Re-Commissioning – Bridging the Gap Between Construction and Operations

Mark Warren

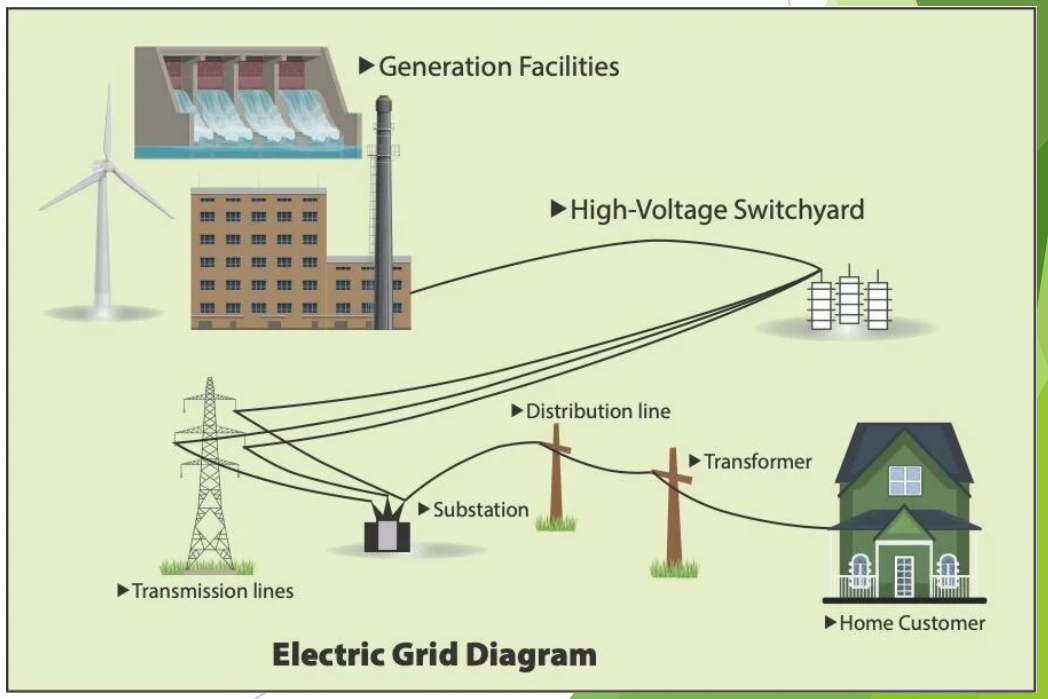
ICO Energy and Engineering

April 15, 2025

Topics and Learning Objectives

- Bridging the Gap between construction and operations with Monitored based Commissioning
- Utilizing Cx as a key strategy for Decarbonization
- Regulations on the Horizon
- Value and benefits of Re-Commissioning/Monitored based cx
- Net zero building case study
- Q and A

Macro Factors Effecting Decarbonization



- Renewable energy production
- CREEP – increase uses of electricity
- Electrification – heat pumps,ev's etc.
- Building Efficiency – Phius, Technologies, AI
- Increased Regulations

MASSACHUSETTS' GOAL:

REDUCE CARBON EMISSIONS BY AT LEAST 85% BY 2050

1990

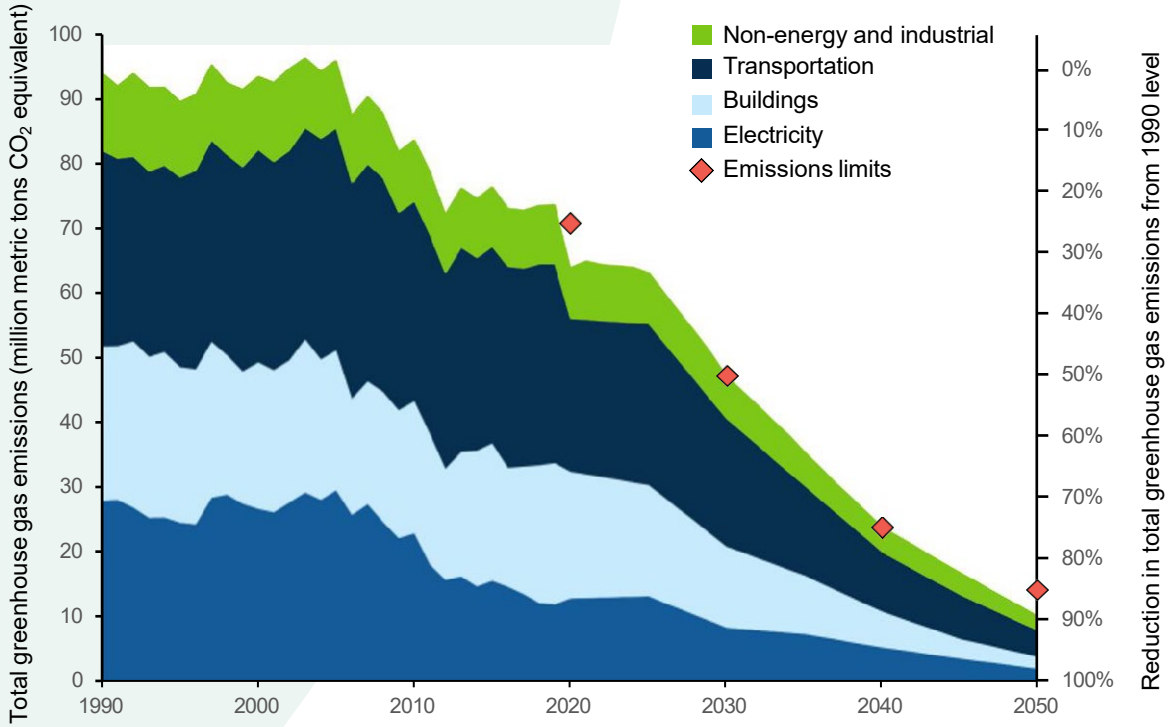
TOTAL GROSS EMISSIONS:
93 MMTCO2e

2025 **30%**

2030 **50%**

2050 **85%**

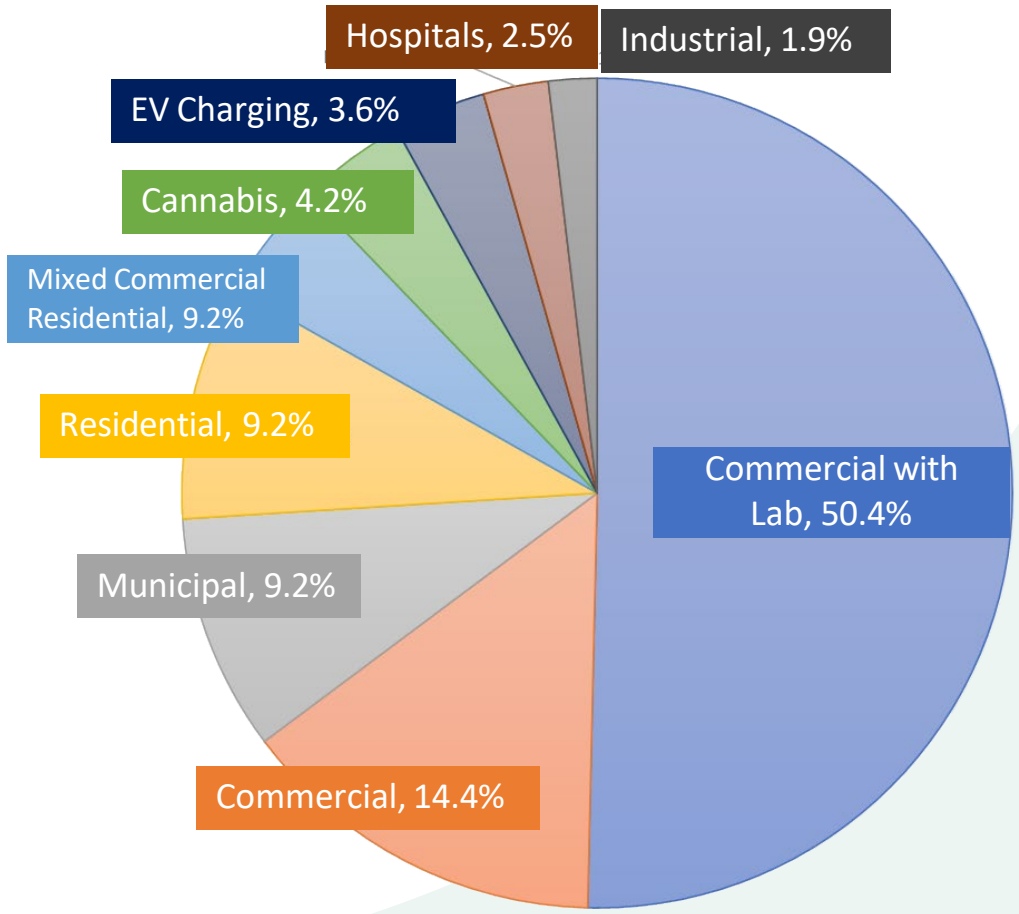
Sector Greenhouse Gas Emission as Shares of Massachusetts Economywide Total



Note: 1990 through 2019 reflect full-year historical data.
Source: Massachusetts Executive Office of Energy and Environmental Affairs

OVERVIEW FORECAST BOSTON

20% Demand Growth over the next decade driven by New Business Development



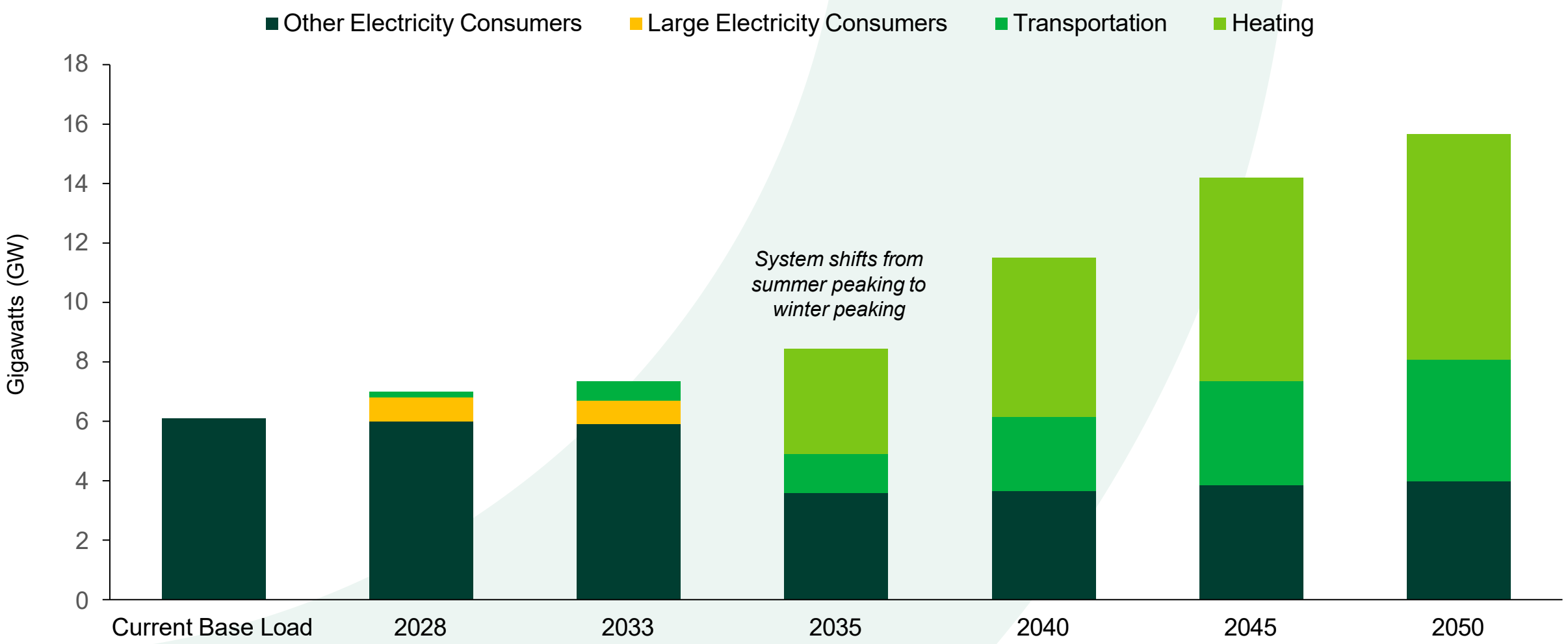
- **800+ MW** of New Business Load Growth
- **300+ MW** of Electric Vehicle Load Projected
  - **7 New** stations in Metro Boston
  - **4 New** Substation in Metro West

East Cambridge Substation

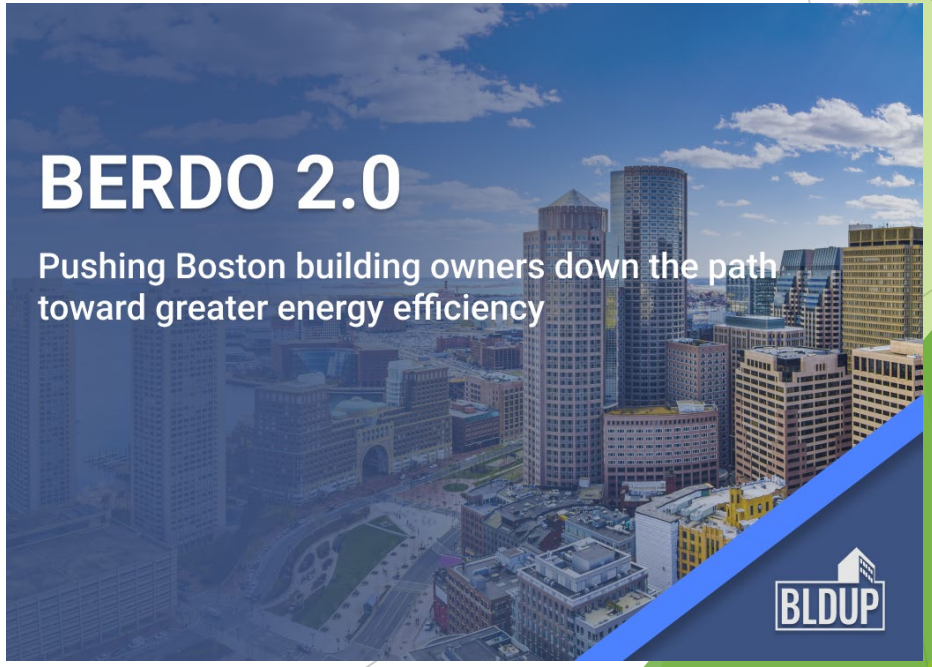


Electric Demand at 60% of Boston and 40% of Metro Boston Distribution Substations are projected to be above their equipment limits

EXPECTED TO INCREASE 150% BY 2050



Decarbonization Challenges for Facility operations



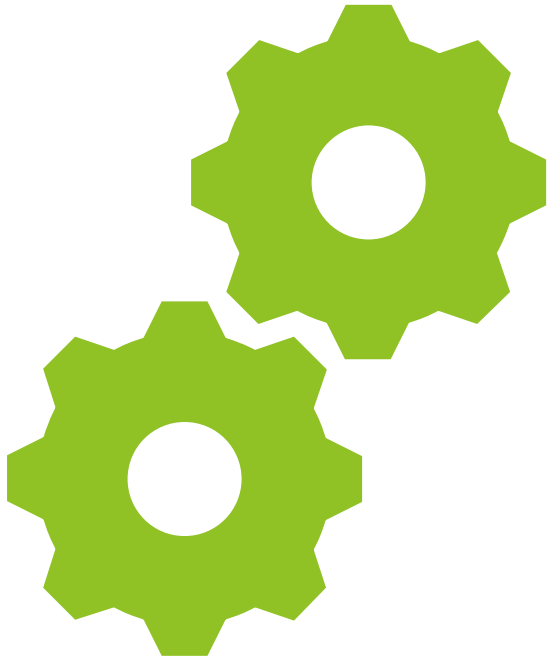
- Building Code Changes
- City And State Ordinances And Permitting
- Building Vintages – Futureproof facilities
- Electrical Capacity (Site)
- Increased Regulations
- Operations Staff Skills/Training
- ???

CUI Factors

Building Use	Emissions Standard ($kgCO_2e/SF/yr$)					
	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

Areas To Comply

- Energy usage reduction
- Electrification
- Renewable Energy Procurement (MARPS Class 1)
- Alternative Compliance Payments ($234/metric ton)



Bridging the Gap between Construction and Operations

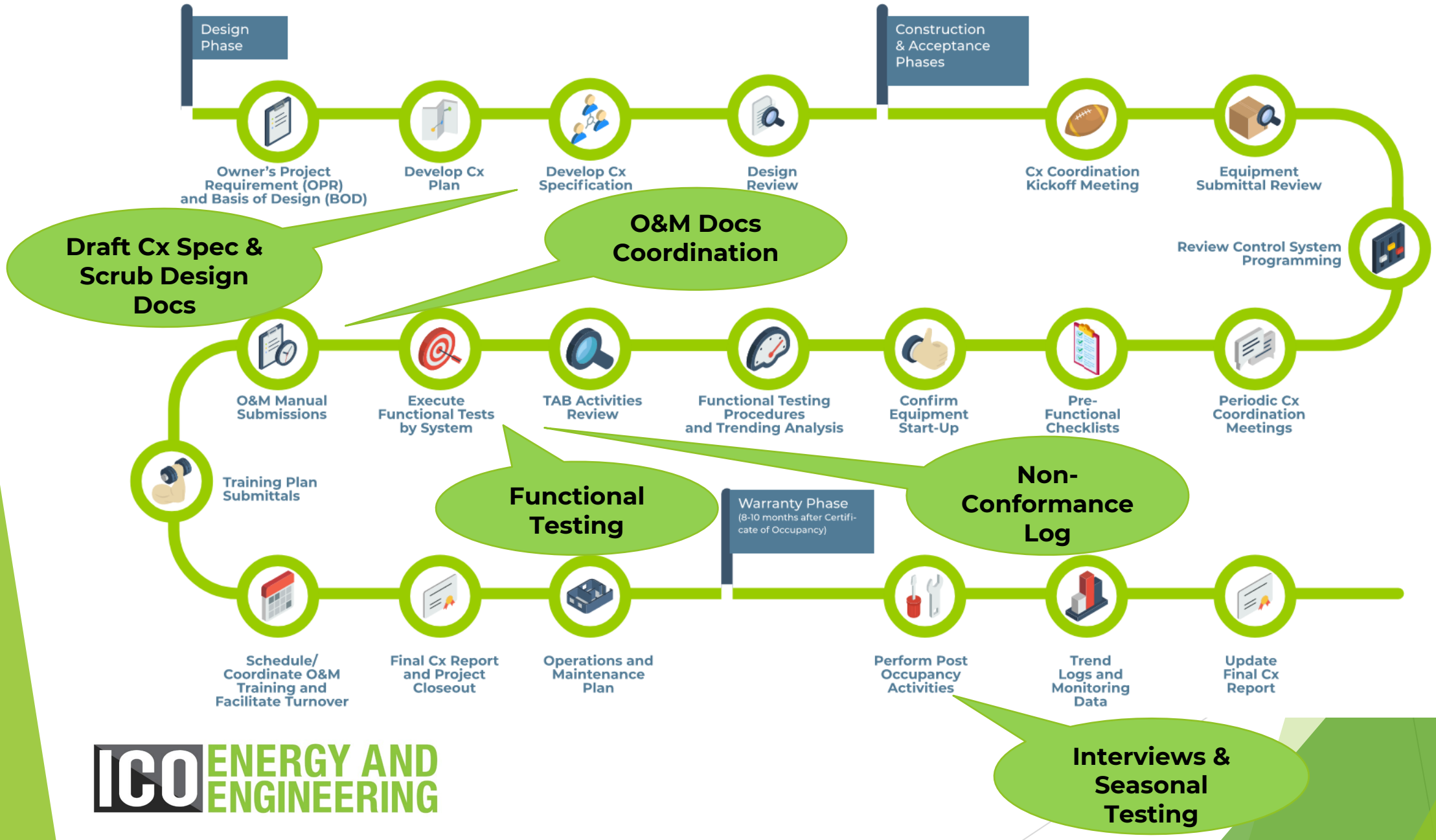
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What is Commissioning?

- "A systematic process that verifies that all building systems perform interactively according to the documented design intent and the owner's operational needs."….PECI (Portland Energy Conservation Institute)



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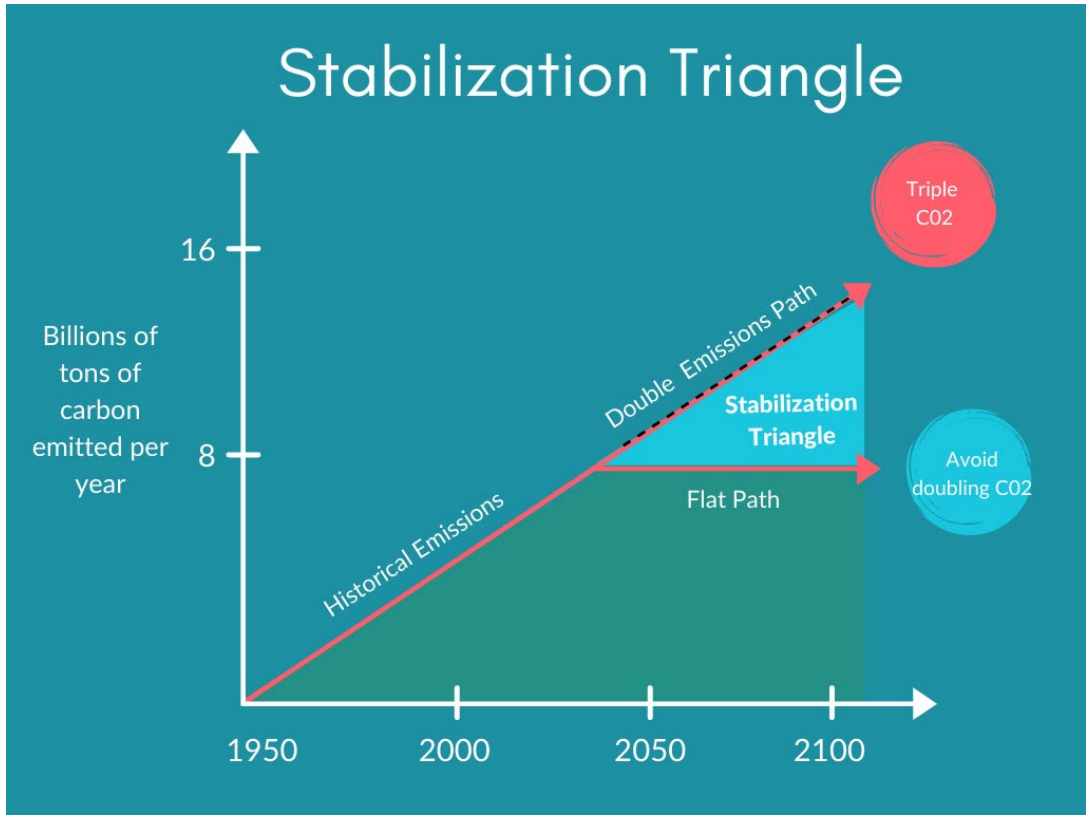
Link to operations

Equipment Start-up	System Commissioning	Re-Commissioning
• Checklist	• Simulations	•AI generated simulations
• Component Based	• Verify System Performance	•Provides auto feedback
• No Interactive Effects	• System Based	•Continual/real time
• Verify Start/Stop	• Testing Procedures	•Fault Detection
• Tested During Construction	• Post-occupancy Verification	•Diagnostics
• Static Testing	• Verify Flow Rates & Temp.	•Calculates deficiency cost

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Building Net Zero Carbon Strategies

- RE-Commissioning and Monitored based Commissioning
- Onsite Renewable Energy
- Peak Energy Demand Reductions (Load Management) – ICO Vision
- Electrification (When?)
- Deep Energy Retrofits



Monitored based Cx and Re-Commissioning

- Re-Commissioning
  - Fine tuning building that went thru Commissioning process. Confirm Current Facility Requirements (CFR)
  - Establish Benchmark (CUI and EUI)
  - Presentation of findings on a re-occurring period
  - FDD completed via eye-witness functional testing
  - Identification of FIM's
  - Action register and list of actions monthly

- Monitored based Cx
  - FDD software supported activities aimed at FIM (facility improvement measures)
  - Service Bureau capability
  - AI generated
  - Analytics Driven Decisions



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Re-Commissioning(Monitored) Process

- Planning Phase – CFR identified by spaces
- Investigation and Data Gathering Phase (metering)
- Implementation Phase
- Turnover Phase
- Persistence or Monitoring Phase (metering to report)

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Re-Commissioning(Monitored) Process Key Tasks

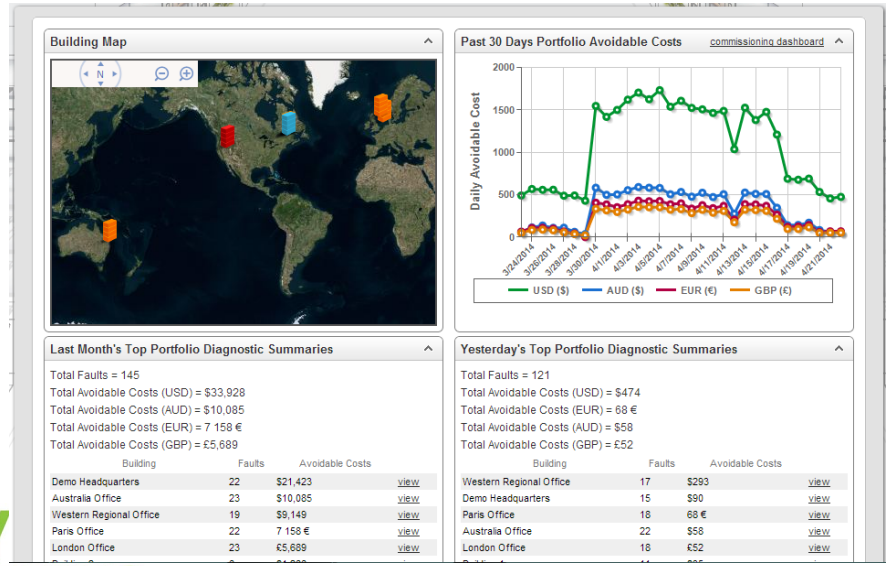
- Establish benchmarking – BERDO/BEUDO, Energy star portfolio manager, 2030 challenge
- Confirm quality of data (metered?)
- System diagnostics via advanced metering and dataloggers
- Integrated functional testing
- Facility performance analysis
- BAS trending and MBCx software integration assessment

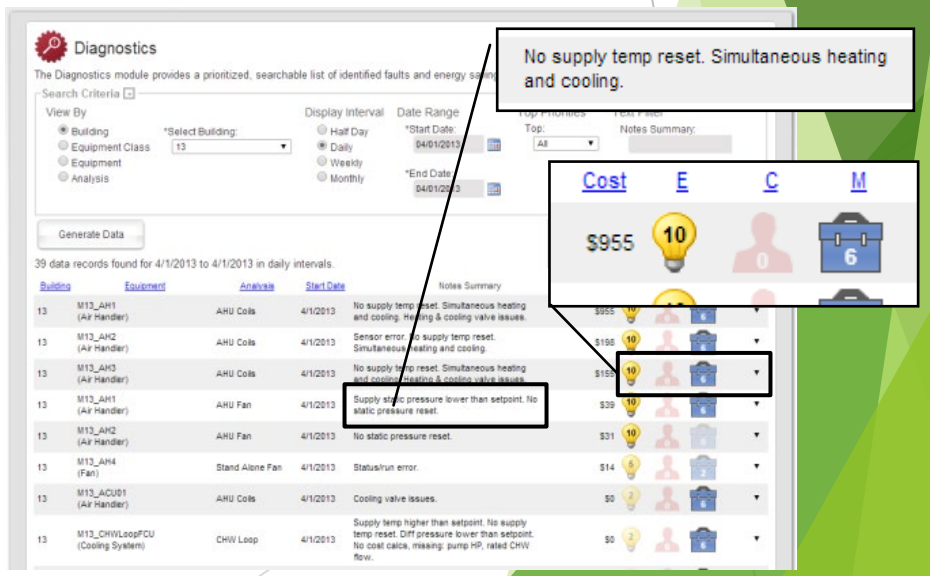
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CLOCKWORKS
Building Performance Management Software
Powered by Windows Azure
Customize Analytics
Setup Assets
DepBoy & Commission
Turn-Key Services
Training & Support
Save Energy
Ongoing Commissioning
Reduce Operating Costs
Prioritize Repairs
Automated Diagnostics
Online Tools
Enterprise Scalability
Global Partners
Systems Integration
Unleash Your Data
How it Works
KGS BUILDINGS
www.KGSBuildings.com

Ensuring FDD Fulfills its Promise

- FAULT DETECTION AND DIAGNOSTICS
- Must work, accurately!
- Adaptable to equipment/systems
- Actionable information about cost, comfort, maintenance
- Identify root cause and suggest corrective action
- Identify opportunities beyond faults – e.g. VFDs, reset schedules
- Scalable delivery





Data Analytics and Existing Building Commissioning

- Spend less time finding problems and more time identifying solutions
- Complete library of Diagnostics to perform root cause analysis

KGS BUILDINGS

Building	Equipment Class	Equipment	Analysis	Start Date	Notes Summary	Cost ($)	C	E	M
46	Air Handler	M46_AHU01	AHU coil analys...	12/1/2011	Heating and cooling valve issues. Simultaneous heating and cooling.	24194	0	10	6
46	Air Handler	M46_AHU03	AHU coil analys...	12/1/2011	Heating and cooling valve issues. Simultaneous heating and cooling. Supply temp off setpoint.	10919	0	10	6
46	Air Handler	M46_AHU07	AHU coil analys...	12/1/2011	Heating and cooling valve issues. Simultaneous heating and cooling.	3163	0	4	6
46	Air Handler	M46_AHU06	AHU coil analys...	12/1/2011	Heating and cooling valve issues. Simultaneous heating and cooling.	1499	0	2	6
46	Terminal Unit	M46_Rm6169	VAV box analysi...	12/1/2011	Room temp off setpoint. Supply flow off setpoint. Leaky reheat valve.	525	10	10	4
46	Group	M46_AH09_VAVsystem	VAV system stat...	12/1/2011	Low damper position. No static pressure reset. Static pressure off setpoint.	290	0	3	6

Prioritize time on site with diagnostic results

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Findings of Monitored/Re-Commissioning

- 15-20% carbon reduction with minimal capital cost (low cost/no cost)
- Financial paybacks of under 1-2 years or less
- Increased building comfort
  Decreased complaints
- Identifies additional decarbonization opportunities

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Benefits of Monitored/Re-Commissioning (continued)

- Confirm CFR (current facility requirements)
- Identify and resolve building system operations/control maintenance issues
- Document system operation and training
- Compliance with BERDO/BUEDO
- Ensure persistence of improvements (constantly monitored and confirm remedy)

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Typical Findings/results

- Inaccurate sensors/meters
- Missing control set backs and occupancy based controls
- Conditioning past set points
- Additional Training
- Simultaneous heating/cooling
- Insufficient Airflows (TAB review with CFR)
- Occupancy schedules



Case Study

Boston University

Center for Computer and Data Sciences

Stats

Largest
Fossil Fuel Free,
Carbon Neutral Building
in Boston

Bldg. Area
345,000 sf

Stories
19

Embodied C
>6% Avoided

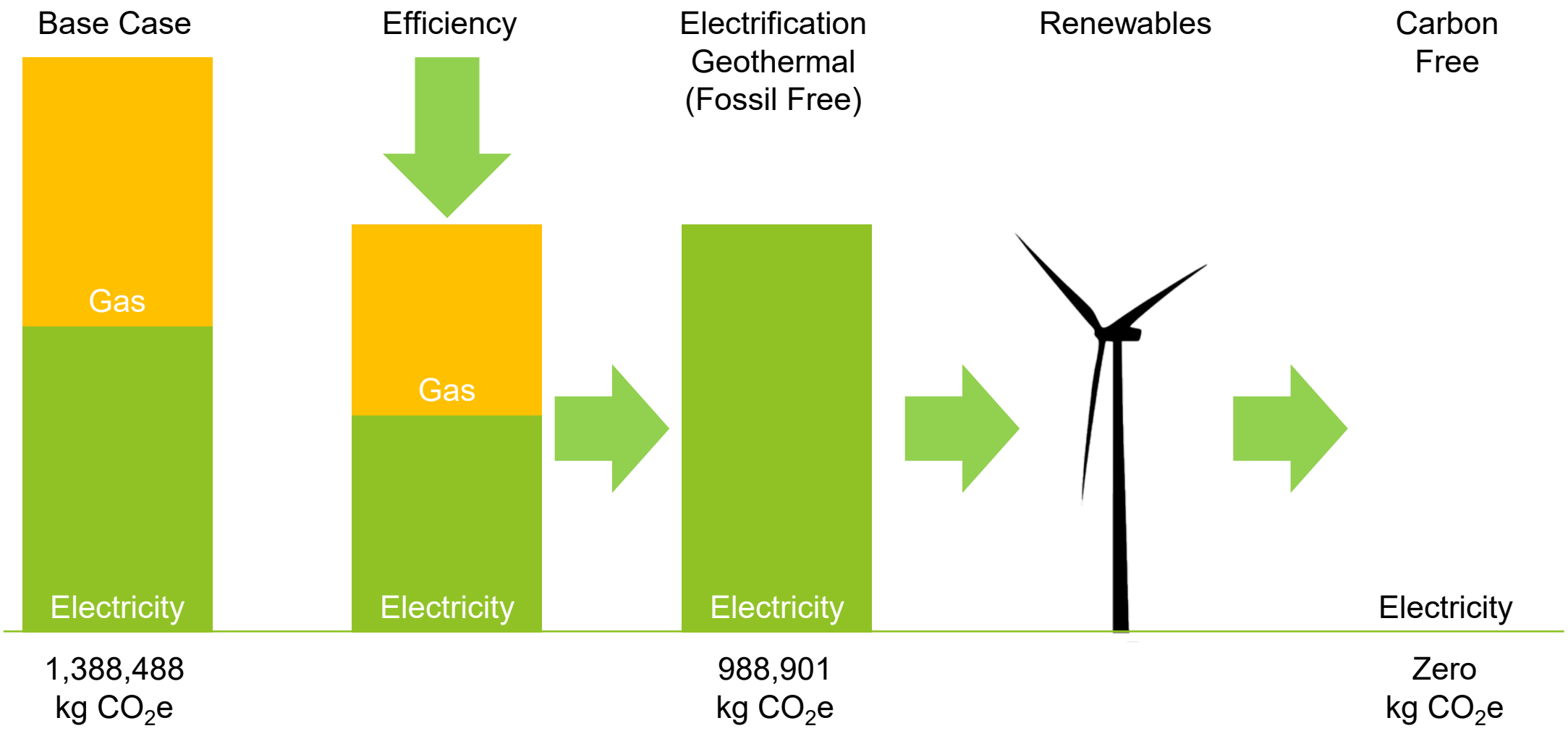
Site EUI
42 kBtu/sf

Emissions
Zero



Reason #2 Net-zero direct emissions

Carbon free building





Site Visits

- “You don’t get what you expect. You get what you inspect!”

Concluding Remarks

- Prioritize/review City/Town decarbonization strategies
- Review past facility actions and results (renewables, fuel switching, EV's, etc)
- Utilize Re-Cx to provide a path for de-carbonization actions
- Identify and plan training program/needs
- Report on past successes via re-cx
- Confirm data and establish BERDO/BEUDO reporting process (ICO Vision)
- Track all corporate decarbonization (transportation, purchases, suppliers, employees,etc).

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