Building Decarbonization 101

Building decarbonization involves reducing the greenhouse gas (GHG) emissions associated with the energy consumption required to operate a building. The BETA: Project Planning program works with participants to explore and disseminate retrofit approaches for commercial buildings, including large multi-family, to prepare for net zero emissions by 2050. This is an introductory guide to understanding building decarbonization and offers steps for owners to begin their own emissions reduction plans.

An owner's guide to getting started:

1. Get to know your building.

Understand the performance and emissions baseline of the building and start thinking about long-term capital planning. Key steps to putting the building on a path to decarbonization include:

☐ **Existing building conditions**

An energy audit in tandem with a capital needs assessment can provide valuable information about the building's current condition and performance. Included are the lifespan of the existing equipment, upcoming repairs or replacements, and projected capital expenses and existing energy use.

☐ **Financial review**

Conduct an internal review of finances and the long-term planning for the building:

- What renovations are expected or planned?
- How are current operating and capital improvements budgets funded?
- Are there any upcoming tenant expirations?

☐ **Decarbonization assessment**

A decarbonization audit identifies strategic and cost-effective opportunities for improvement efforts and corresponding GHG baseline and trajectory.

☐ **Regulatory review**

Research relevant local regulations and compliance requirements:

- Is the building in a jurisdiction that requires disclosure and enforces emissions reductions?
- Which building improvements may trigger compliance with current building energy codes?

☐ **Supplemental assessments**

Depending on decarbonization goals, implementation timeline, and the scope of retrofit work, additional building assessments from qualified professionals may be required.

2. Set project goals.

What is most important for you to achieve with this project and long-term planning? What issues may influence the decision-making process?

Consider these factors inform project goals:

- Regulatory compliance
- Equipment end-of-life replacement
- Planned renovations and upgrades
- Tenant improvement cycles
- Recapitalization periods
- Investor demands
- Utility cost savings
- Building resilience

3. Assemble project team.

An integrated project delivery with close collaboration among technical providers, building scientists, and contractors from the outset will clearly communicate project performance goals.

4. Structure financing stack.

Explore financing solutions and incentive programs available across local, state, and federal sources. While some decarbonization work may be completed over time, funding criteria may encourage consolidation of improvements.

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Operating emissions can be direct or indirect, encompassing any electricity or fossil fuel used for heating, cooling, lighting, and other energy needs within a building.

A decarbonized building is…

All-electric. All mechanical systems, including heating, cooling, hot water, and appliances convert to electric. Switching from fossil fuel to all-electric systems will reduce air pollution, improve indoor air quality, and protect against fossil fuel price volatility, ensuring more stable utility costs for owners and residents.

Highly efficient. In some cases, an equipment swap with highly efficient electrical systems is enough to optimize building performance, but in most cases, especially in cold climates such as Massachusetts, buildings need efficiency measures, such as insulation and air sealing, to increase thermal comfort and reduce energy demands. Efficiency measures are key to minimizing utility costs, emissions, and impacts on the local grid.

Powered by clean energy. While today's electricity supply still relies on fossil fuels and is not emissions free, the grid is steadily becoming cleaner every year as our electricity system transitions away from fossil fuels. Buildings can accelerate their access to clean energy by adding on-site renewable energy where feasible or procuring clean electricity supplies.

Today, electrification reduces energy use and carbon emissions

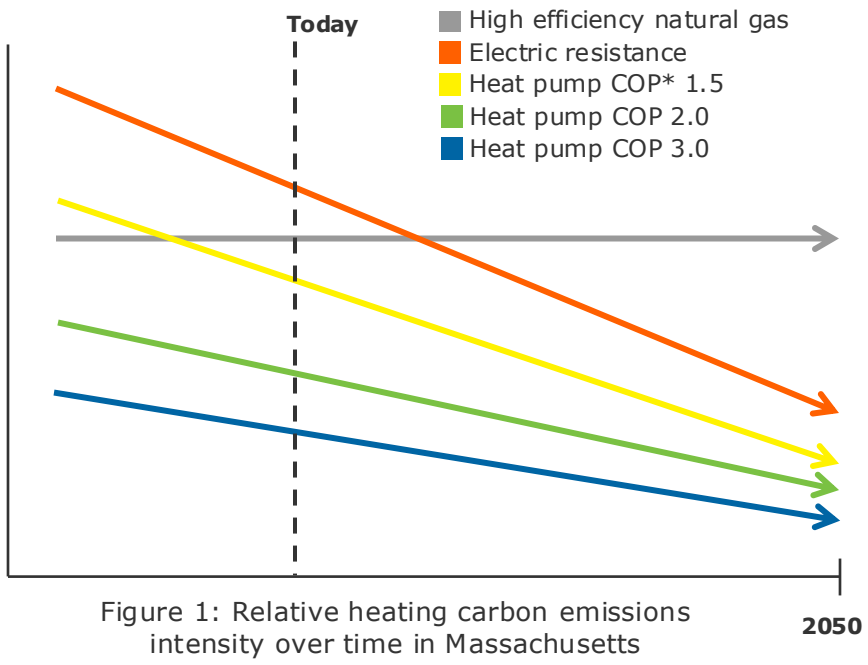

Figure 1: Relative heating carbon emissions intensity over time in Massachusetts

As electrical grid infrastructure within Massachusetts integrates cleaner energy sources and buildings transition to efficient all-electric systems, full decarbonization is becoming increasingly attainable.

Figure 1 illustrates that higher system efficiency leads to greater emissions reductions over time. While high-efficiency heat pumps are ideal, every future scenario projects electricity to have lower carbon emissions than natural gas.

*COP stands for Coefficient of Performance and is an efficiency metric for HVAC systems.

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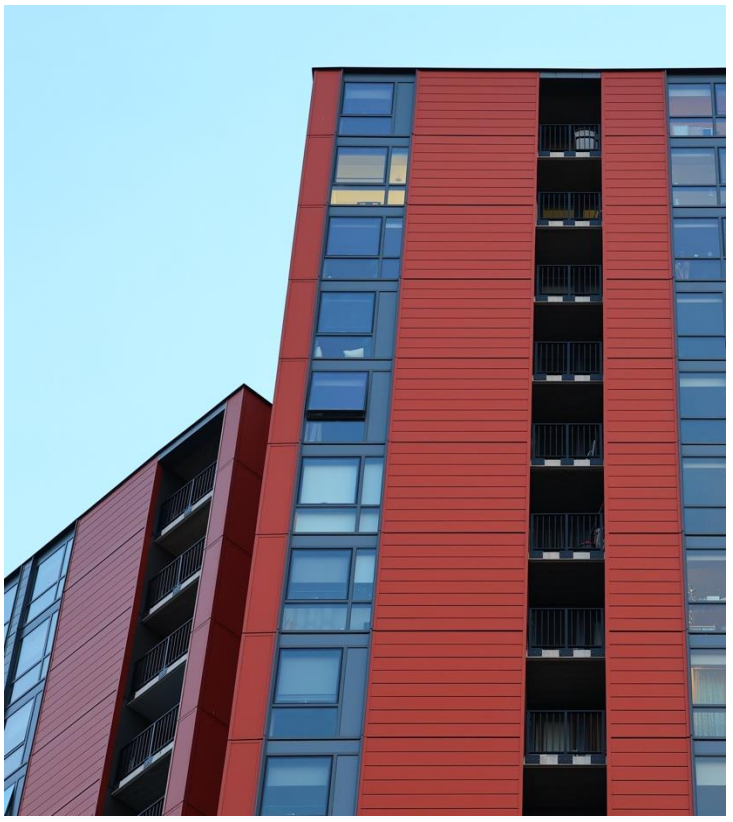
With the state goal of carbon-free buildings by 2050, the BETA Project Planning strategy for meeting this target in a cost-effective, comprehensive way centers on the following process and key components. These principles serve as a valuable guide for creating an optimized decarbonization pathway for buildings.

The decarbonization assessment process:

1. **REDUCE** energy loads to an optimized state
2. **RECONFIGURE** systems to enable electrified heating solutions
3. **RECOVER** energy from air, water, and other sources
4. **REPLACE** equipment over time until fully decarbonized



Key components:

There are three key components to reducing building emissions: improving energy efficiency and reducing load, electrifying systems, and incorporating renewable energy. The decarbonization assessment identifies cost-effective opportunities to enhance performance in each of these areas.

Energy Efficiency & Load Reduction

Identify existing inefficiencies & propose efficient alternatives (e.g., appliances, lighting, windows, and insulation)

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Electrification of Systems

Identify opportunities and enabling measures to shift heating, cooling, and hot water systems from fossil fuels to high-efficiency electric equipment

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Renewable Energy

Evaluate opportunities for on-site renewable energy