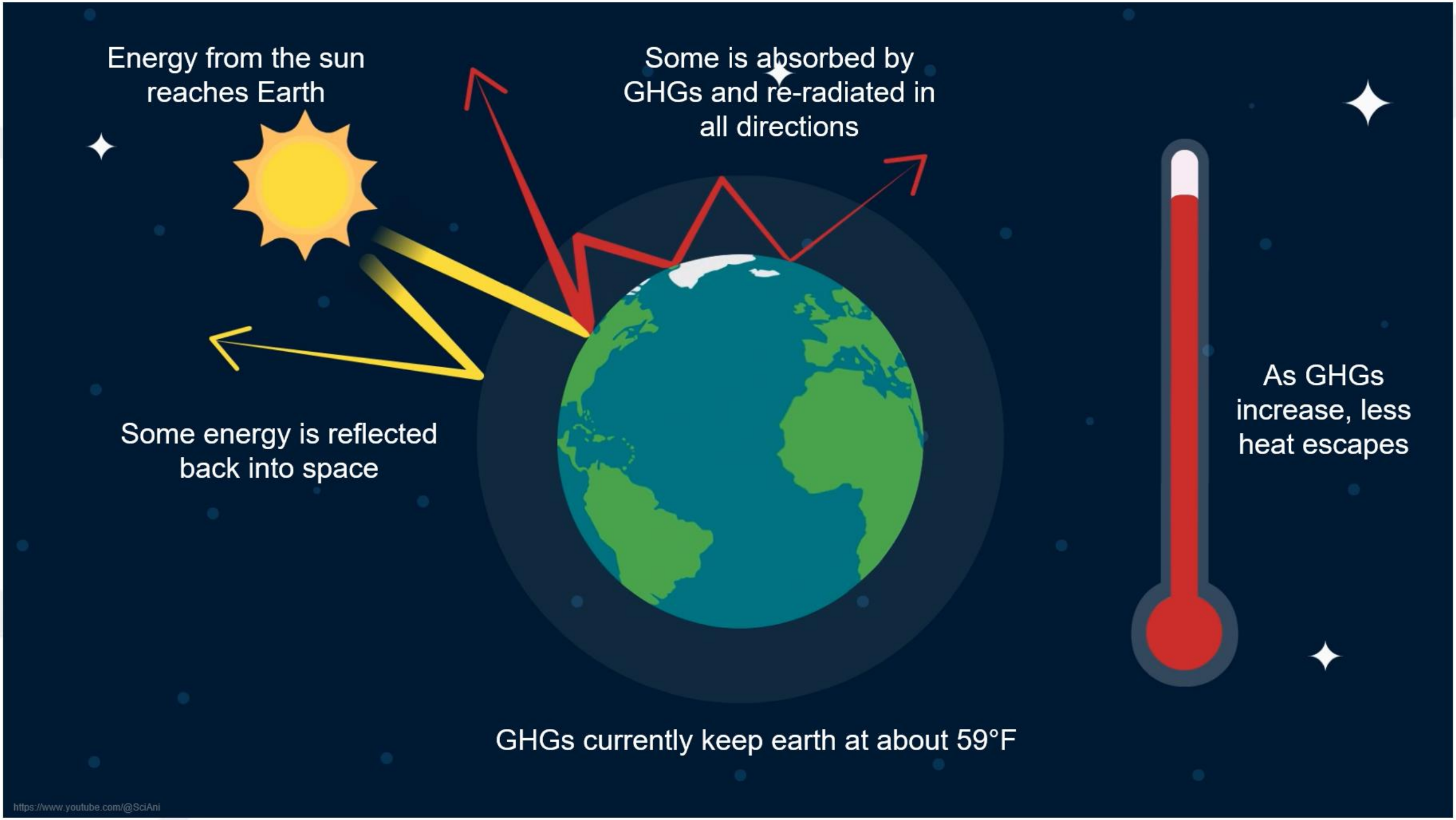
https://geologyscience.com/

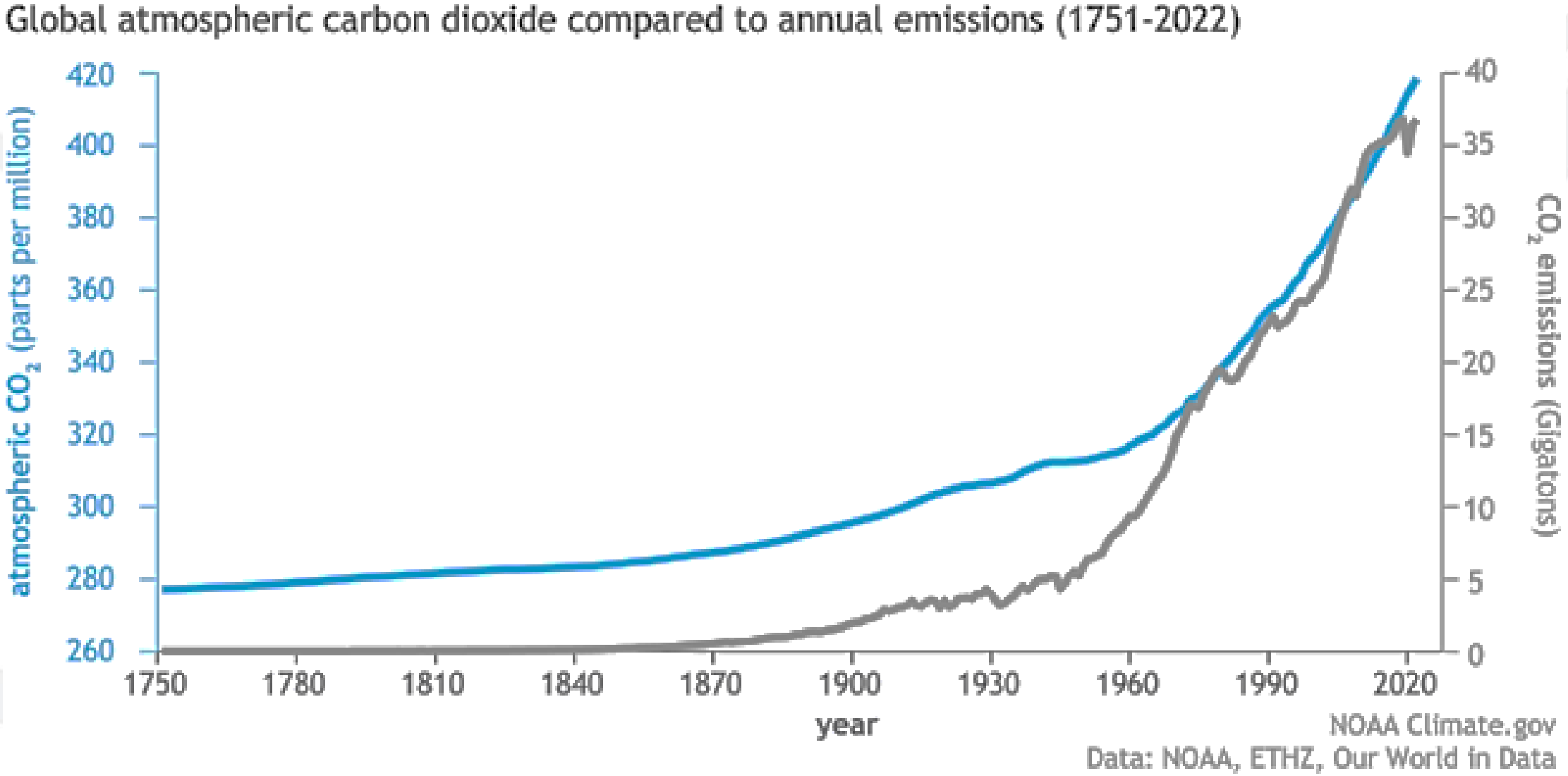
Greenhouse Gases (GHGs)





https://geologyscience.com/

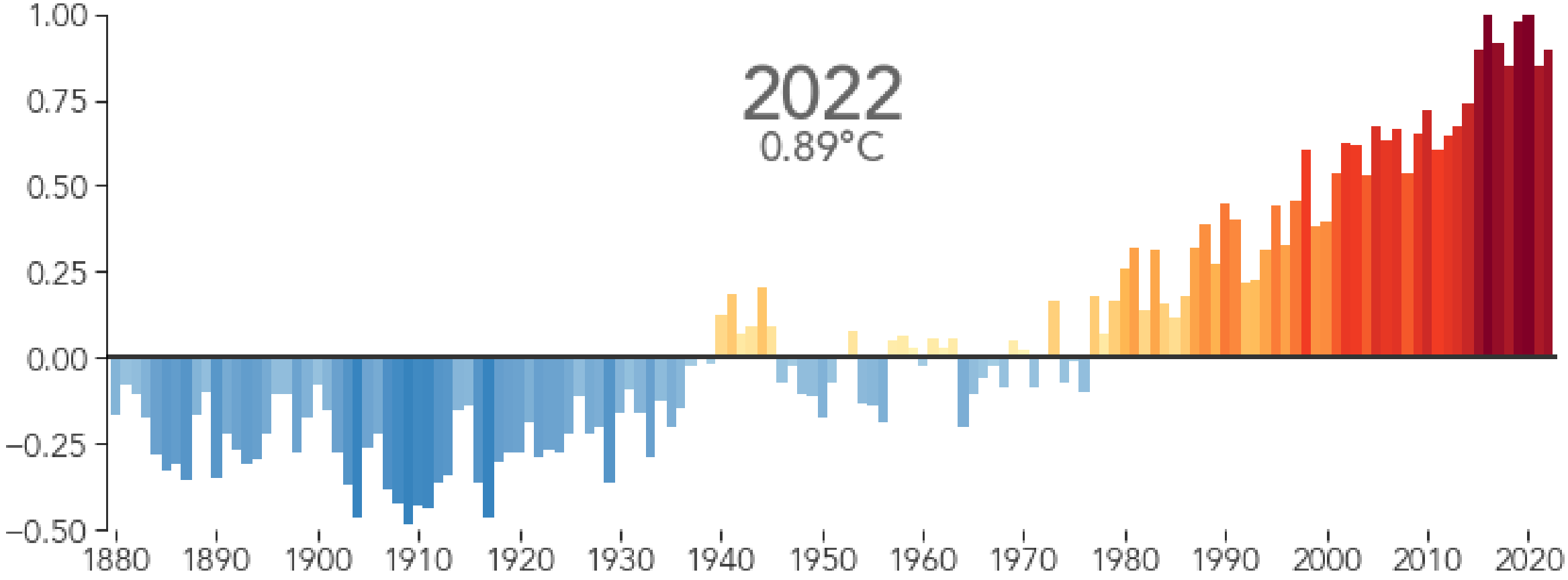

Energy from the sun reaches Earth
Some is absorbed by GHGs and re-radiated in all directions
Some energy is reflected back into space
As GHGs increase, less heat escapes
GHGs currently keep earth at about 59°F
https://www.youtube.com/@SciAni



Atmospheric CO_2e is 50% higher than pre-Industrial Revolution levels

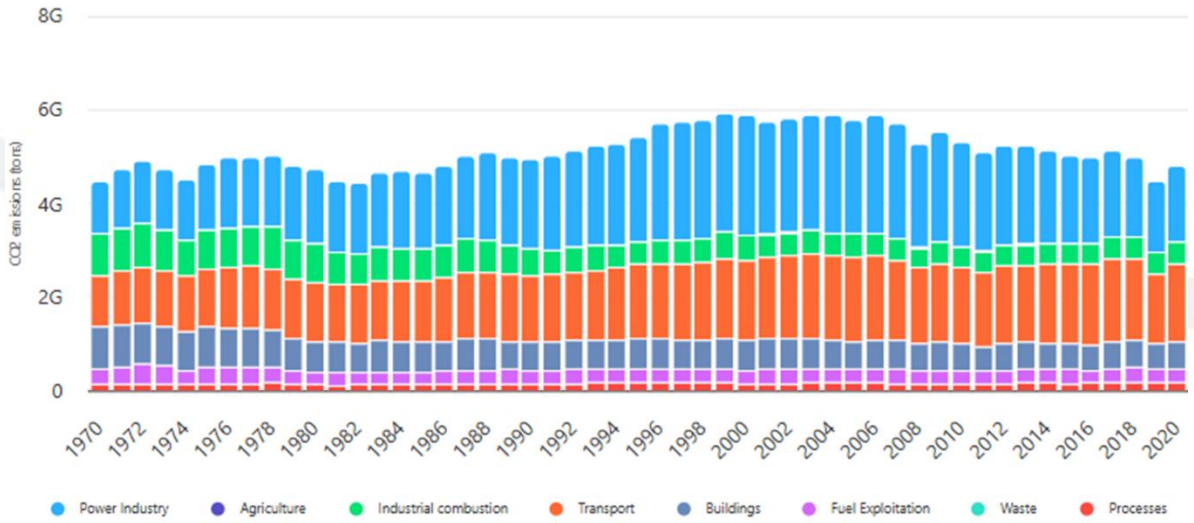
Last 9 Years Warmest on Record

Global Temperature Anomaly (°C compared to the 1951-1980 average)

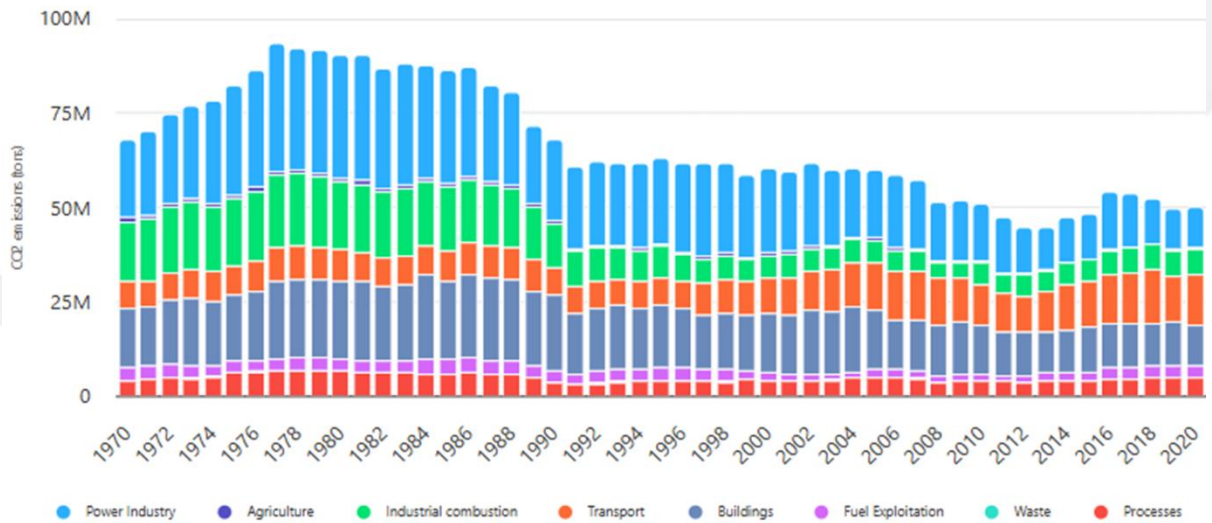


https://earthobservatory.nasa.gov/

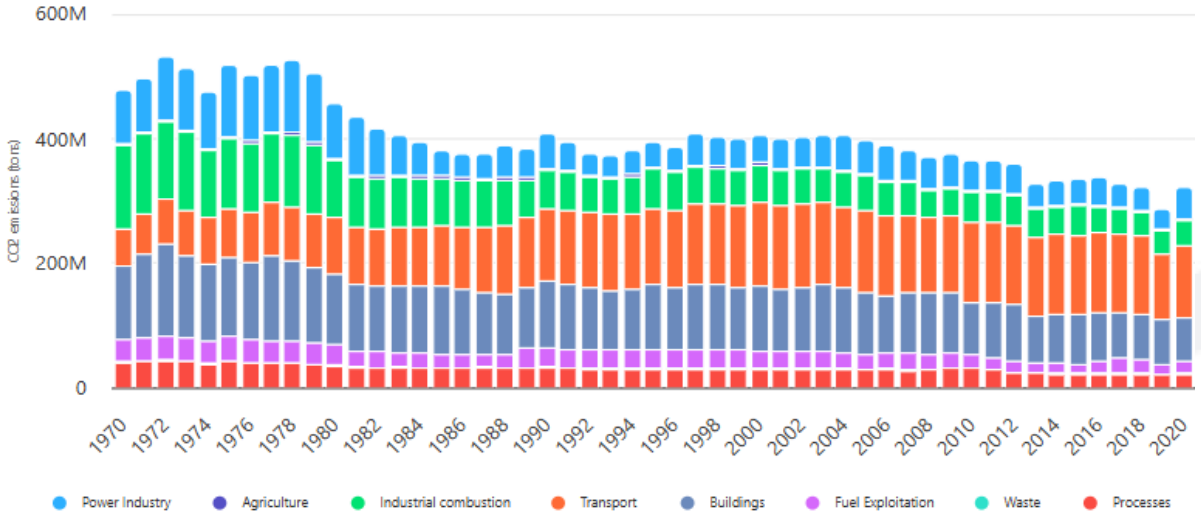
United States CO2 emissions by Year (tons)



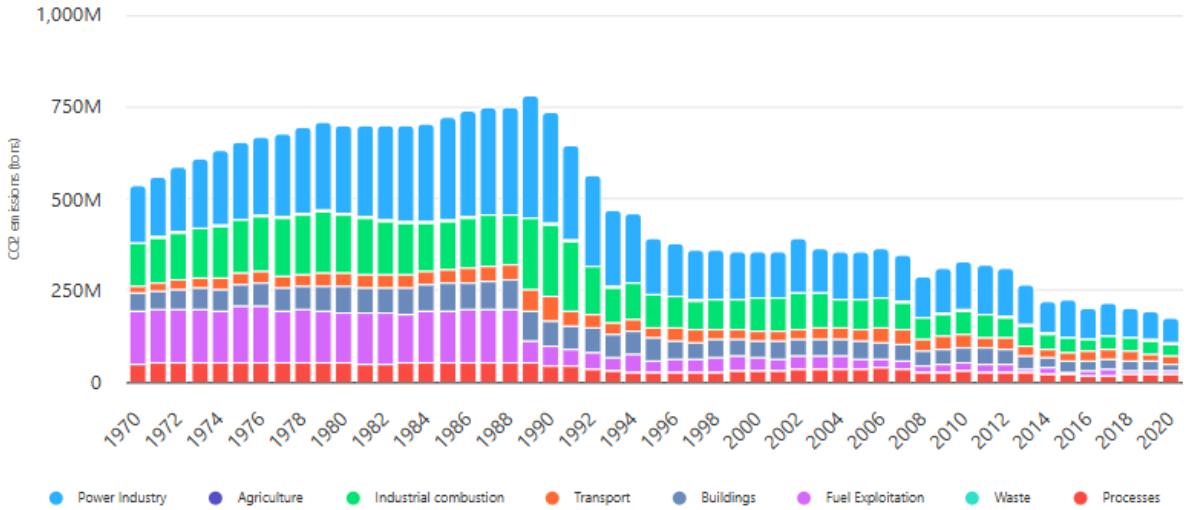
Hungary CO2 emissions by Year (tons)



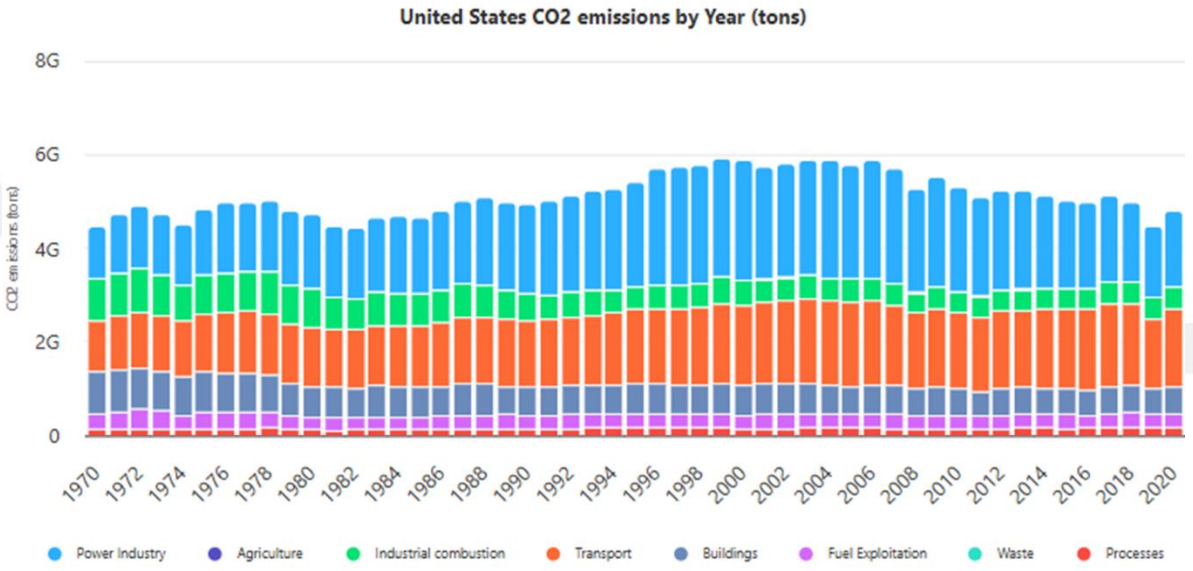
France CO2 emissions by Year (tons)

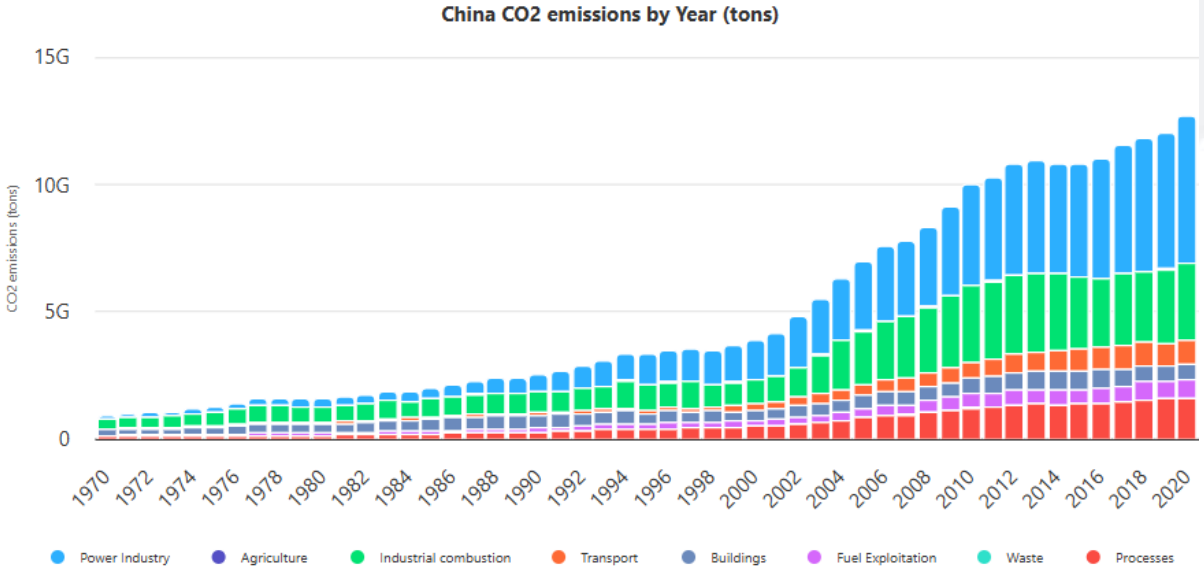


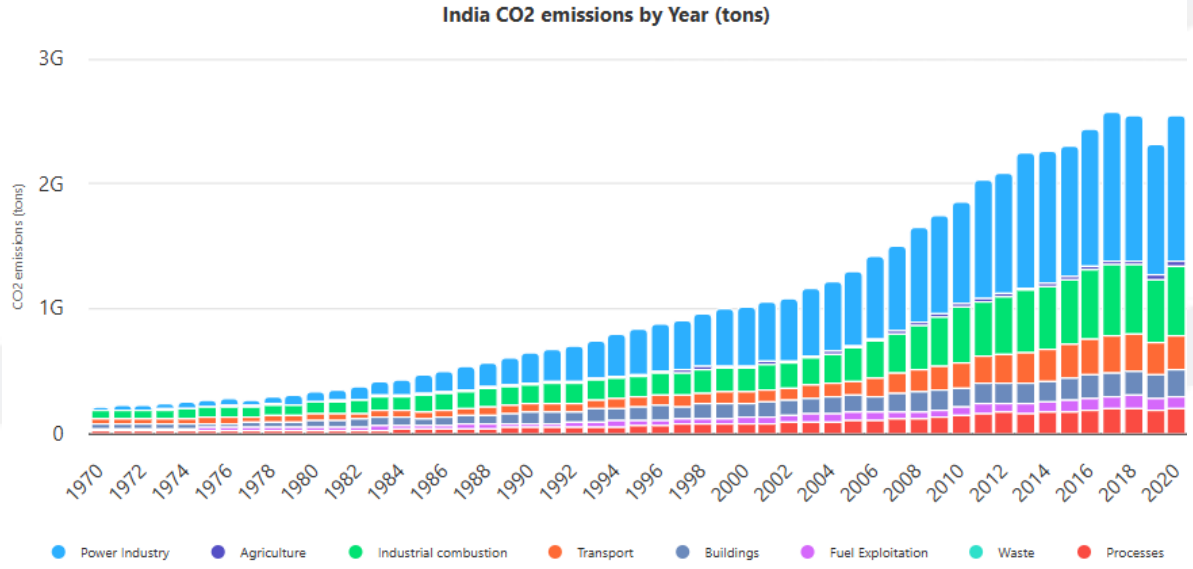
Ukraine CO2 emissions by Year (tons)



https://www.worldometers.info/



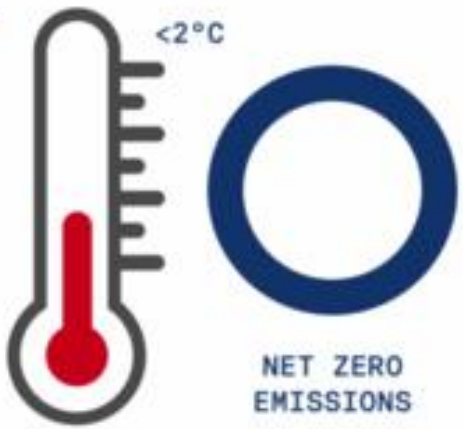




52.5% of the World's Emissions

PARIS CLIMATE AGREEMENT

1.



Limit the avg. global temperature increase to < 2° centigrade + achieve net zero emissions by mid-century

2.

Enhance resilience and adaptation to climate impacts certain to occur

3.

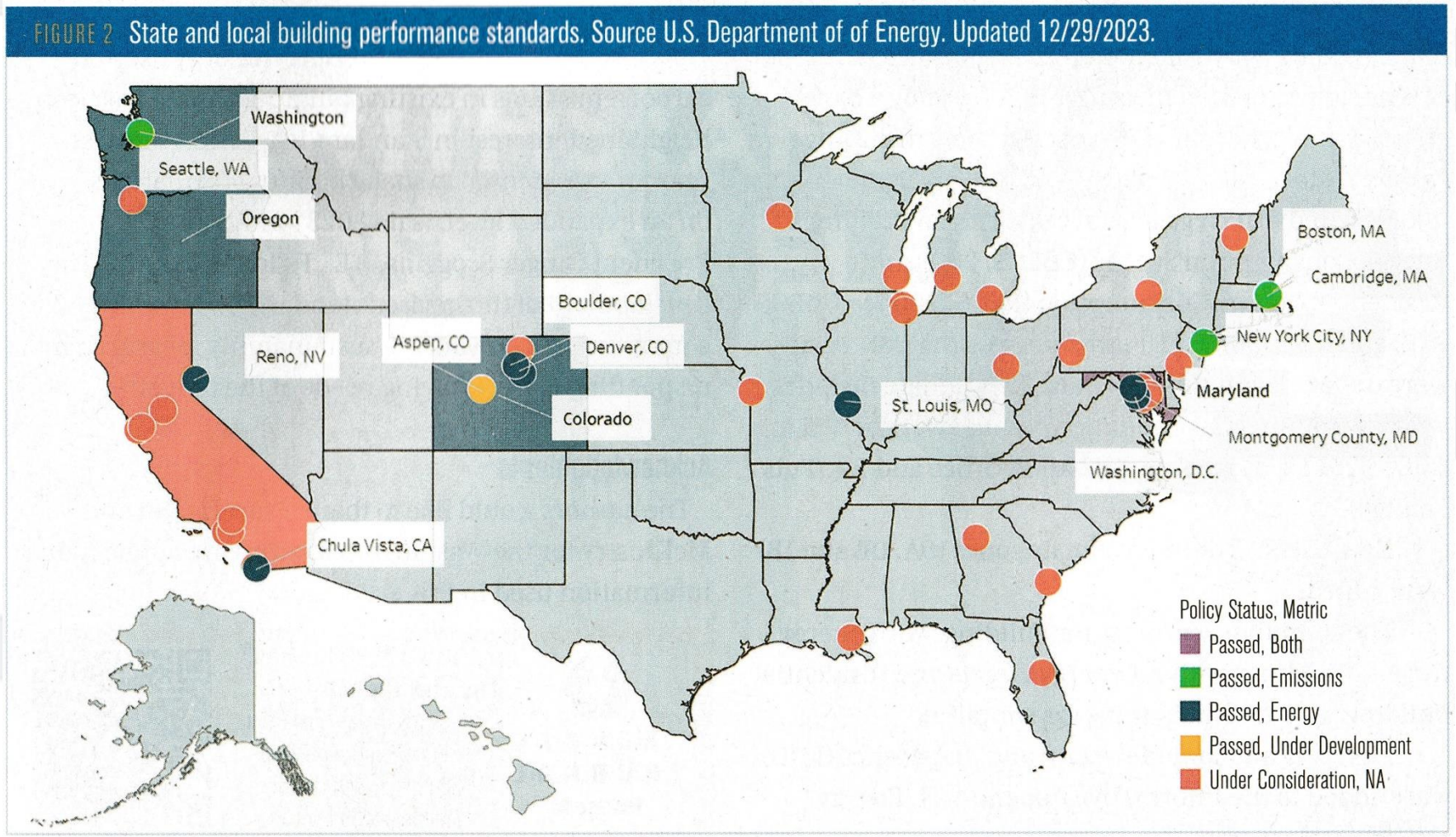
Align financial flows in the world with these objectives

https://sustainability.yale.edu/

Emissions Goals

70% of Boston's emissions come from buildings

Government Ordinances



ASHRAE Journal, March 2024

- BERDO 2.0 (Boston)
- BEUDO (Cambridge)
- NYC Local Law 97

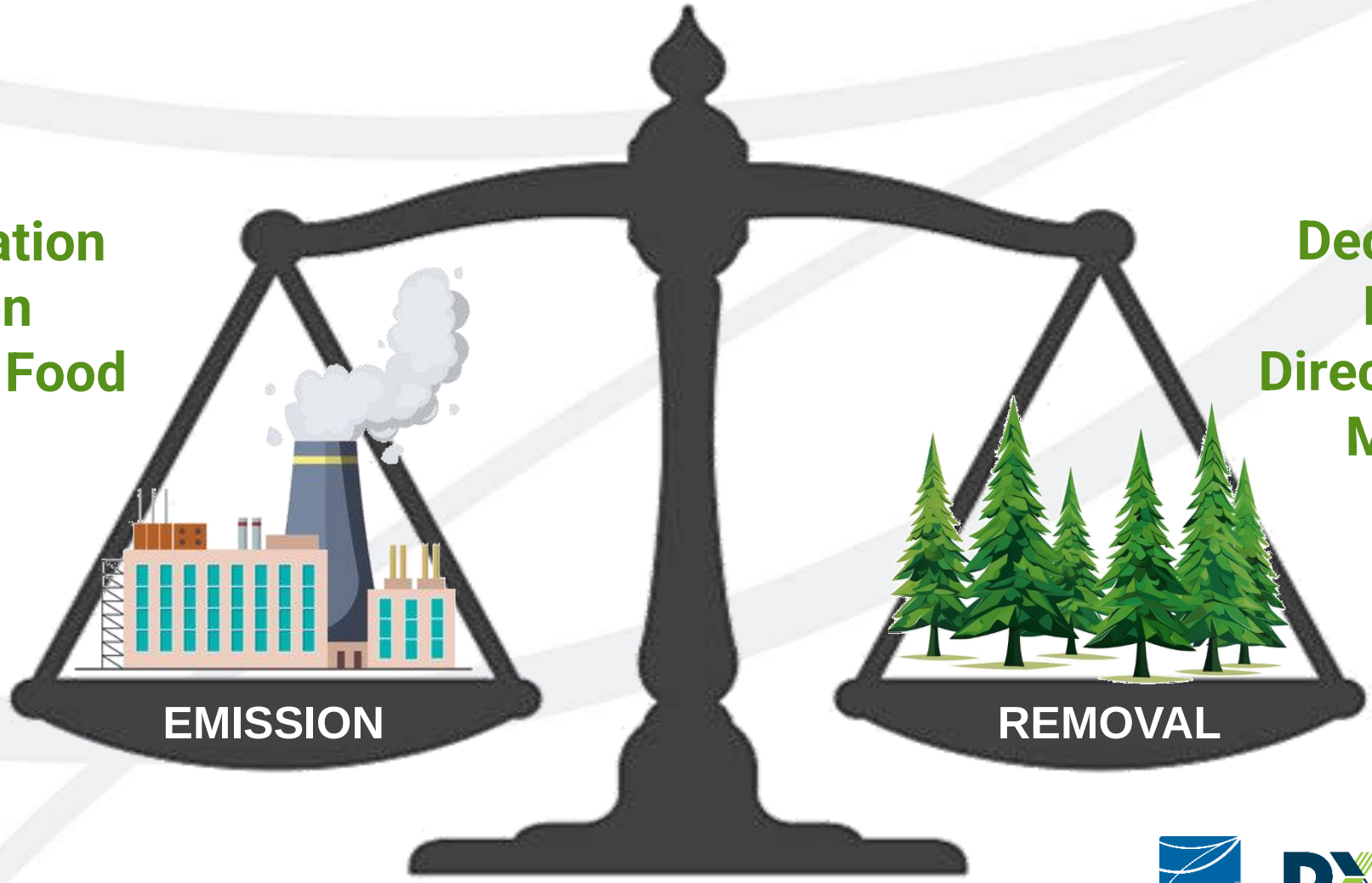
NET ZERO BY 2050

Building Emissions Reduction Disclosure Ordinance

Building Emissions Reduction Disclosure Ordinance

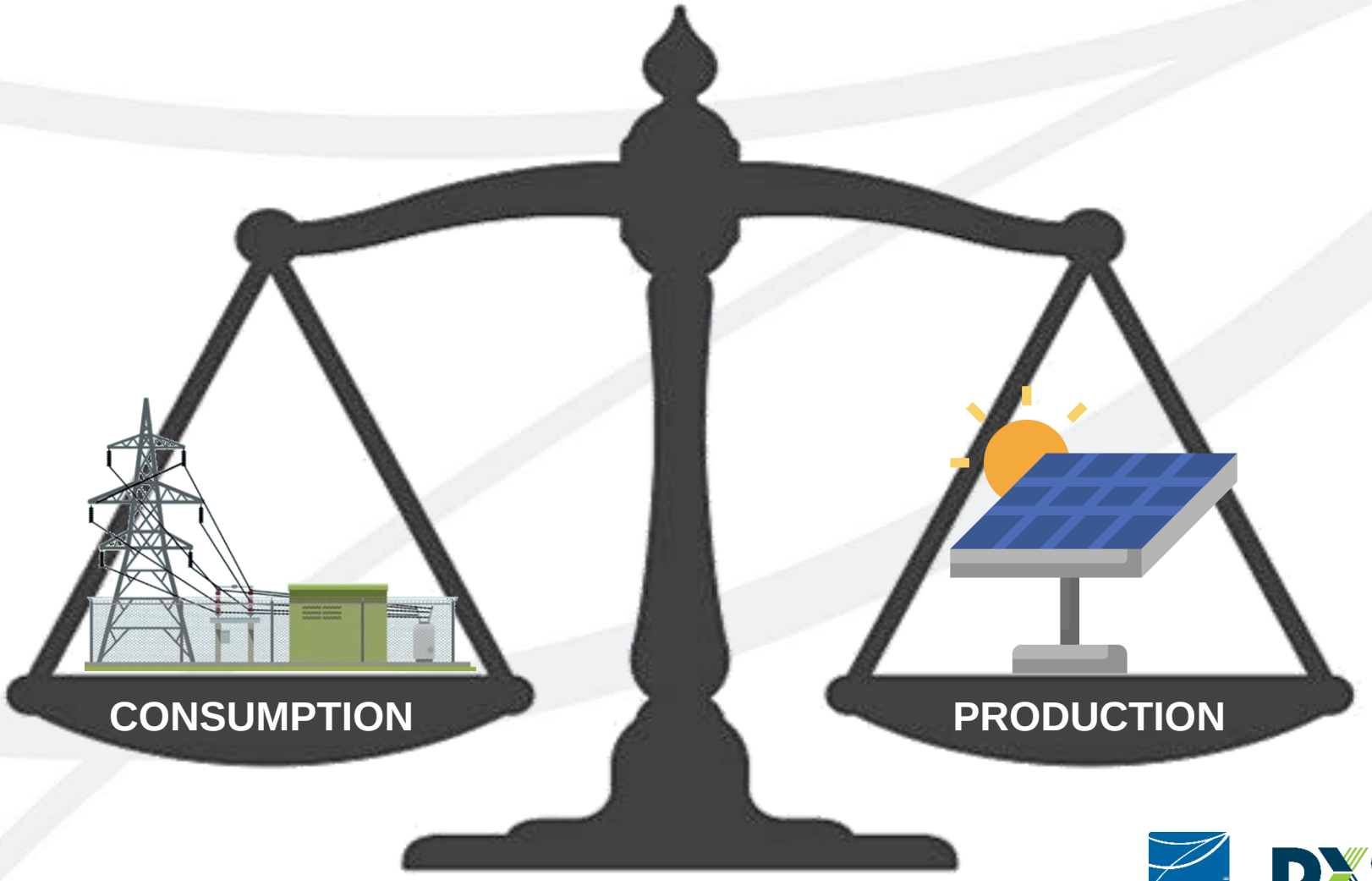
What is Net Zero?

Power Generation
Transportation
Agriculture & Food
Deforestation

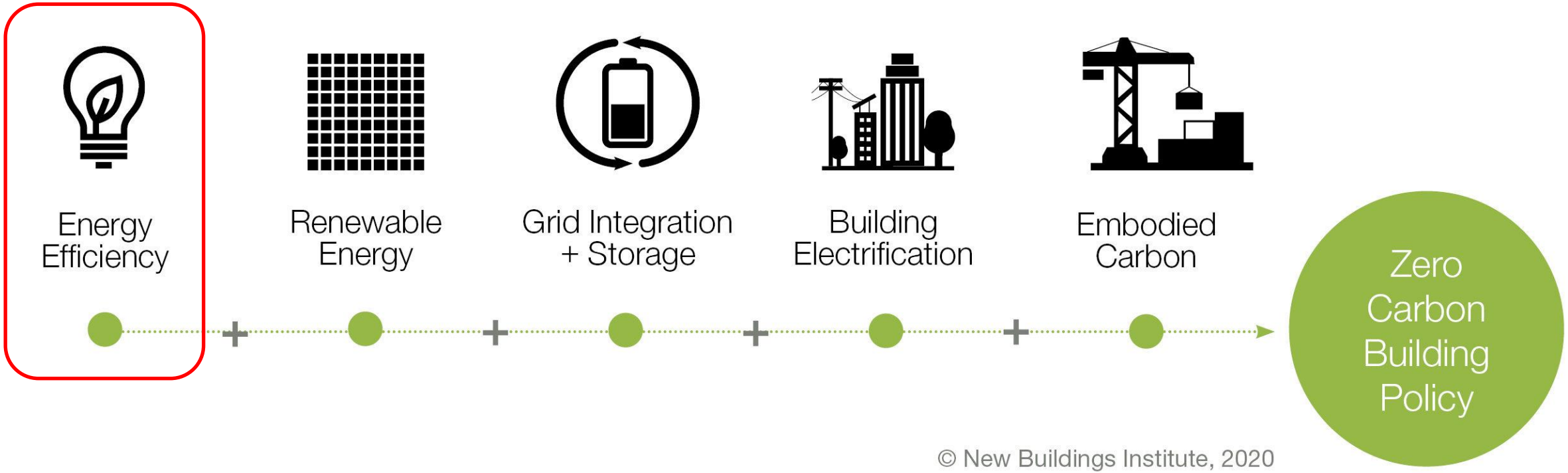


Decarbonization
Reforestation
Direct Air Capture
Mineralization

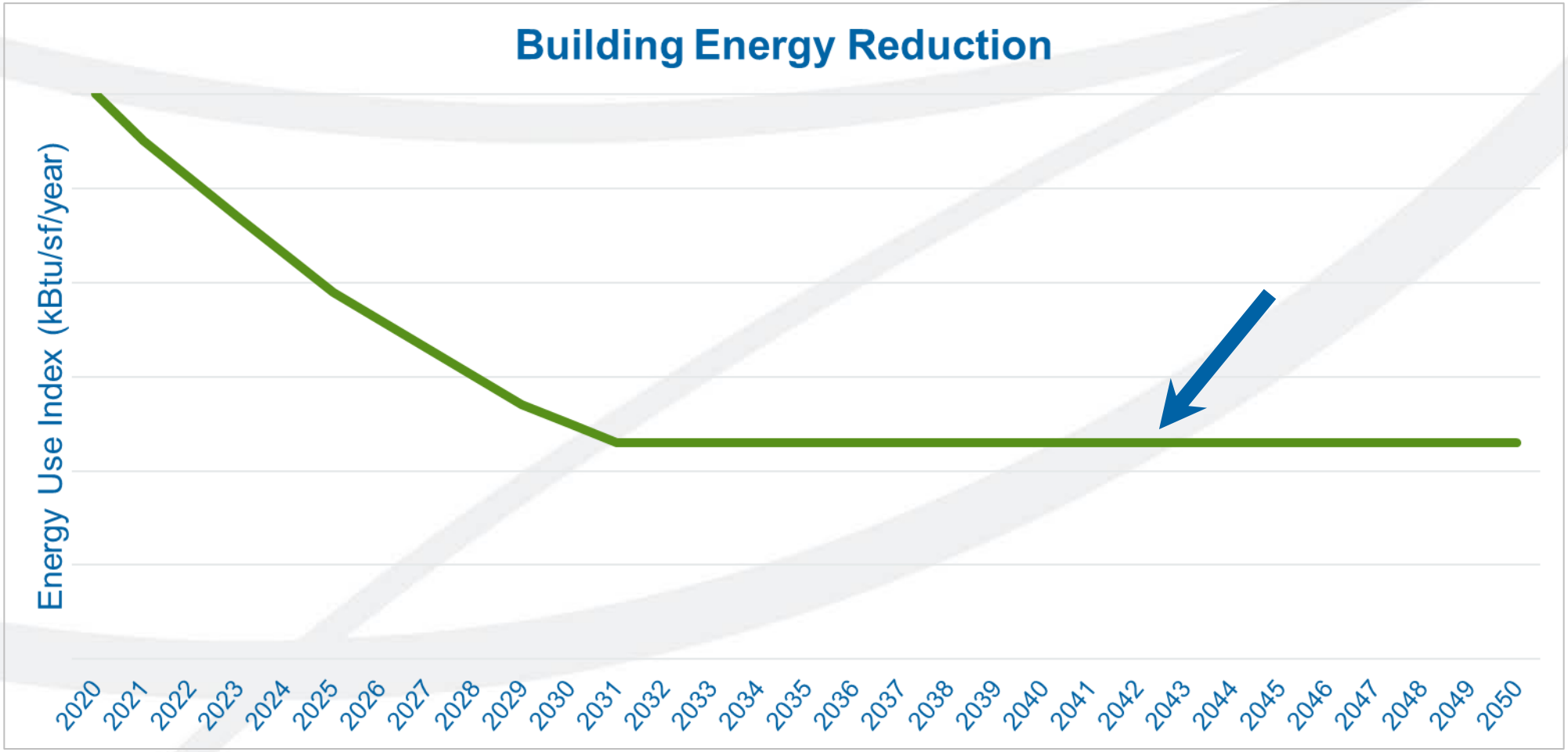
What is Net Zero?



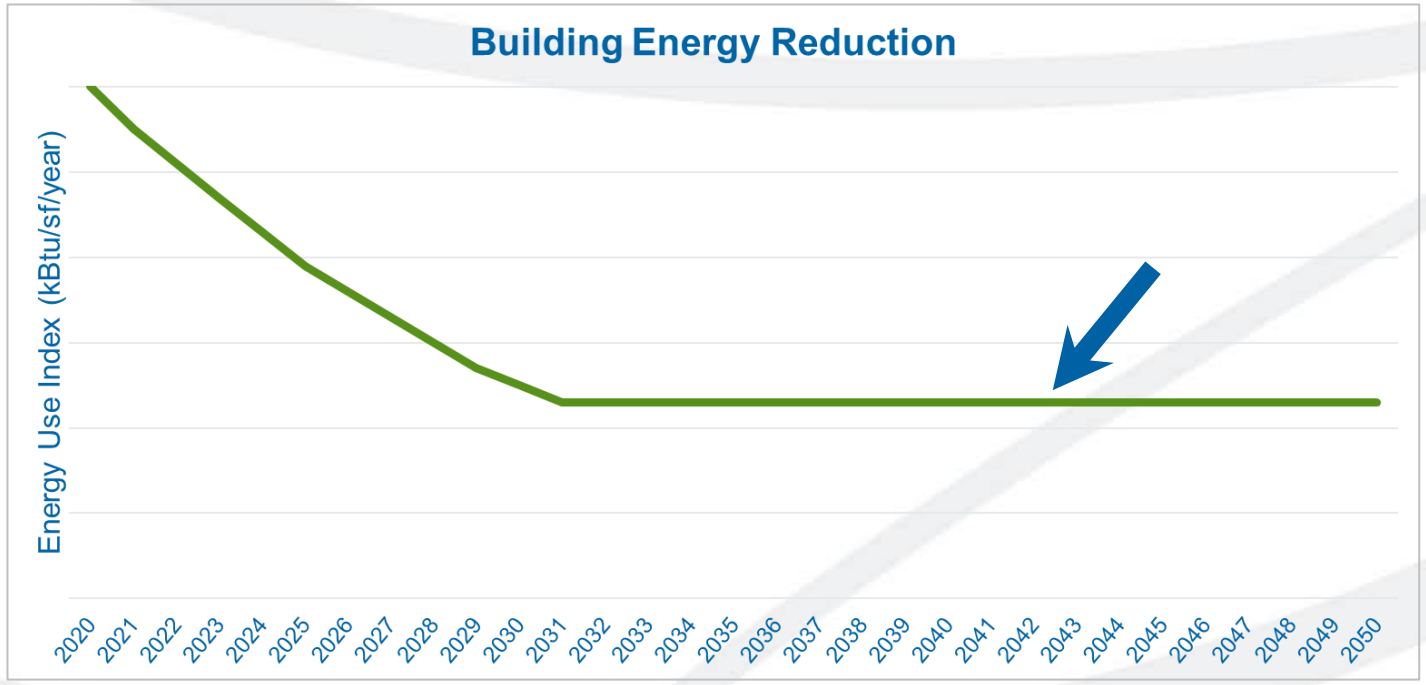
The Five Foundations of Zero Carbon Building Policies



Energy Efficiency: Measure & Maintain



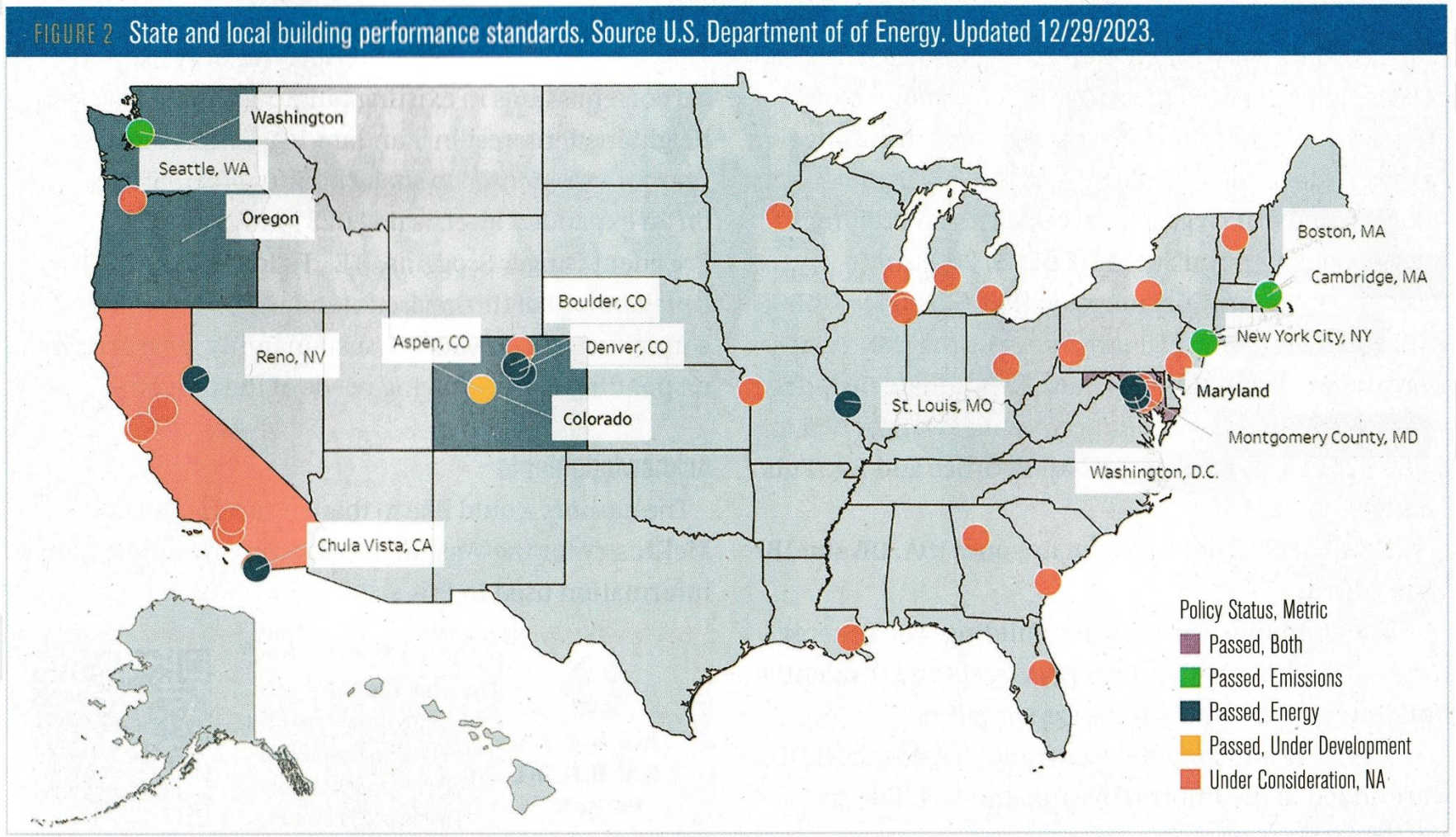
Energy Efficiency: Measure & Maintain



Factors Affecting Persistence
Total Project Cost Savings
Major Retrofit
Training
BAS Management
Size of Building
Staff Turnover
Building Type

61% Average Persistence in Energy Savings

Government Ordinances



ASHRAE Journal, March 2024

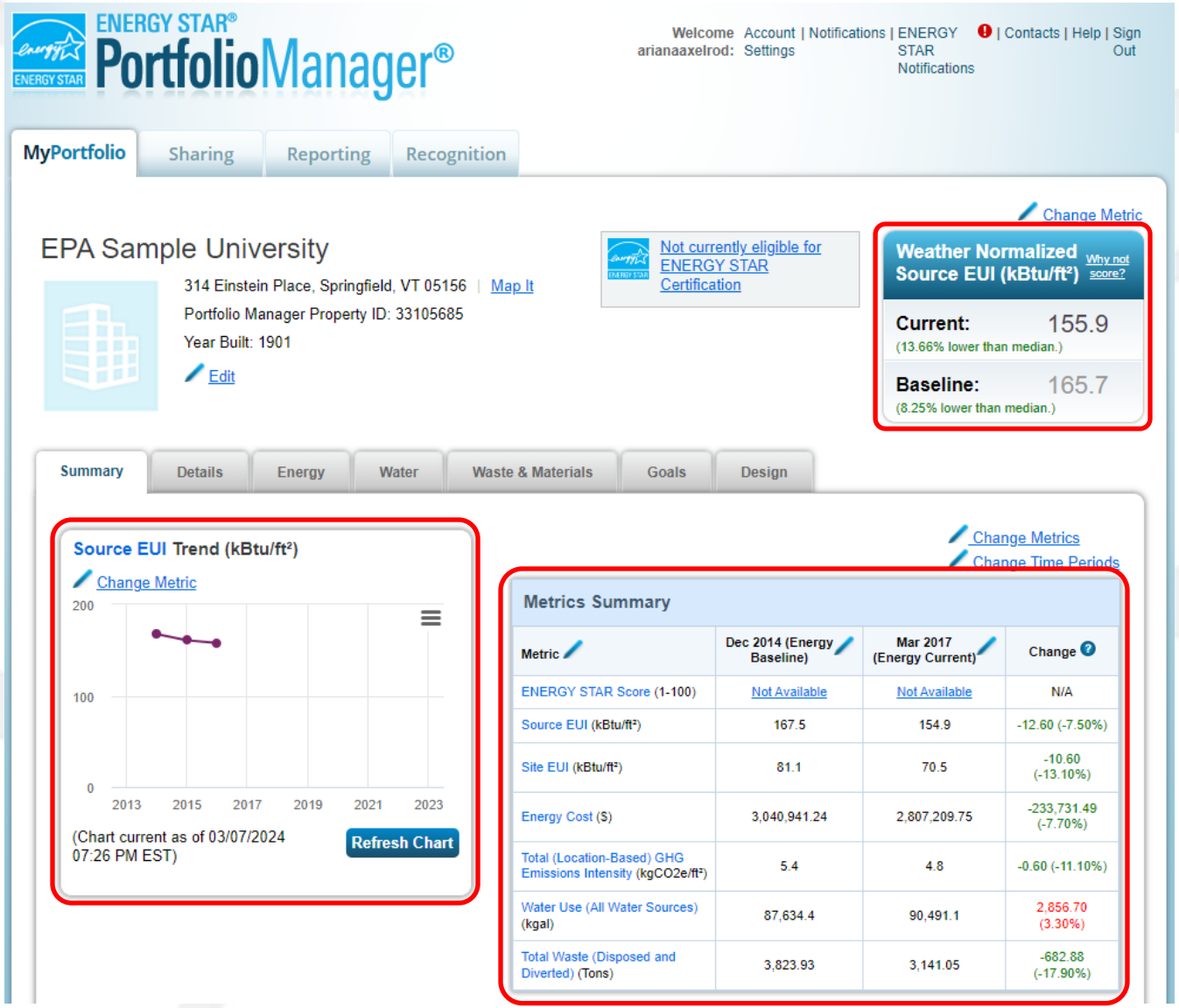
- BERDO 2.0 (Boston)
- BEUDO (Cambridge)
- NYC Local Law 97

NET ZERO BY 2050

Definitions

Benchmarking	Comparison of energy use to similar facilities
EUI	Energy Use Intensity (energy/ft^2/year)
EnergyStar Score	EPA EnergyStar's benchmark score

Government Ordinance Requirements



- Reporting
- Compliance
- Improvement

BERDO Emissions Standard ($kgCO_2e/ft^2/yr$)

Building Use	2025-2029	2030-2034	2035-2039	2040-2044	2045-2049	2050-
Assembly	7.8	4.6	3.3	2.1	1.1	0
College/University	10.2	5.3	3.8	2.5	1.2	0
Education	3.9	2.4	1.8	1.2	0.6	0
Food Sales & Service	17.4	10.9	8.0	5.4	2.7	0
Healthcare	15.4	10.0	7.4	4.9	2.4	0
Lodging	5.8	3.7	2.7	1.8	0.9	0
Manufacturing/Industrial	23.9	15.3	10.9	6.7	3.2	0
Multifamily Housing	4.1	2.4	1.8	1.1	0.6	0
Office	5.3	3.2	2.4	1.6	0.8	0
Retail	7.1	3.4	2.4	1.5	0.7	0
Services	7.5	4.5	3.3	2.2	1.1	0
Storage	5.4	2.8	1.8	1.0	0.4	0
Technology/Science	19.2	11.1	7.8	5.1	2.5	0

BEUDO Benchmarking

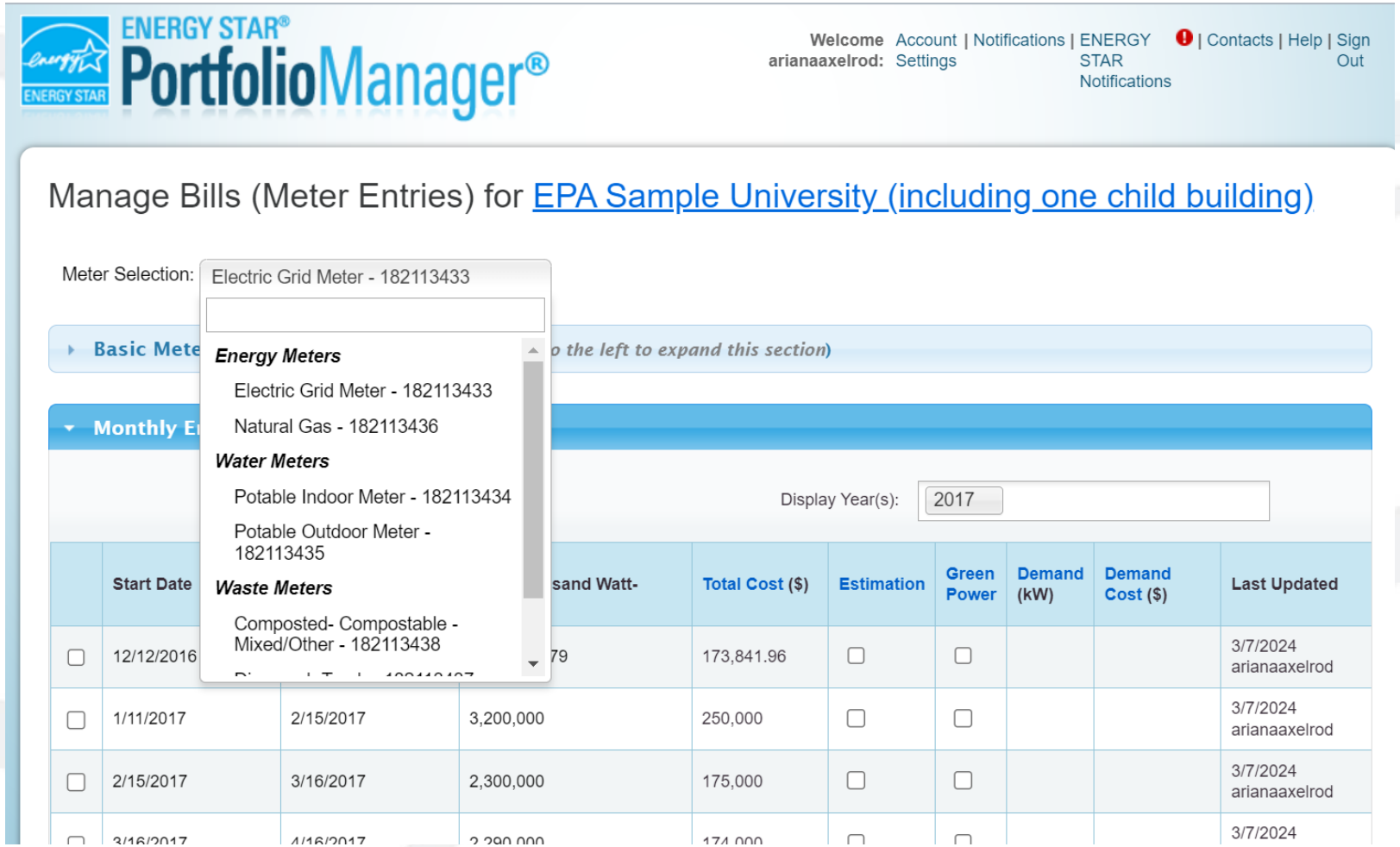
Baseline: 2018 & 2019

>100,000 sqft

Year	May Not Exceed
2026-2029	80% of baseline
2030-2034	40% of baseline
2035-	GHG emissions shall not exceed 0

25,000-99,999 sqft

Year	May Not Exceed
2026-2029	100% of baseline
2030-2034	60% of baseline
2035-2039	40% of baseline
2040-2044	20% of baseline
2045-2049	10% of baseline
2050-	GHG emissions shall not exceed 0



Can we automate this?

Automate Your Reporting

- High Speed Infrastructure
- Metering
- Data Storage

Automate Your Reporting

- **High Speed Infrastructure**
- **Metering**
- **Data Storage**

BAS Architecture

Enterprise

Server

Building (Global Control)

Building A

Building B

Equipment (AHU/Plant Control)

AHU-1

AHU-2

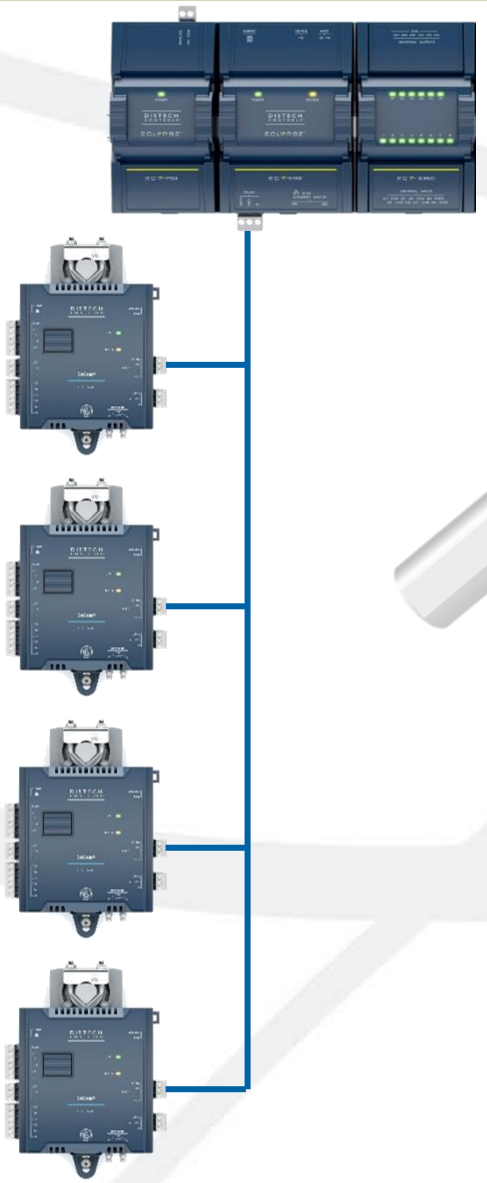
AHU-1

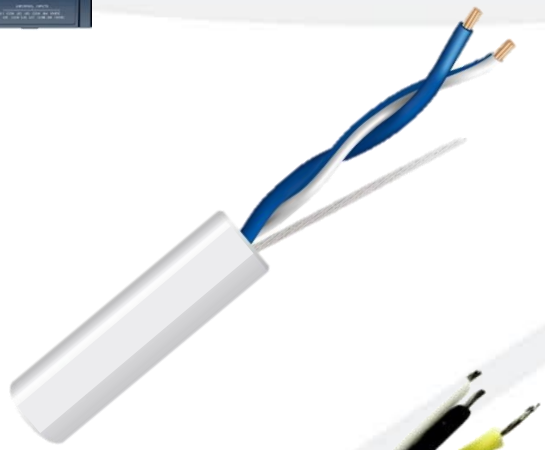
Central Plant

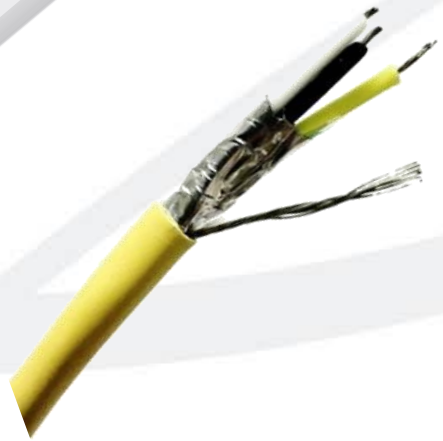
Sensors and Actuators (Device Control)

Field Devices

Serial Communication Networks







Protocol	Max Data Rate
LONTalk	12.5 kbps
BACnet MS/TP	78.4 kbps

BACnet IP

Protocol	Max Data Rate
LONTalk	12.5 kbps
BACnet MS/TP	78.4 kbps
BACnet IP	100 **M**bps

BACnet IP

Protocol	Max Data Rate
LONTalk	12.5 kbps
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BACnet IP	100 **M**bps

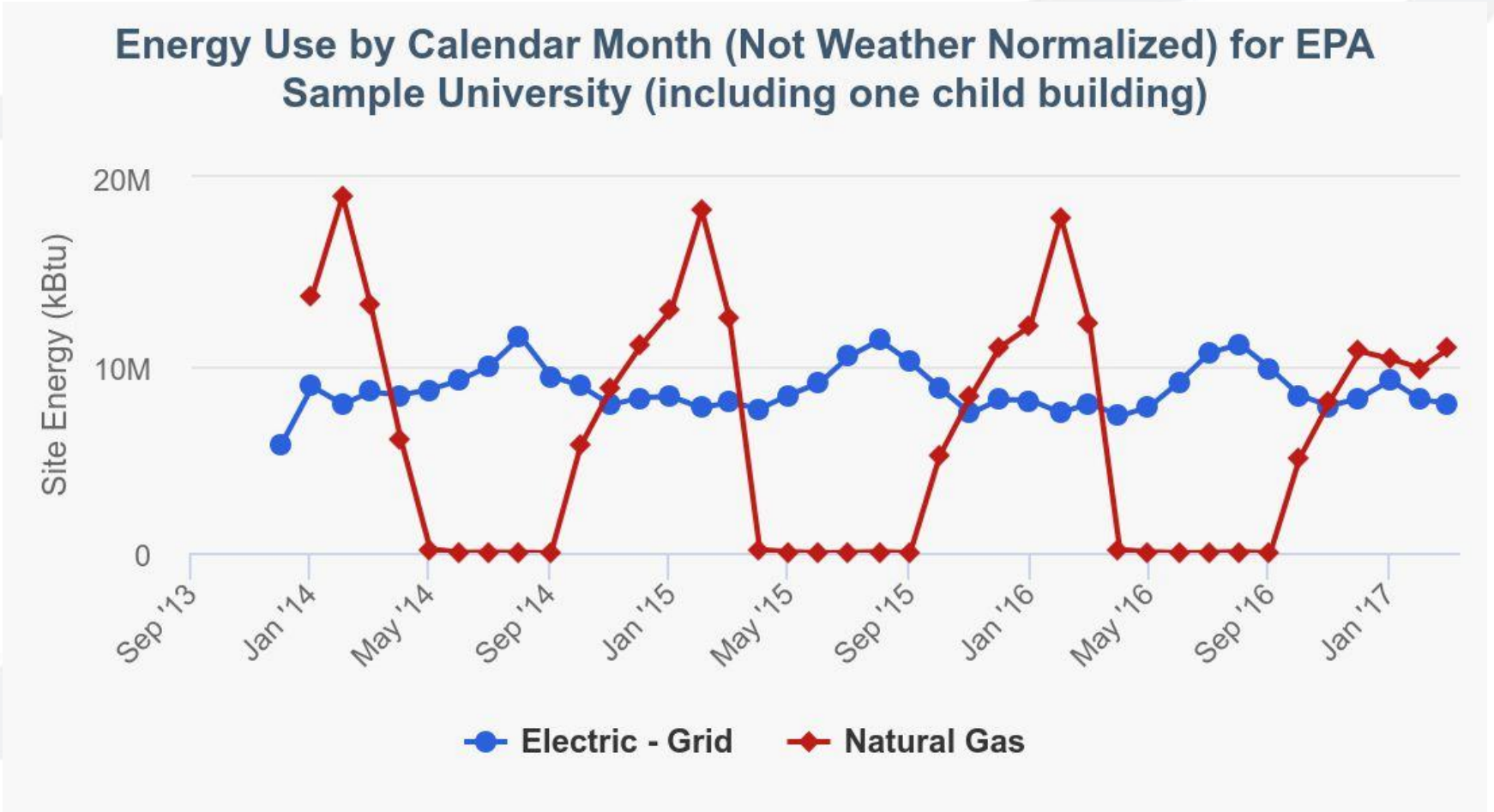
100x FASTER

HTS DXS CONTROL TECHNOLOGIES

Automate Your Reporting

- High Speed Infrastructure
- **Metering**
- Data Storage

Energy Disaggregation



Energy Audits

Collect Energy Data	Collect 2-3 years of utility data
Site Survey	Collect nameplate from building systems
Analysis	Calculate system specific energy usage
Identify ECMs	Identify areas of potential energy savings
Economic Evaluation	Complete cost analysis and calculate payback

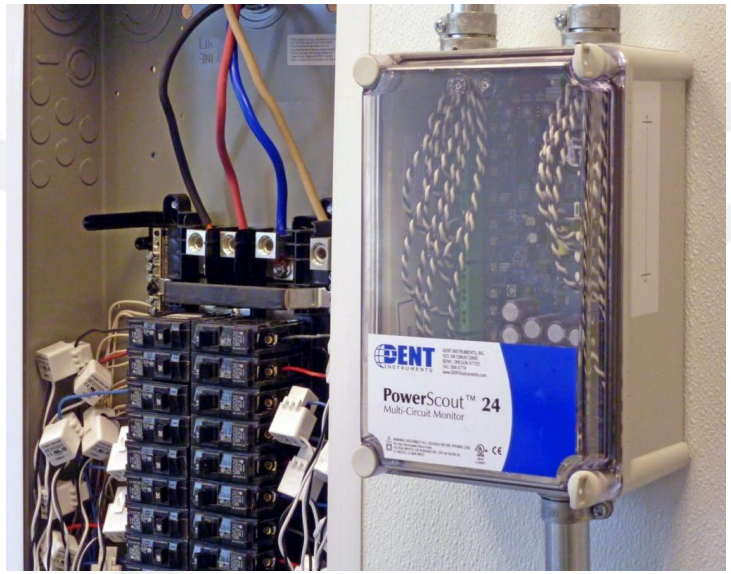
Energy Audits

Analysis

Calculate system specific energy usage

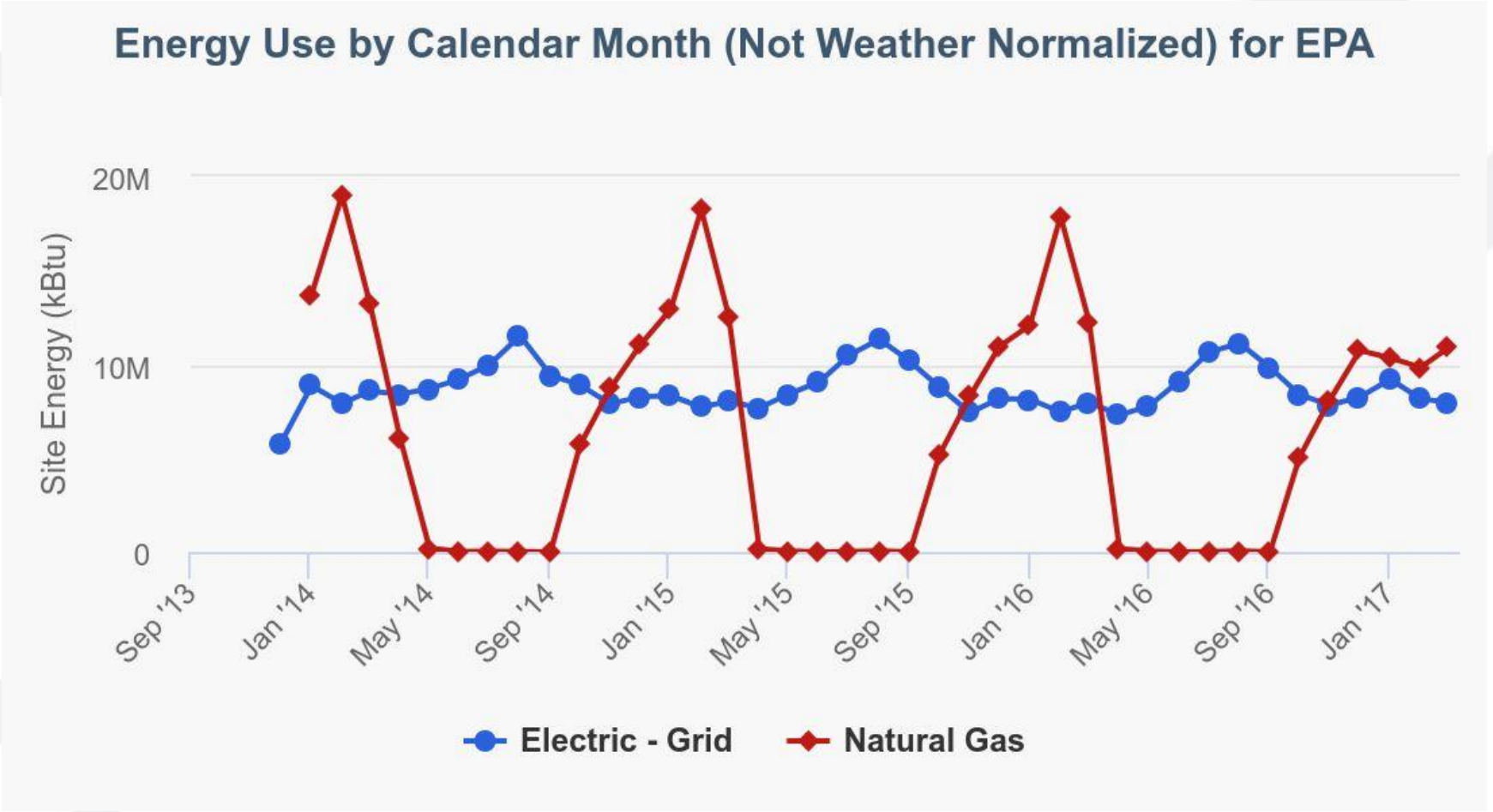
- Makes assumptions about general operating hours and building use
- Uses historical weather data to estimate system loads
- Uses nameplate data, which assumes ideal conditions
- Subject to human error

Energy Disaggregation

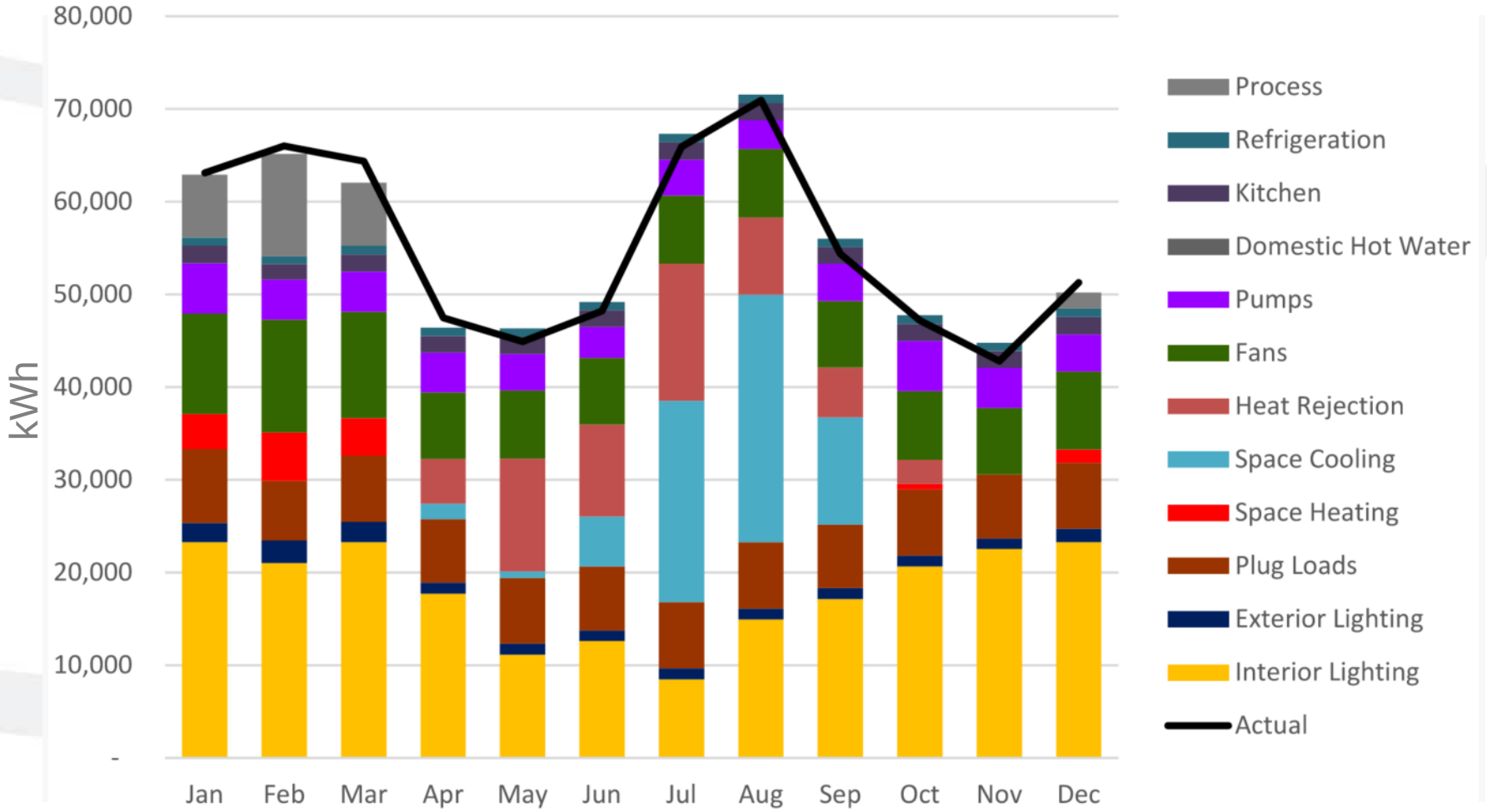


HTS DXS CONTROL TECHNOLOGIES

Energy Disaggregation

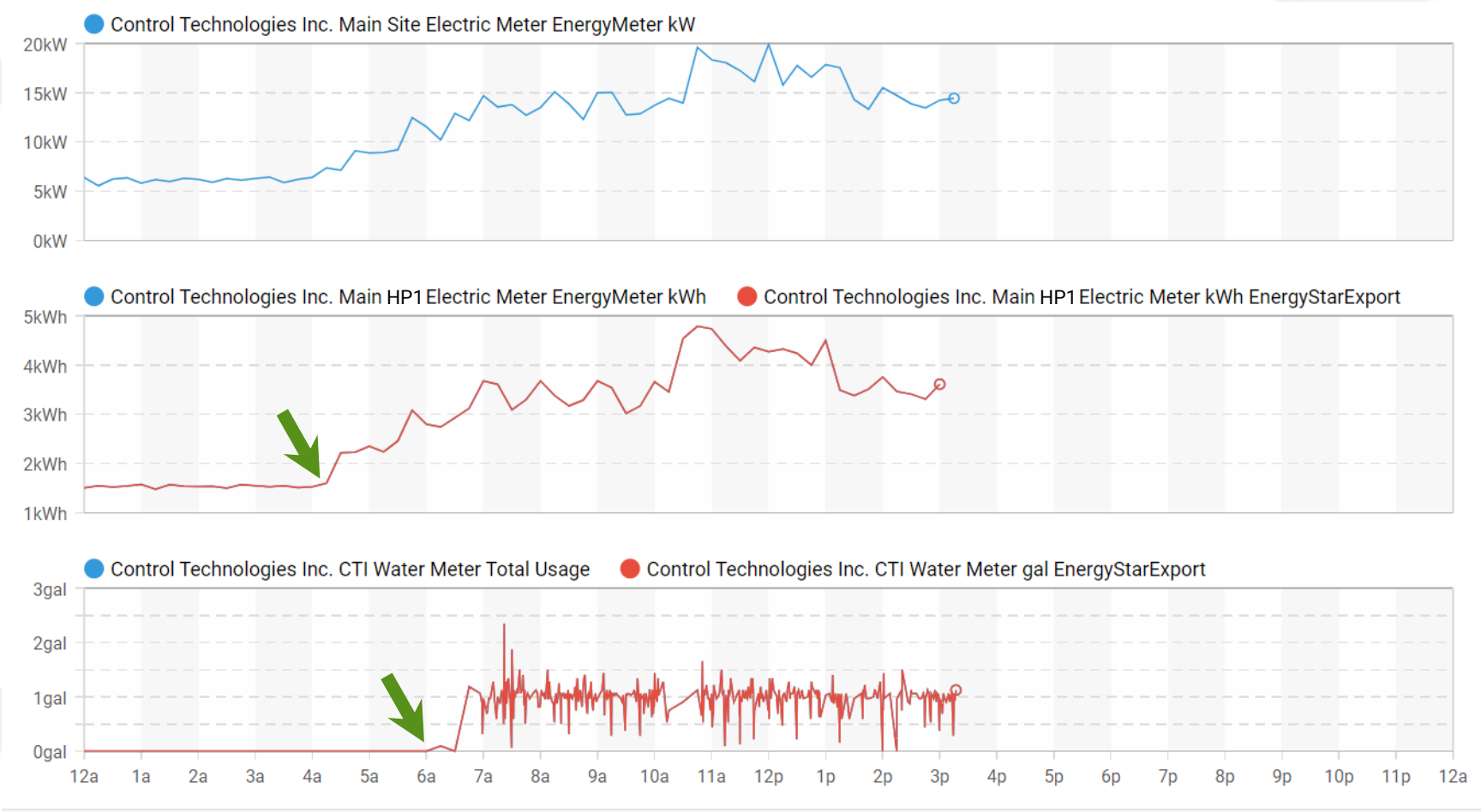


Energy Disaggregation




Terminal Units
Air Handling Systems
Hot Water Plant
Chiller Plant
Backbone Infrastructure

Energy Disaggregation



Automate Your Reporting

- High Speed Infrastructure
- Metering
- **Data Storage**

BAS Architecture

Enterprise

Building
(Global Control)

Server

Building A

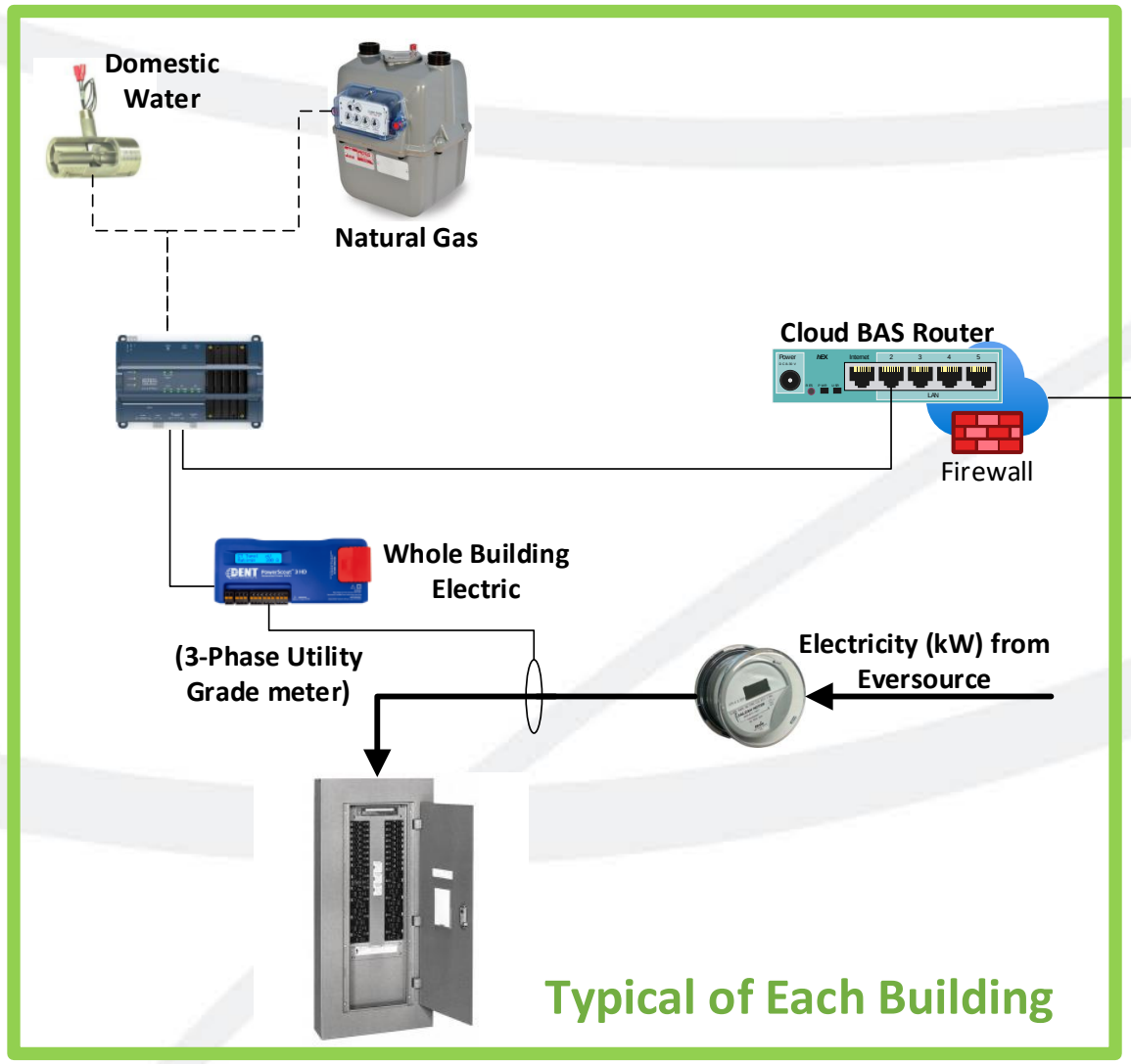
Building B

What is the Cloud?

What is the Cloud?

What is the Cloud?

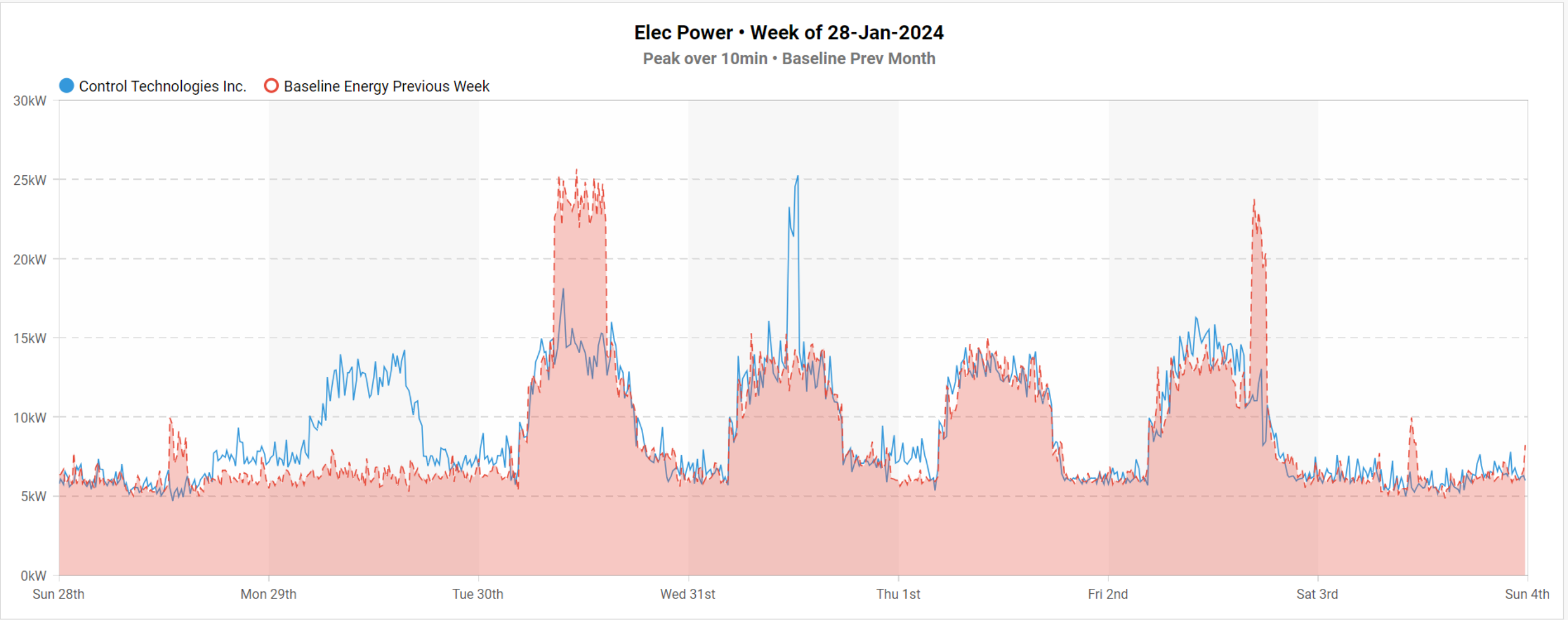
CloudZERO^{e}™



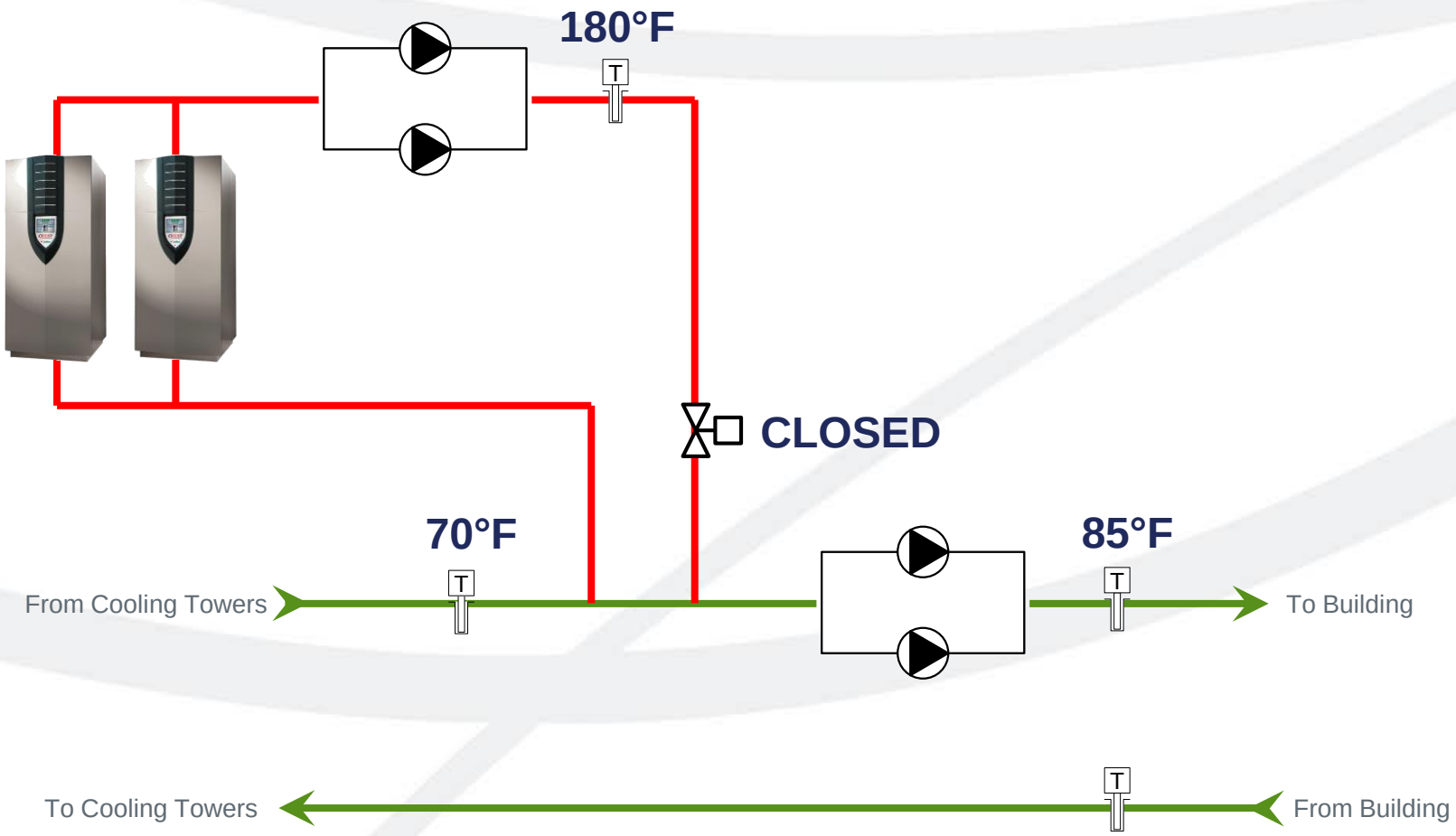
ENERGY STAR® Portfolio Manager®

CloudBAS™

HTS DXS Control Technologies

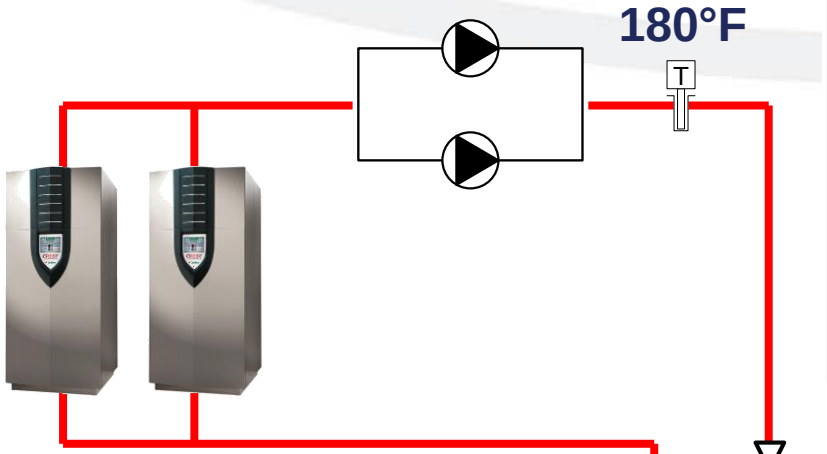

Elec Power • Week of 28-Jan-2024
Peak over 10min • Baseline Prev Month
Control Technologies Inc.
Baseline Energy Previous Week
30kW
25kW
20kW
15kW
10kW
5kW
0kW
Sun 28th
Mon 29th
Tue 30th
Wed 31st
Thu 1st
Fri 2nd
Sat 3rd
Sun 4th

Fault Detections & Diagnostics (FDD)



CWS Set Point: 80°F
Alarm Limits: Below 60°F
Above 95°F

CloudFDD™



180°F

T

CLOSED

70°F

T

85°F

T

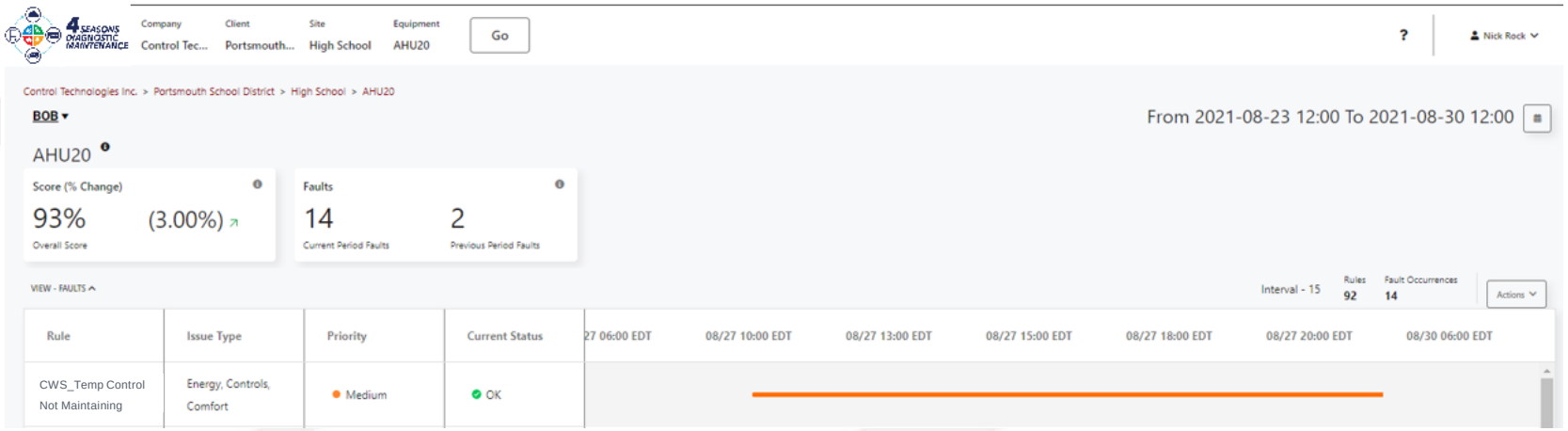
From Cooling Towers

To Building

To Cooling Towers

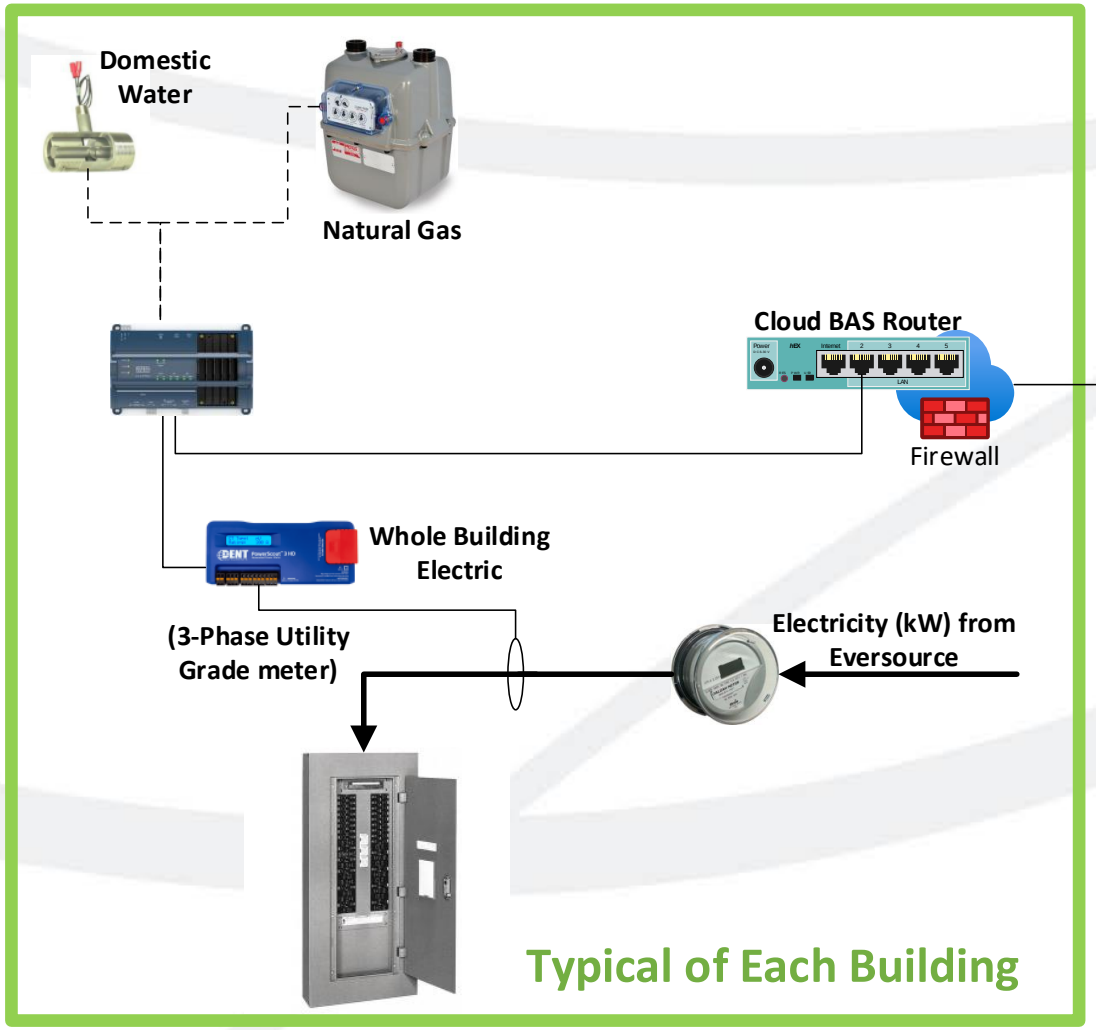
T

From Building



CWS Set Point: 80°F
Alarm Limits: Below 60°F
Above 95°F

Smart Grid



ENERGY STAR® PortfolioManager®

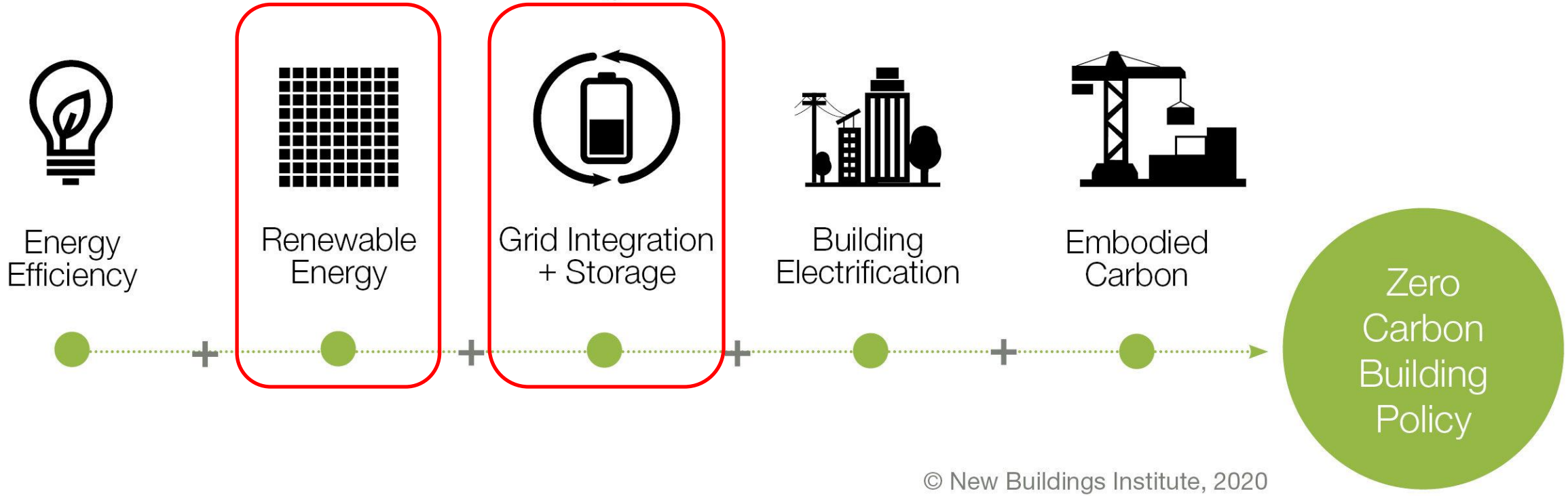
CloudBAS™

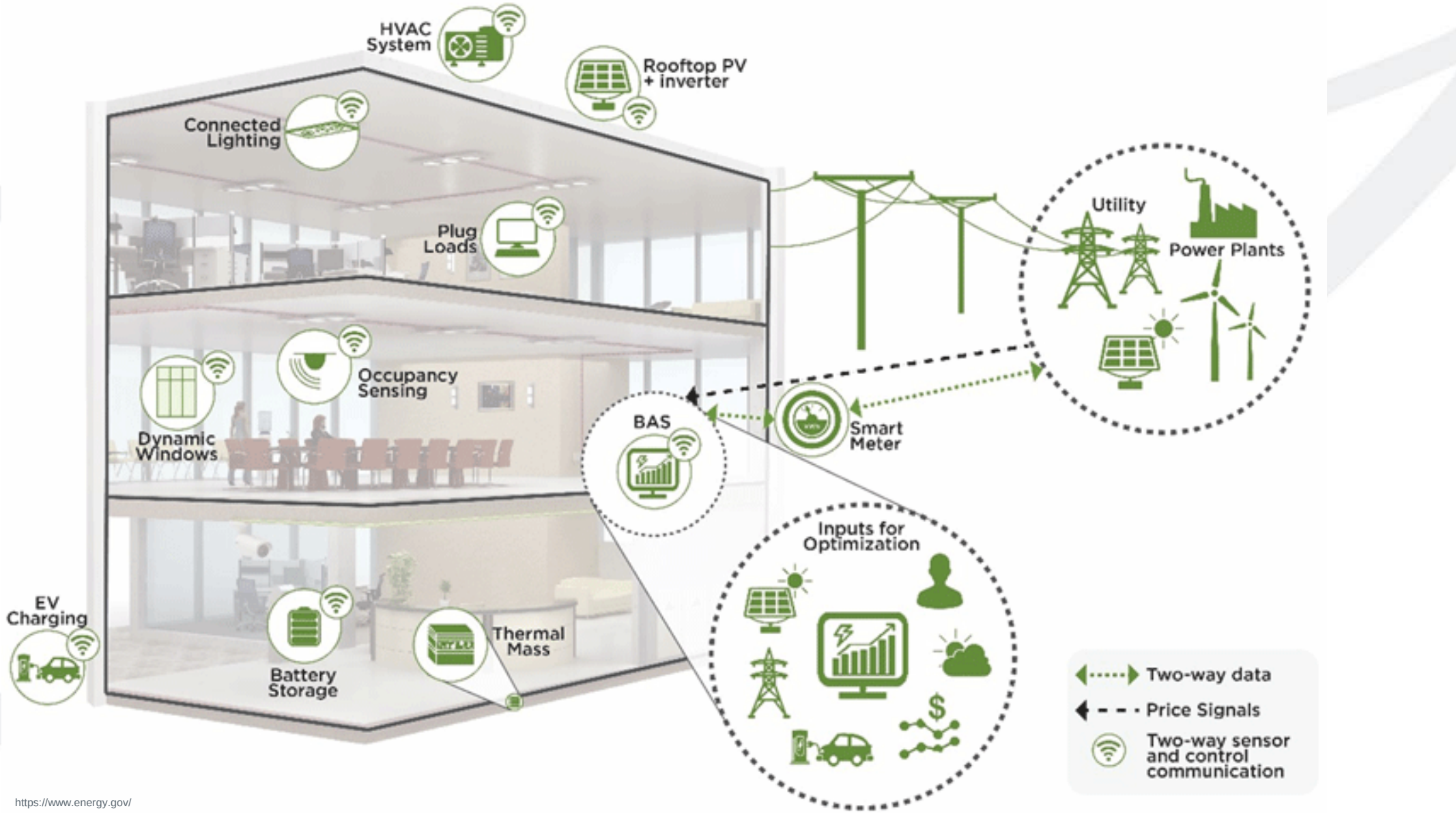
Electrical Grid

EVERSOURCE
nationalgrid
conEdison

HTS DXS CONTROL TECHNOLOGIES

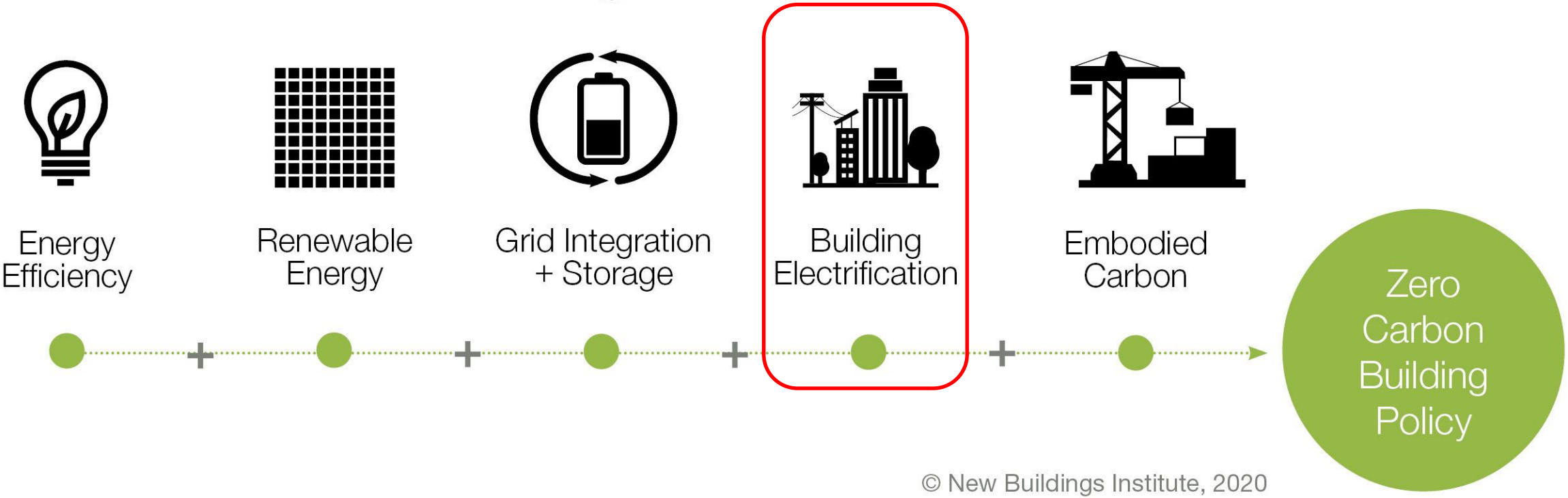
The Five Foundations of Zero Carbon Building Policies





https://www.energy.gov/

The Five Foundations of Zero Carbon Building Policies



Carbon Dioxide Emissions Coefficients

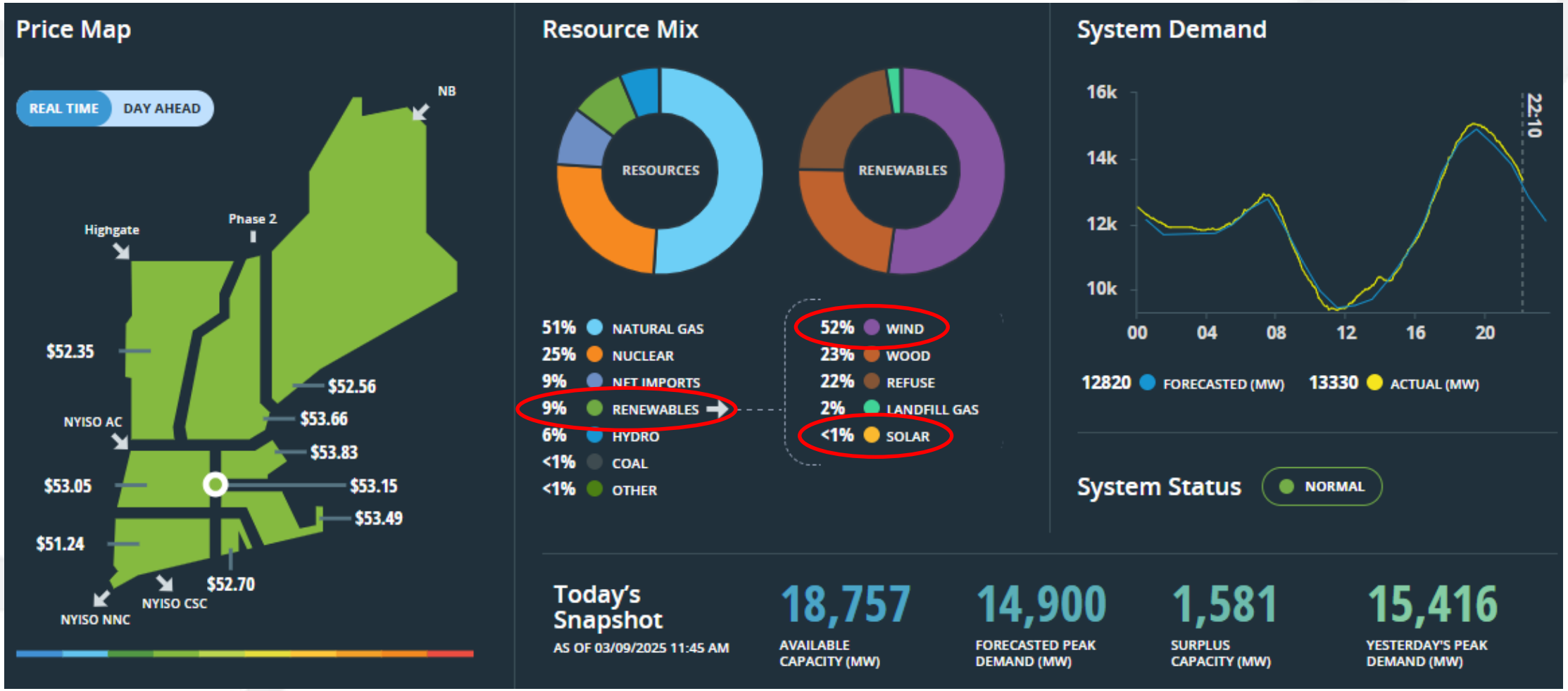
Carbon Dioxide (CO_2) Factors:	Pounds CO_2 Per Unit of Volume or Mass
For homes and businesses	
Propane	12.68 gallon
Diesel and Home Heating Fuel (Distillate Fuel Oil)	22.45 gallon
Kerosene	21.78 gallon
Coal (All types)	3,890.78 short ton
Natural Gas	120.96 thousand cubic feet
Finished Motor Gasoline[a]	17.86 gallon
Motor Gasoline	19.37 gallon
Residual Heating Fuel (Businesses only)	24.78 gallon

https://www.eia.gov/

What about electricity?

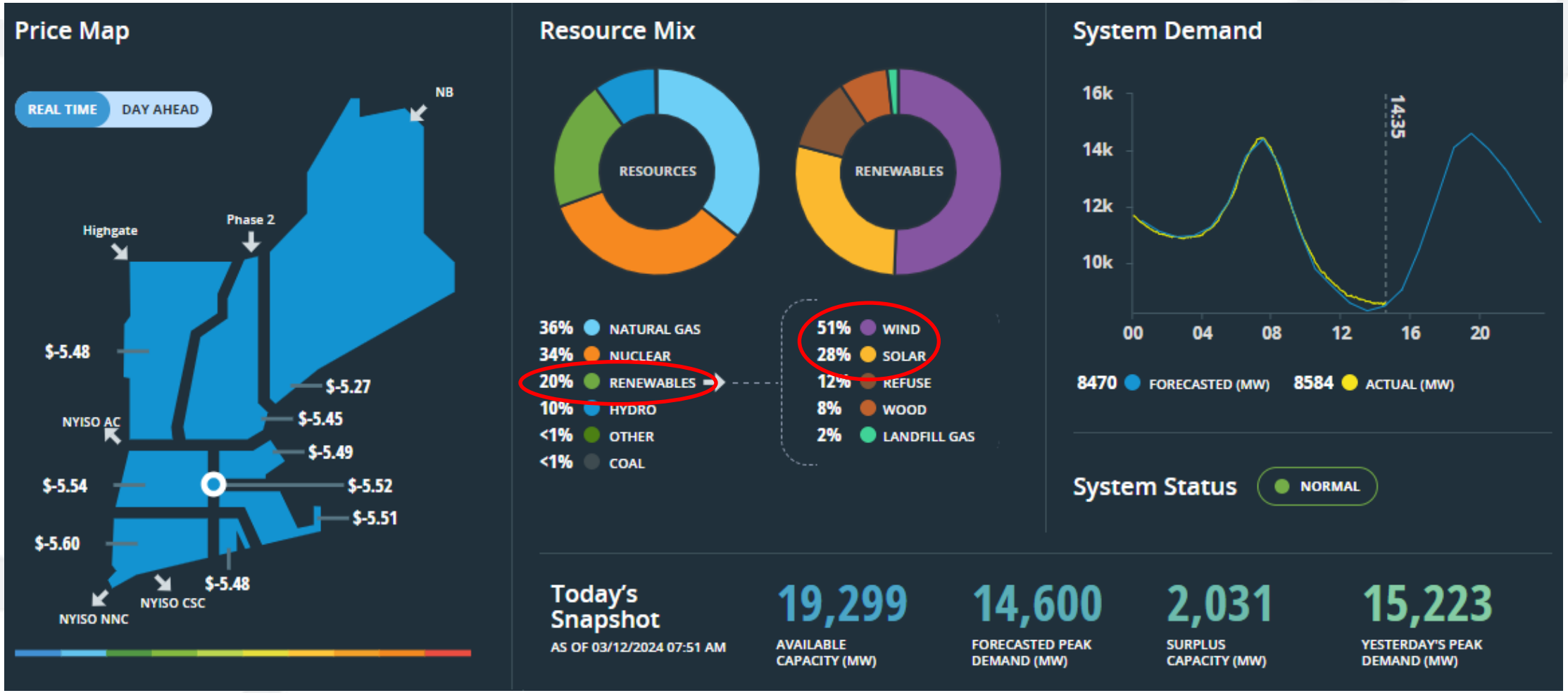
HTS DXS CONTROL TECHNOLOGIES

New England Resource Mix – 3/9/2025



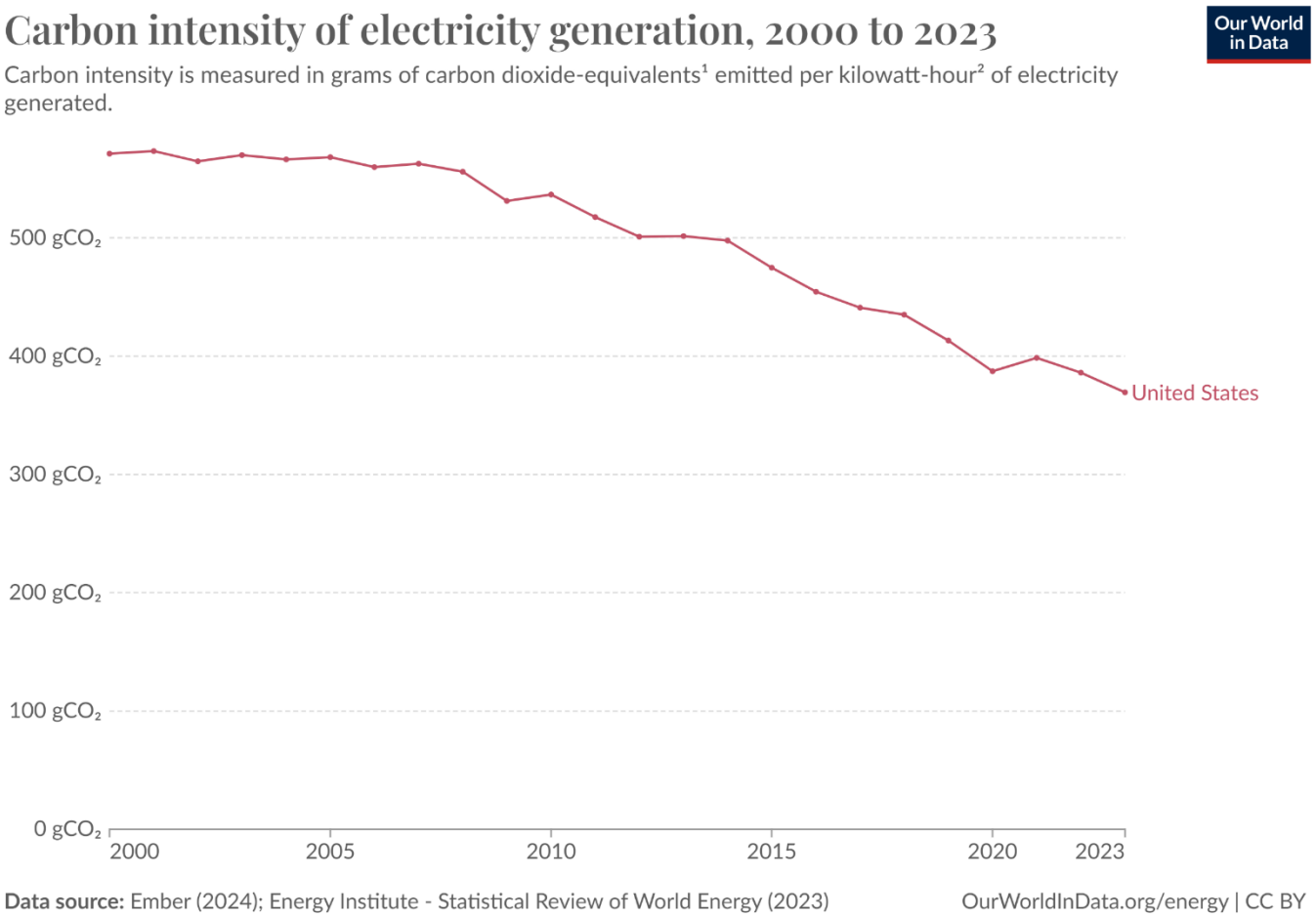
https://www.iso-ne.com/

New England Resource Mix – 3/12/2024

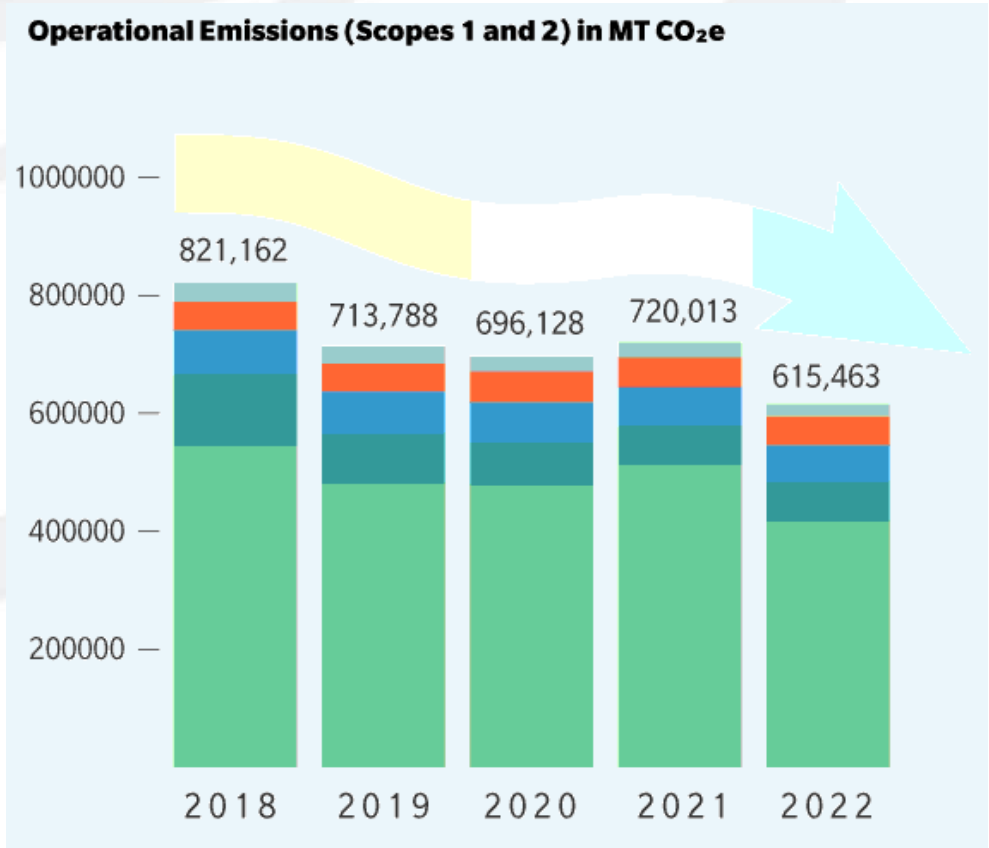


https://www.iso-ne.com/

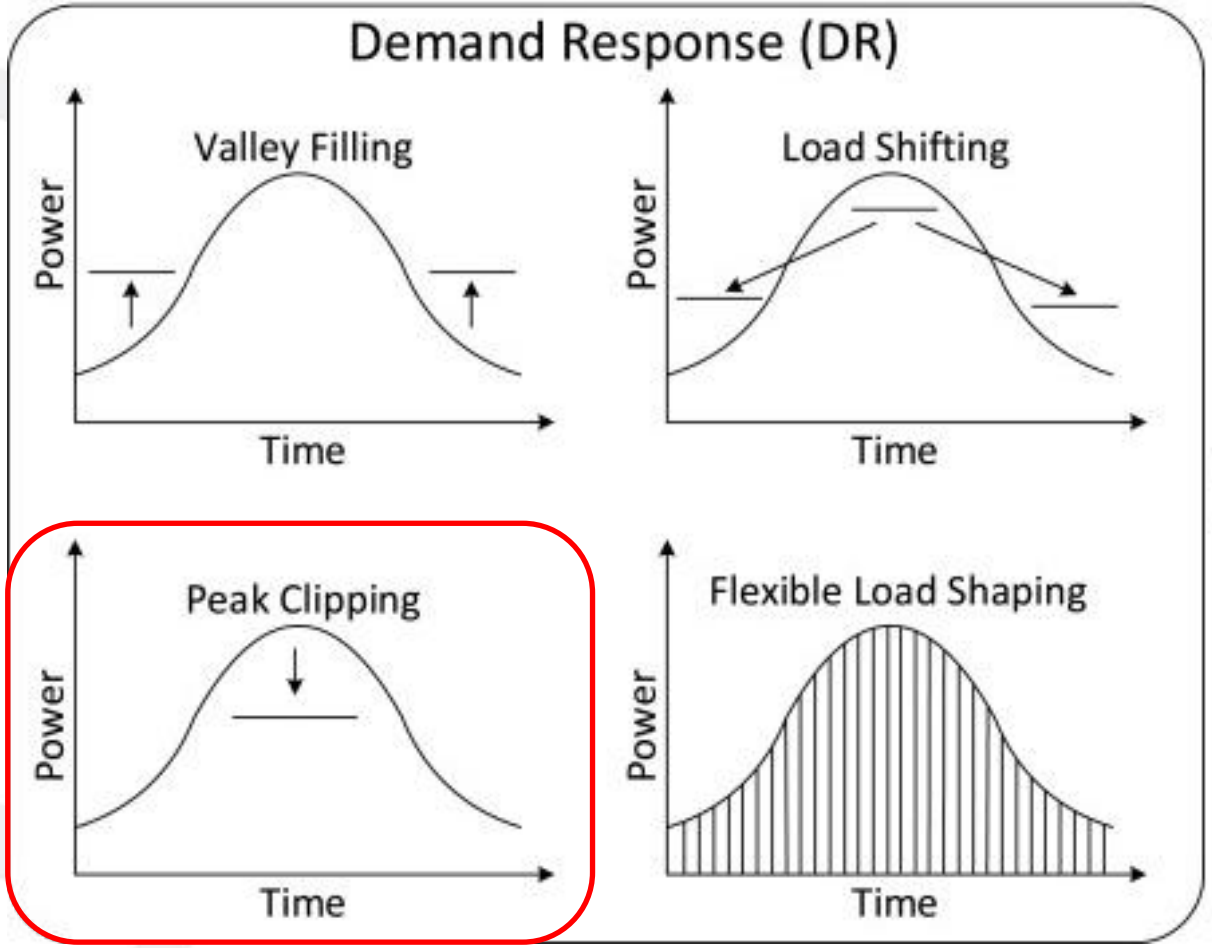
Electrification

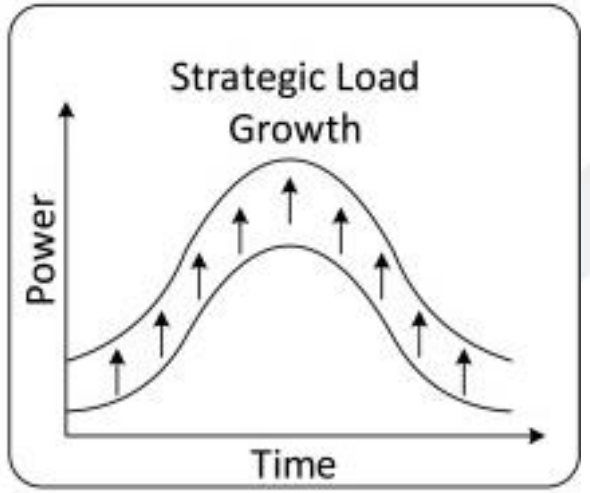


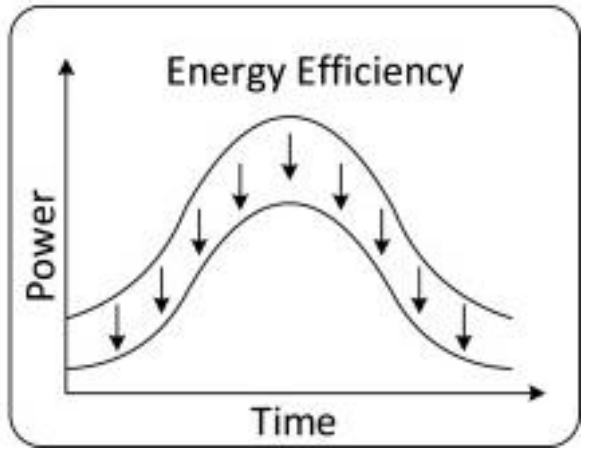
Eversource Emissions Progress



Demand Side Management

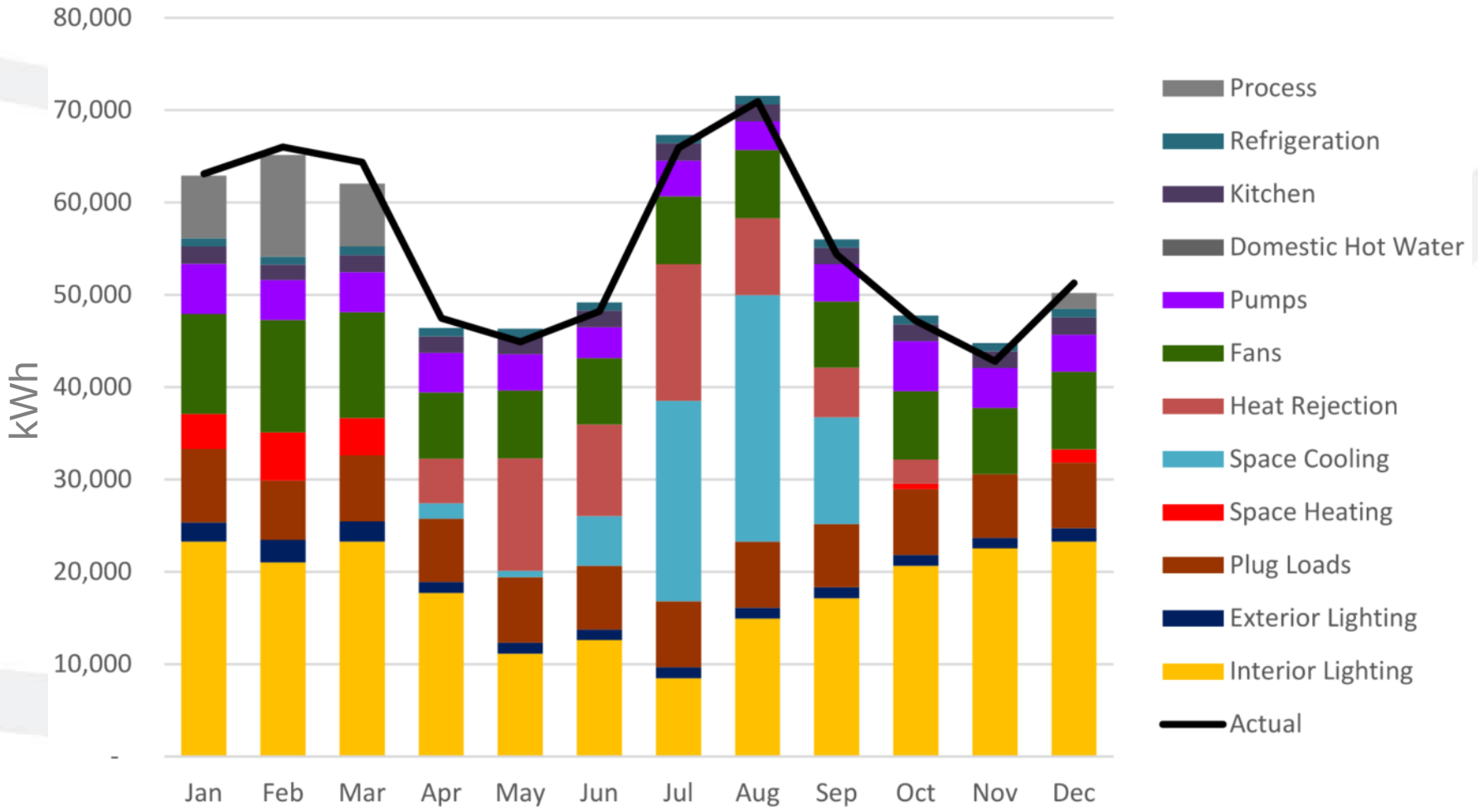






https://www.sciencedirect.com/

Energy Disaggregation



BEUDO Benchmarking

Baseline: 2018 & 2019

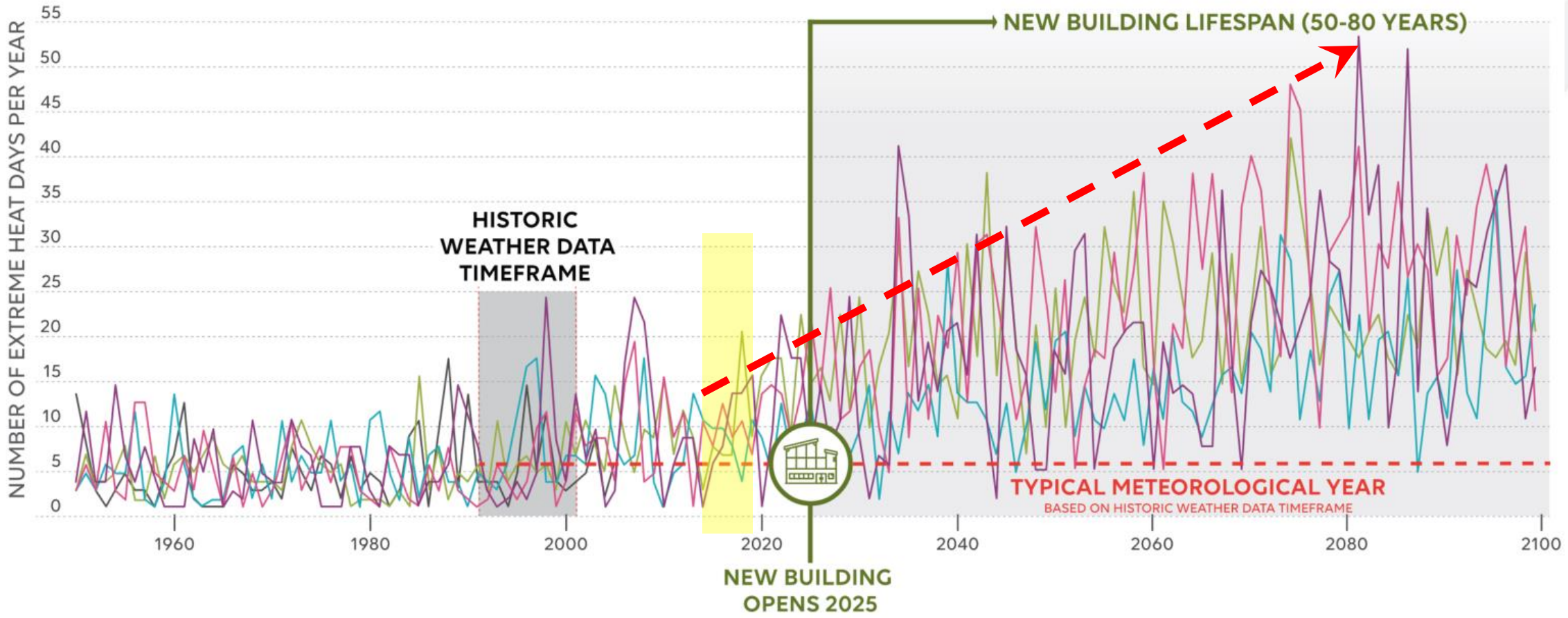
>100,000 sqft

Year	May Not Exceed
2026-2029	80% of baseline
2030-2034	40% of baseline
2035-	GHG emissions shall not exceed 0

25,000-99,999 sqft

Year	May Not Exceed
2026-2029	100% of baseline
2030-2034	60% of baseline
2035-2039	40% of baseline
2040-2044	20% of baseline
2045-2049	10% of baseline
2050-	GHG emissions shall not exceed 0

RISKS OF USING HISTORIC WEATHER DATA FOR BUILDING DESIGN



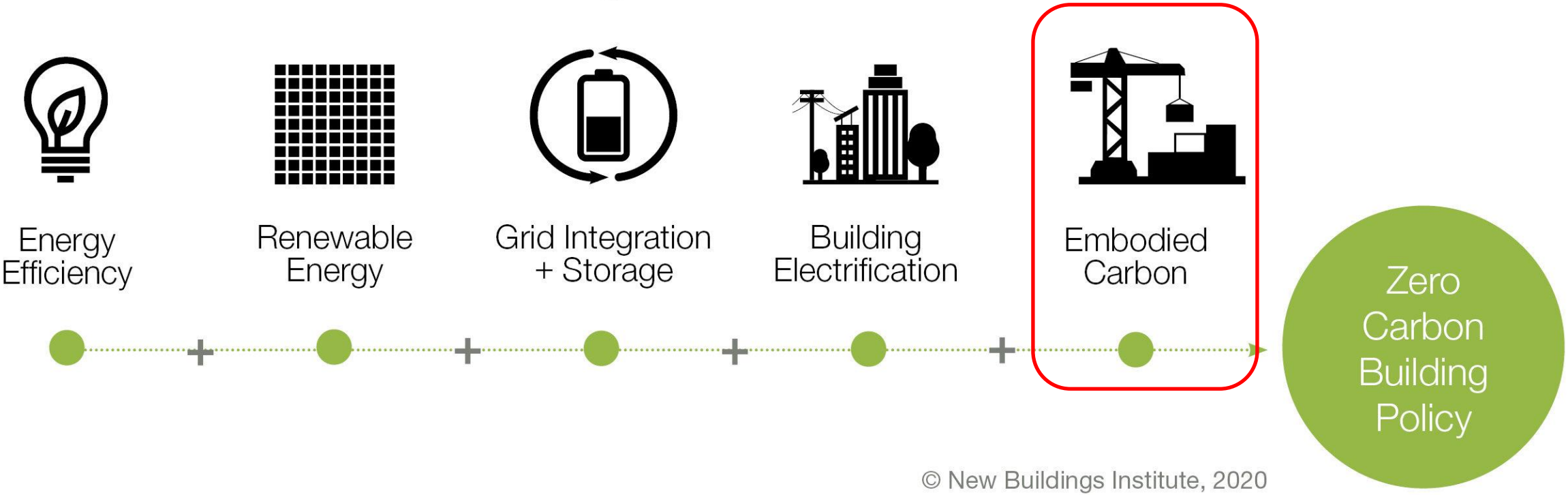
MODELS: Observed Warm/Dry Cool/Wet Average Complement

Typical meteorological year (TMY) based on historic weather data

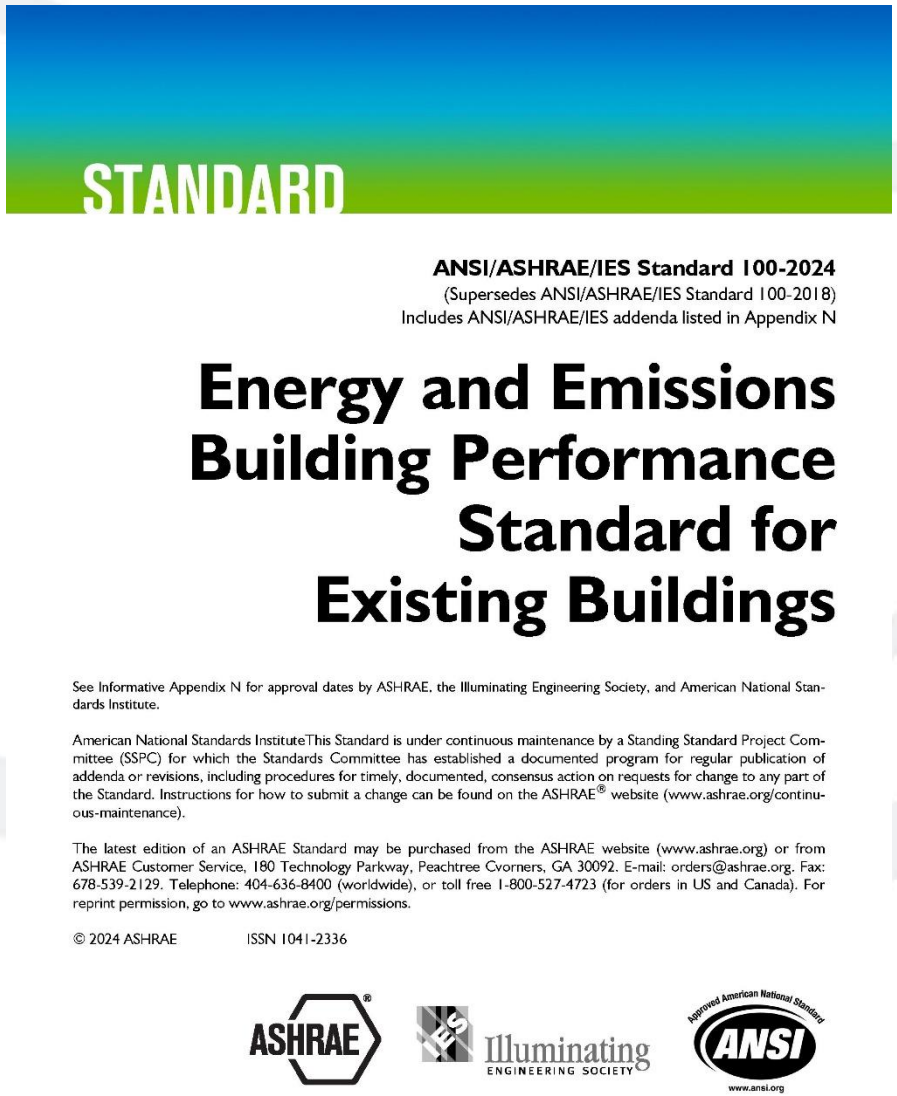
Model location: Sacramento, CA with a daily maximum temperature above 103.9 °F and a medium emissions (RCP 4.5) scenario. Source: Cal-Adapt. Data: LOCA Downscaled CMIP5 Climate Projections (Scripps Institution of Oceanography), Gridded Observed Meteorological Data (University of Colorado Boulder), LOCA Derived Products (Geospatial Innovation Facility).

Climate Forward? How Architects and Engineers Are(n't) Using Climate Projections to Inform Design, March 2023

The Five Foundations of Zero Carbon Building Policies



ASHRAE Standard 100-2024



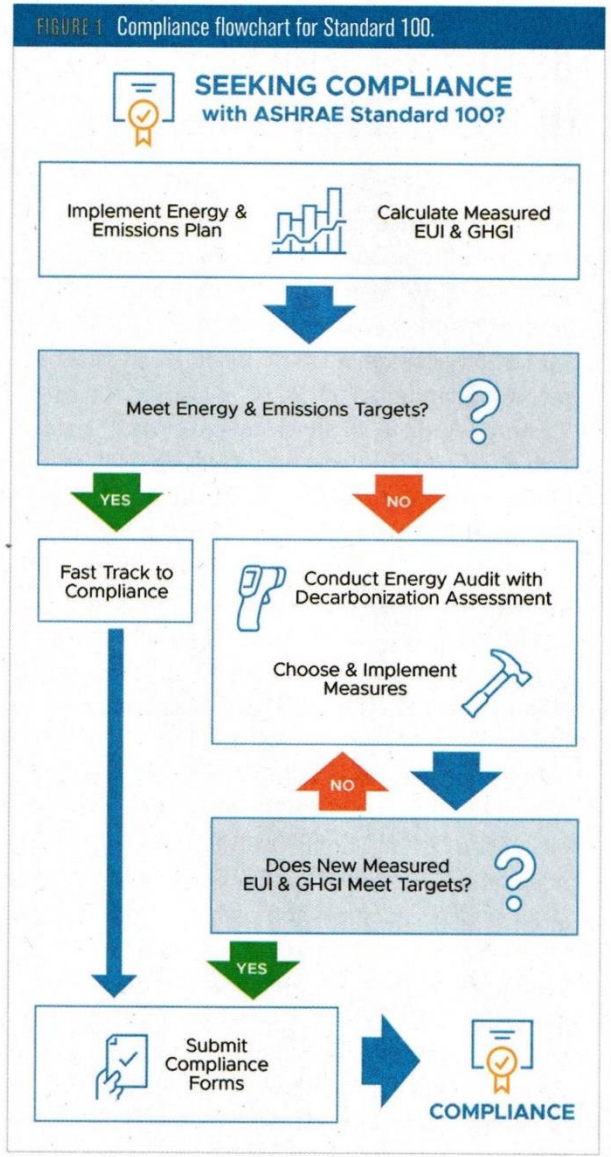
2018:

Energy Efficiency in Existing Buildings

2024:

“Model for building performance standard adoption across the U.S. and internationally”

ASHRAE Standard 100-2024



ASHRAE Journal, March 2024

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Ariana Axelrod, PE, CEM

845.323.9299

ariana.axelrod@controltechinc.com