



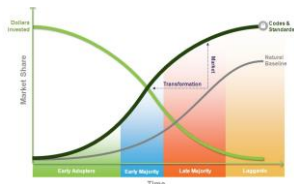
AGENDA

- 1 DECARBONIZATION OBJECTIVES
- 2 CONDUITS TO ENERGY REDUCTION
- 3 POLICY DRIVERS
- 4 RELEVANT TECHNOLOGIES
- 5 WHAT IS OUR ROLE MOVING FORWARD
- 6 Q&A

What is Market Transformation?

"Market transformation describes both a policy objective and a program strategy to promote the value and self-sustaining presence of energy efficient technologies in the marketplace"

- What we study in energy efficiency programs
- Facilitating the Adoption Curve
- How do we develop the levers at our disposal?
- What can learn from history?



Market Transformation - Wikipedia

What is the current objective?

- **80% Carbon Reduction by 2050**
- Understanding what that means
- Carbon reduction ~ Energy Reduction
- Trend has been pushing for removal of fossil fuels
- Can we achieve 80% reduction without complete elimination of fossil fuels?
- Our role as professional engineers in this new ecosystem

What is carbon reduction?

- $1,562.4 \text{ lbs CO}_2/\text{MWh} \times (4.536 \times 10^{-4} \text{ metric tons/lb}) \times 0.001 \text{ MWh/kWh} = 7.09 \times 10^{-4} \text{ metric tons CO}_2/\text{kWh}$
- Key metric – tCO2e/square foot
- Natural Gas vs. Electricity
- FTM Source
- Regional characteristics will differ

Greenhouse Gases Equivalencies Calculator - Calculations and References | US EPA

Additional Carbon equivalencies

- Each greenhouse gas (GHG) has a different **global warming potential (GWP)** and persists for a different length of time in the atmosphere

Greenhouse Gas	Formula	100-year GWP (AR4)
Carbon dioxide	CO ₂	1
Methane	CH ₄	25
Nitrous oxide	N ₂ O	298
Sulphur hexafluoride	SF ₆	22,800
Hydrofluorocarbon-23	CHF ₃	14,800
Hydrofluorocarbon-32	CHF ₂	675
Perfluoromethane	CF ₄	7,390
Perfluoroethane	C ₂ F ₆	12,200

CO2 equivalents | Climate Change Connection

Conduits to reduction

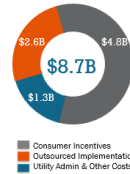
- Utility DSM/EE programs
- Statewide Renewable programs and subsidies for energy efficiency
- Energy Service Companies (ESCOs)
- Design Build and Engineering Procurement Construction (EPC) firms
- New(er) Emerging Technology manufacturers and suppliers
-as a Service (EaaS, HaaS, EEaaS, RaaS)
- Policy drivers – Local Laws, Municipality decarbonization initiatives, Codes and Standards

Fragmented market and lack of mass adoption to scale are the issues that the industry is addressing

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Utility Demand Side Management Market

North American Utilities Energy Efficiency Funding



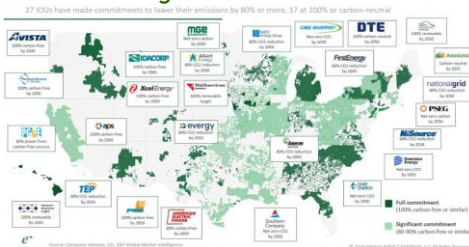
Today: Serving ~\$9B Utility Energy Efficiency Market

- Attempt to achieve 2-3% in reduction of sales
- EE measure and program (stress) saturation has leveled in the last 5 years
- Increased Pay for Performance basis

Growth Drivers: Increased Mandates, EE as a Resource & Electrification Growth Initiatives

- Decarbonization commitments from utilities & other jurisdictions are increasing goal expectations/requirements
- Federal Stimulus & Economic Recovery Plans are emphasizing clean energy & EE related initiatives due to job growth and customer bill savings

Utilities across the country are setting their own emissions goals



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Energy Service Companies (ESCOs)

- Long history....
- Evolution of Energy Service Performance Contracts (ESPCs)
- Proliferation of MUSH market (Municipal University School Hospital)
- Long term contract structures with evolving guaranteed savings models
- Repeated attempts to leverage in Commercial Real Estate and other C&I markets
- Increase in renewables and higher impact carbon reductions

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Design Build

- Contract structure variations
- In roads into Non-MUSH
- Renewable firms have absorbed Engineering, Procurement, and Construction capabilities
- Solar Lease
- Power Purchase Agreements



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Emerging Technology

- New vs. underutilized
- 1000s of Cleantech companies formed in the last 7-8 years
- Well-funded
- Most will not get beyond early adoption phase
- Application is specific
-But should be considered in combination with multiple measures and packaged solutions and not on individual merits

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....as a Service

- Most recent versions are shifting risk from the owners to 3rd party investors
- Financially oriented to the demands of the market
- Energy as a Service (EaaS) – Disaggregation of utilities and control of energy consuming assets
- Addresses the split incentive issue
- Can it be done to scale?

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Municipal Decarbonization Process

- Planning phase
- Benchmarking
- Grading system based on carbon footprint
- In some cases, “Accelerator” programs and initiatives
- Taxation
-which hopefully prompts consumer activity to scale

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Decarbonization trends

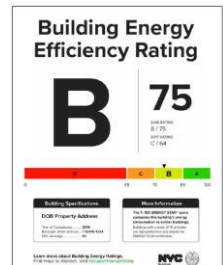
Many jurisdictions to follow the trends of preceding initiatives like benchmarking, decarbonization planning, and implementation their own programs.....

Jurisdiction	Building Type	Minimum Square Footage	Metric	Initial Year of Performance Requirements	Standards
Boulder	C, I	NA	Points based on carbon and water	2019	Earn 100 points using prescriptive table or LEED score
Reno	C, MF	30,000	E Star Benchmark	2026	Multiple Energy and water options
Washington, DC	C, MF	10,000	E Star Benchmark	2026	Star score or reduce energy use 30%
New York, NY	C, many MF	25,000	kCO ₂ e/sq ft	2024	40% reduction by 2030, 80% by 2050
Washington state	C	50,000	kBTU/sq ft	2026	Must not be more than median for that building type
St. Louis	C, MF	50,000	kBTU/sq ft	2025	Must be based on 65th percentile (currently met by 35% of building stock)

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Local Law 97 illustration

- The goal is to reduce the emissions produced by the city’s largest buildings 40 percent by 2030 and 80 percent by 205
- Covers nearly 60,000 buildings
- By now, buildings would have received a “grade”
- By May 2025, any building that is impacted by Local Law 97 will have to file an annual Greenhouse Gas Emission report



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Clean Energy Jobs Act (CEJA)

- The Clean Energy Jobs Act (CEJA) is a comprehensive climate and energy bill that centers equity and puts Illinois on a track to achieve 100 percent renewable energy by 2050
- Equity and Inclusion
- Job Creation
- EV Infrastructure
- Restructuring Utilities, Assets and Rates

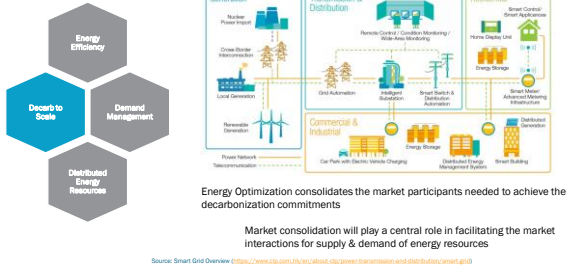
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What needs to happen?

- Confluence of Distributed Energy Resources, Demand Management and Energy Efficiency
- Market Consolidation
- **Strategic engineering designs and plans with an eye on longer-term benefits**
- Shifting risk away from end-user
- Patience
- Both Math and Economics have to support the ambitious goals
- Consumers MUST participate in this process

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Market Consolidation



Relevant Technologies

- Heat Pumps
- Solar/Storage
- Distributed Energy Management System
- Smart Building Controls
- Hydrogen

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Real World Example

- Commercial office in Iowa
- Audit recommendations produce ~25% energy reduction
- Question: *How do we achieve 80% carbon reduction?*
- Strategic considerations:
 - Electrification realities (e.g., existing capacity)
 - End of useful life (present and future)
 - Need DER assets to be paired with energy efficiency projects
 - Economic sensitivities
 - Occupancy

Energy Conservation Measures	Savings	Units
Chiller Upgrade	47,830	kWh
Interior LED retrofit	111,506	kWh
LED Exit Signs	4,570	kWh
Occupancy Lighting Controls	21,310	kWh
Exterior LED retrofit	18,360	kWh
Building Automation System	63,770	kWh
Boiler Retrofit (Condensing)	27,150	Therms
DHW Pipe Insulation	280	Therms
DHW Valve Control	1,120	Therms
Electric total	267,766	kWh
Natural Gas total	28,350	Therms

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What is our role?

- Environmental impacts does not have to be part of the discussion
- Understanding regional characteristics and differences
- Understanding Electrification and what is "beneficial"
- Not forgetting about Energy Efficiency
- Monetization opportunities
 - MEP
 - Design Build
 - Equipment Manufacturers
 - Renewable – Consolidate with EE firms
 - Shifting risk from customers
-Market Transformation will occur at scale within normal economic environment and pace

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Questions

1. What comes **directly** after early adoption in the adoption curve?
 - a. Laggards
 - b. Early Majority
 - c. Late Minority
2. What is the current decarbonization objective by 2050 for most policy driven initiatives?
 - a. 80%
 - b. 50%
 - c. 100%
3. Which of the following are NOT electrification measures?
 - a. Electric Vehicle infrastructure
 - b. Solar + Storage
 - c. Condensing Boilers
 - d. Electric Heat Pumps

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Questions

4. In our facility assessment example, 80% reduction is feasible if....
 - a. Install Renewables only
 - b. Combination of DER and EE
 - c. Can't be done
5. All U.S. regions must follow the same guidelines and policies in order to successfully decarbonize to scale
 - a. True
 - b. False

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**THANK
YOU!**

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