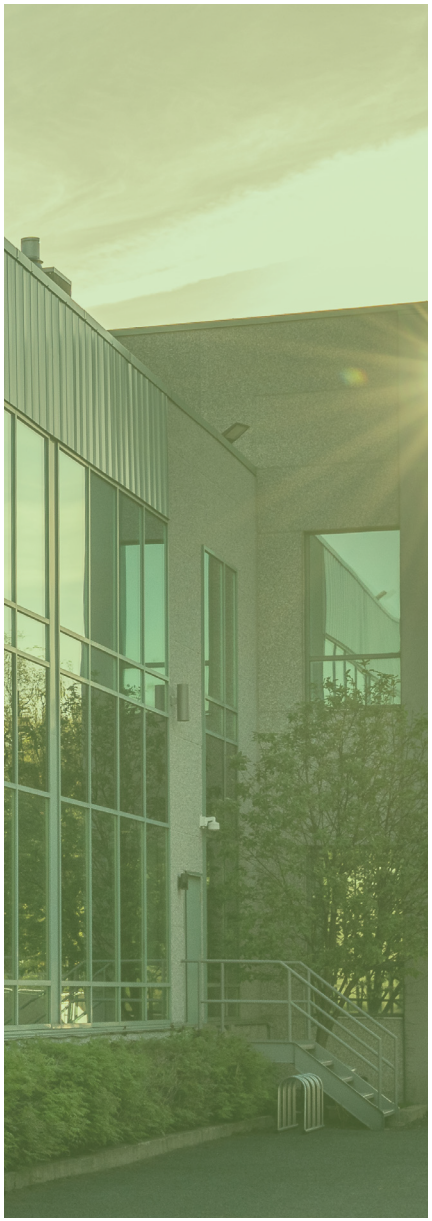
THE FIELD GUIDE *to* DECARBONIZATION PLANNING

Strategies to net zero for the built environment

Presented by:

AMERESCO

Show the Way: The Field Guide to Decarbonization Planning



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Climate Action in the Built Environment

As a major contributor to global greenhouse gas (GHG) emissions, the built environment bears a substantial share of the responsibility to decarbonize. The buildings we live and work in are responsible for roughly 40% of energy-related CO_2 emissions. This resource focuses in on that area of opportunity to decarbonize.

The urgency of climate action across facilities and buildings is driven by a combination of external pressures and internal commitments spanning a range of industries. In higher education, for instance, there is an increasing demand for robust sustainability plans to modernize existing infrastructure as an illustration of environmental stewardship and the opportunity to incorporate climate action into education curricula. In the healthcare sector, the principle of "do no harm" extends beyond patient care to encompass environmental responsibility and health equity. Municipalities and public sector agencies are driven by government policy and regulations in addition to providing improved services and the environment for the community.

Globally, favorable policy and programs are influencing the clean energy transition within the built environment. For instance, the U.S. Department of Energy's Blueprint aims to decarbonize U.S. buildings by reducing greenhouse gas emissions by 65% by 2035 and 90% by 2050. Similarly, the World Green Building Council's EU Policy Whole Life Carbon Roadmap supports the European Green Deal's goal to fully decarbonize buildings and construction by 2050. These initiatives are addressing all aspects of buildings emissions to ensure a low carbon future and achieve global climate goals.

From the lens of the built environment, this resource maps out building system levers available to tackle emissions and achieve net zero over time. We'll guide facility owners and operators through key components and considerations when crafting an actionable, prioritized decarbonization plan.

What is the built environment?

The built environment spans all of the man-made infrastructure that surrounds where we live, work, and play.

This guide discusses buildings and facilities from a general perspective, making the strategies applicable across use cases – from public facilities, K-12 schools, corporate offices, community buildings, and more.

Building Emissons 101

Common building systems that contribute to emissions:

Scope 1:

Heating systems and infrastructure burning fossil fuels

i.e., Boilers, furnaces, generators

Scope 2:

Lighting systems

i.e., Energy intensive lighting

Heating, Ventilation, and Air Conditioning (HVAC) systems

i.e., Consumers of electricity for heating and cooling

Electric appliances and equipment

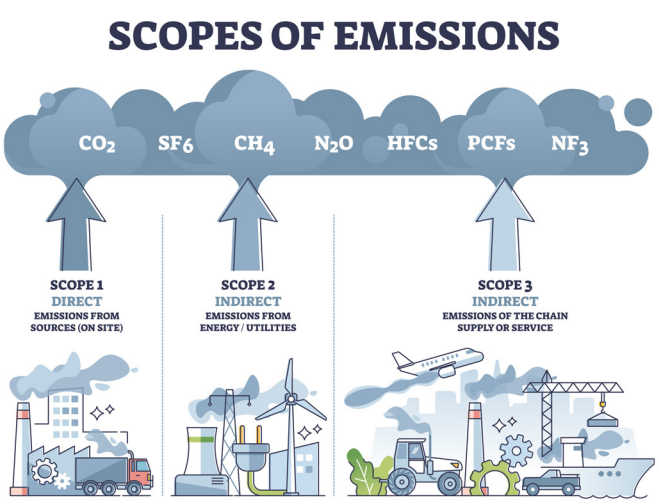
i.e., Computers, elevators, and other systems powered by electricity

Planning for emissions reductions begins with establishing a GHG emissions inventory in conformance with the Greenhouse Gas Protocol. An inventory will establish a baseline for an organization's scope 1, scope 2, and scope 3 emissions. Identifying and defining strategies to reduce GHG emissions begins with an understanding of what each emissions scope entails. Using the definitions from the GHG Protocol:

Scope 1 includes direct emissions that come from sources that an organization owns or controls.

Scope 2 refers to indirect emissions from the consumption of purchased electricity, steam, heating, and cooling. These emissions occur at the facilities where the energy is generated, not at the point of consumption.

Scope 3 are all other indirect emissions that occur in an organization's value chain and supply chain. With 14 categories in this scope, organizations typically focus on the most material ones, such as travel, waste disposal, as well as emissions embedded into the supply chain.



Establishing an accurate GHG inventory helps define the baseline, baseline year, and timeline for decarbonization targets. It also serves as a reference point to measure progress and identify the most effective emissions reduction opportunities. As we look to decarbonize the built environment, scope 1 and scope 2 emissions are our primary focus when developing effective emissions reduction measures that address the environmental impact of the built environment, paving the way to achieve net zero goals. Various tools and resources, ranging from advisory services to software, are available to assist organizations in quantifying and managing their emissions. The first place to start is with the data; continued measurement and monitoring of emissions is a critical first step in determining which programs will best help drive decarbonization.

Setting Achievable Net Zero Goals

Making significant progress towards net zero emissions in our existing buildings is feasible with today's technology. Organizations must navigate intertwined pathways to integrate the right mix of efficiency measures, electrification, and renewable energy resources for their environment.

Many organizations set ambitious sustainability goals, planning to work out the tactics for achieving these strategic initiatives further down the road. Setting achievable net zero goals goes beyond aspirational targets and proxy timelines.

It requires a sustainable, strategic plan with a detailed roadmap, defined milestones, and a clear sequence of actions. Most importantly, it requires optionality and prioritization. One thing is certain: there will be unknowns encountered throughout the always-evolving process of decarbonization.

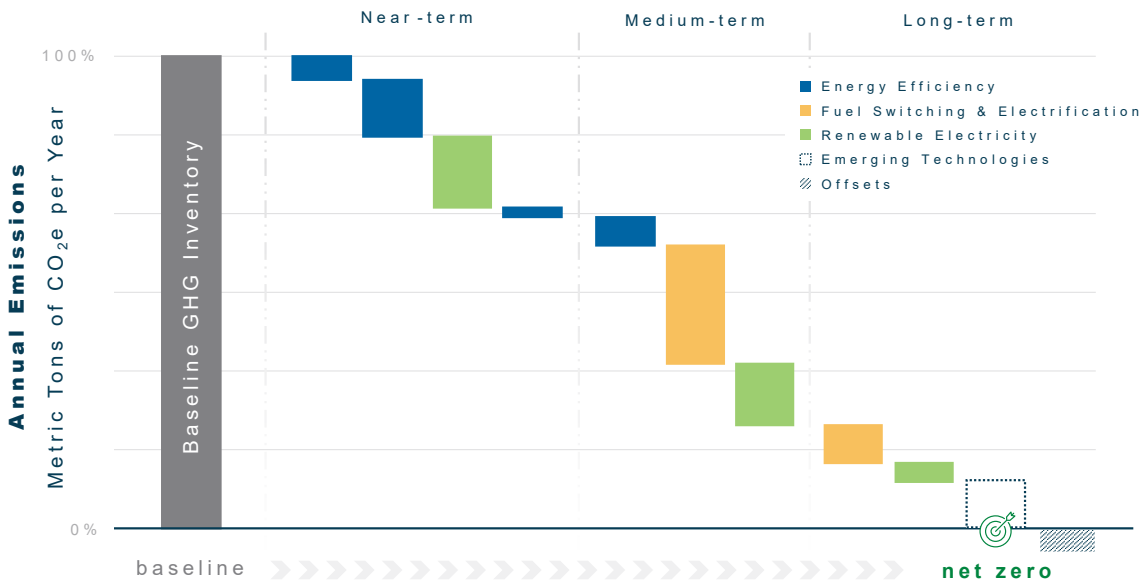
Ensuring you have resources in place to guide you in understanding the basics of emissions and their relationship to your existing building systems is crucial. With a solid foundation of data governance, experts can help you establish your baseline, map out a path to success, establish targets and milestones, and help you adapt your plan over time.

Emission Reduction Levers in the Built Environment

While the building and facility management industry has commoditized energy planning, in many cases, it remains without a playbook for decarbonization planning. Facility owners and operators are tasked with balancing consumption and production efforts and channeling those into a transition towards net zero or other sustainability targets.

Decarbonization planning is essential for translating goals into actionable steps by educating stakeholders, securing resources, and aligning operational decision making. Integrating decarbonization principles within an organization's strategy not only fosters a sustainable culture but also prevents decisions that could lock in carbon emissions for years to come. Careful planning that also influences policy ensures that low-carbon options become the most likely decision made by staff, driving environmental benefits.

A robust decarbonization plan must offer flexibility and adaptability, so optionality is key. Technologies and policies will continue to evolve, and what is practical or economical today may change in the future. By keeping options open while working toward an achievable end-goal, organizations can adjust their strategies over time, ensuring the plan remains viable and effective.



Considerations when developing a decarbonization plan:

A decarbonization plan should be documented and mapped into phases: near-term actions, medium-term considerations, and long-term strategies.

To start, organizations will want to consider efficiency measures, electrification and thermal energy shifts, renewable energy resources, and solutions beyond the building walls.

Gaining Efficiency through Reduced Consumption

Field Tip #1

The goal of efficiency in decarbonization planning is to reduce the overall amount of clean energy that will be needed to power your built environments.

By focusing on these key areas within buildings and their systems, organizations can effectively reduce energy consumption, lower operating costs, and move the needle on their decarbonization goals.

Implementing efficiency measures is a crucial step in creating sustainable, high-performance buildings.

Reducing energy consumption is a critical component of any decarbonization strategy. According to the International Energy Agency, energy efficiency is the single largest measure to avoid energy demand in the net zero emissions by 2050 scenario. Not only is it a foundational tool for decarbonization, energy efficiency has an important role in enhancing energy security and affordability, and accelerating the clean energy transition. By improving the efficiency of building systems, organizations can significantly lower their energy use and associated Scope 1 and 2 emissions. Here are some key solutions and building systems that contribute to enhanced efficiency:

Building Envelope: The building envelope (walls, roofs, windows, doors) is the first defense against energy loss. Improving insulation, sealing leaks, and using energy-efficient windows can drastically reduce heating and cooling demand. These improvements not only lower energy consumption but also enhance occupant comfort and reduce operating costs.

HVAC: HVAC systems are among the largest energy consumers in buildings. Upgrading to high-efficiency HVAC systems, incorporating variable speed drives, and using energy recovery ventilators can greatly reduce energy use. Advanced systems that balance energy efficiency with air quality improvements create healthier, more comfortable indoor environments.

Water Management: Installing low-flow fixtures, implementing greywater recycling systems, and optimizing irrigation systems are effective strategies to reduce water consumption. Reducing hot water use through efficient upgrades also decreases energy for water heating, contributing to overall efficiency.

LED Lighting: Lighting accounts for a substantial portion of a building's electricity use. Replacing traditional lighting with LED fixtures can reduce energy consumption by up to 75% and LEDs last up to 25 times longer than traditional incandescent bulbs, which also reduces maintenance costs. In addition, when paired with smart lighting controls and sensors, the combination can continuously optimize energy consumption and savings.

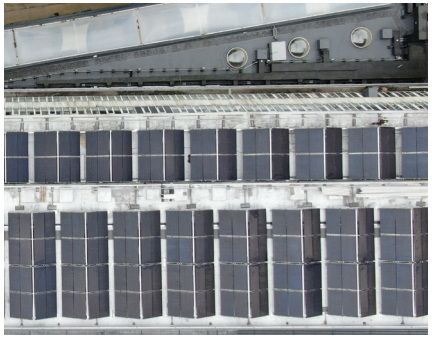
Building Automation Systems & Controls: Smart building automation systems optimize the operation of building systems in real-time, based on occupancy patterns and environmental conditions. These systems can control lighting, HVAC, and other building services to minimize energy use while enhancing comfort. Advanced controls and sensors enable precise monitoring and management of energy consumption, leading to significant efficiency gains and cost savings.

Thermal Energy Shifts

Field Tip #2

By incorporating these thermal energy solutions, buildings can transition away from high-carbon heating fuels and embrace cleaner, renewable alternatives.

Each solution offers unique benefits and can be tailored to the specific needs and constraints of different building. Similar to all solutions discussed in this guide, these are not one-size-fits-all – electrification or geothermal may not be the best choice for every environment, for example.



Transitioning to low-carbon thermal energy sources is a vital aspect of decarbonization in the built environment. Electrification of heating systems and integrating renewable energy resources offer a highly efficient and sustainable alternative to traditional fossil fuel-based systems. Additionally, fuel switching and the adoption of renewable fuels can significantly reduce scope 1 and 2 GHG emissions associated with heating and cooling. Here are some key solutions and building systems for thermal energy management:

Electrification: Electrification involves replacing fossil fuel-based heating systems with electric alternatives, such as heat pumps and electric resistance heaters. Heat pumps, which can be air-source or ground-source, are highly efficient and can provide both heating and cooling. By shifting to electric systems, buildings can leverage renewable electricity sources, further reducing their carbon footprint. Facilities can consider full or partial electrification, depending on what additional thermal energy resources are available regionally in their community.

Geothermal Systems: Geothermal systems use more stable temperatures below the earth's surface to provide heating and cooling. Ground-source heat pumps are a common geothermal technology that can be highly efficient and cost-effective over the long term. Geothermal systems reduce reliance on fossil fuels and can significantly lower operational emissions.

Solar Thermal: Solar thermal systems capture and utilize heat from the sun to provide hot water and space heating. These systems typically involve solar collectors installed on roofs or other sun-exposed areas. Solar thermal energy systems are a renewable resource that can drastically reduce the need for conventional heating fuels.

Renewable Natural Gas (RNG): Produced from organic waste materials through anaerobic digestion or other biogas upgrading processes, RNG can be used as a direct replacement for conventional natural gas in heating systems. RNG is a renewable and carbon-neutral alternative, helping to reduce emissions in buildings that currently rely on natural gas.

Biomass: Biomass energy systems use organic materials, such as wood pellets, agricultural residues, or dedicated energy crops, as fuel for heating. Biomass boilers and stoves can be integrated into existing heating systems. While biomass is considered renewable, it is important implement biomass systems sustainably to ensure net carbon benefits.

The Shift to Renewable Electricity

Transitioning to renewable energy sources for electricity is a cornerstone of any decarbonization strategy. In 2023, renewable electricity capacity additions reached an estimated 507 gigawatts – almost 50% higher than in 2022. The significant increase highlights the growing trend of building power plants with renewable energy sources, driven by continuous policy support in over 130 countries. Additionally, for the first time ever, wind and solar power have generated more electricity than coal through the first half of 2024. By adopting clean energy supply, buildings can significantly reduce their carbon footprint and craft a more sustainable energy system to evolve towards net zero. Here are key solutions and building systems for integrating renewable electricity:

On-Site Solar: On-site solar photovoltaic systems allow buildings to generate their own electricity from sunlight. Installing solar panels on rooftops, parking structures, canopies, or open land can provide a reliable source of clean energy, reducing reliance on grid electricity and lowering energy costs. On-site solar also offers the benefit of energy independence and resilience, especially when paired with battery energy storage systems, to address their intermittent nature.

Off-Site Solar: For buildings with limited space for on-site solar installations, off-site solar options provide a viable alternative. This can include purchasing solar power through power purchase agreements (PPAs) or participating in community solar programs. Off-site solar allows organizations to access renewable energy generated at larger, centralized solar farms, contributing to their decarbonization goals without the need for extensive on-site installations.

Battery Energy Storage Systems (BESS): As renewable energy is generated, it must be stored for future use. Battery storage is critical for managing energy demand and enhancing the reliability of renewable energy sources. BESS can store excess energy generated by on-site solar systems for use during periods of low sunlight or peak demand. This not only maximizes the use of renewable energy but also provides backup power during outages, improving the overall resilience of the building's energy system.

Electric Vehicle (EV) Charging Infrastructure: As electric vehicles become more prevalent, integrating EV charging infrastructure into building systems is increasingly important. When planning for EV charging, it is crucial to consider the electrical load and ensure that the building's energy system can support the additional demand, potentially integrating with on-site renewable energy and BESS to optimize energy use.

Field Tip #3

By leveraging renewable energy supply resources, buildings can make calculated headway towards scope 2 carbon reduction targets.

It is critical to consider how these solutions work together to deliver firm, reliable electricity.

Each solution can be tailored to the specific needs and capabilities of the building, creating a flexible and sustainable energy strategy that supports long-term decarbonization goals.

Solutions Beyond Building Walls

A portion of a building's scope 1 and 2 emissions may need to be supplemented with tools outside of controllable supply or demand. Additionally, scope 3 emissions, which often constitute a significant portion of an organization's total carbon footprint, are typically not addressed via building and infrastructure retrofits. Focusing on high-quality, locally impactful solutions can be supportive to a robust and credible strategy. To address the remaining GHG emissions and craft a reduction strategy, the following solutions could be considered:

Renewable Energy Certificates (RECs): These certificates represent proof that one megawatt-hour (MWh) of electricity was generated from a renewable energy source, and these are available for purchase. However, this approach can be controversial. Simply buying RECs can be perceived as a form of greenwashing if it doesn't result in actual reductions in local grid emissions. Purchasing RECs without integrating renewable energy into your local grid can damage your organization's reputation. Stakeholders may view it as a superficial measure rather than a genuine commitment to sustainability.

Offsets: Carbon offsets allow organizations to compensate for their emissions by investing in projects that reduce or remove an equivalent amount of greenhouse gases elsewhere. While useful, offsets run into a similar perception as RECs, and should be part of a comprehensive strategy that prioritizes direct emission reductions first. If considering carbon offsets, ensure you are selecting high-quality, verified projects that deliver real, measurable, and permanent emission reductions.

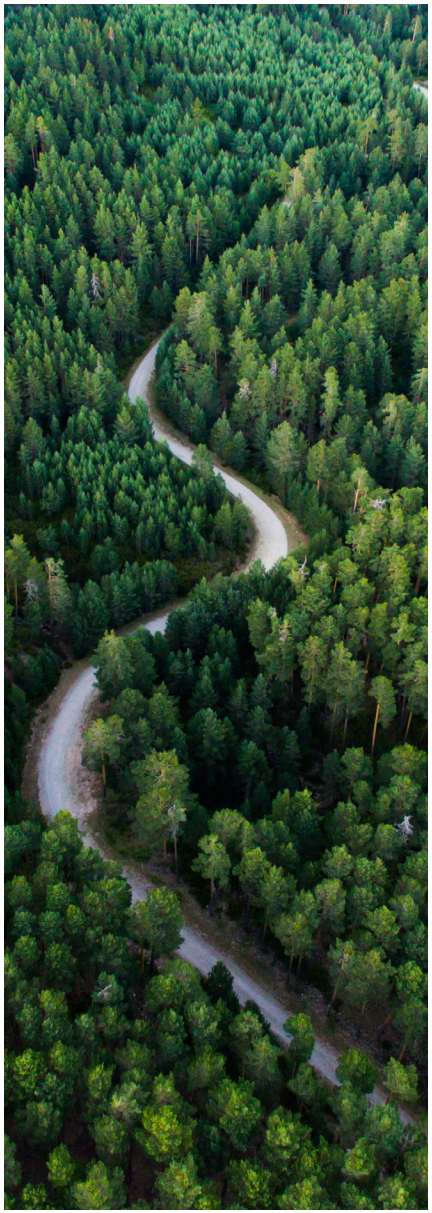
Carbon Removal: Carbon removal involves extracting carbon dioxide from the atmosphere and storing it in such a way that it cannot re-enter it. This can be achieved through various methods, such as reforestation, soil carbon sequestration, and direct air capture. For example, Carbon Capture, Utilization, and Storage (CCUS) reduces carbon dioxide from industrial processes and power generation by capturing emissions before they enter the atmosphere.

Did you know?

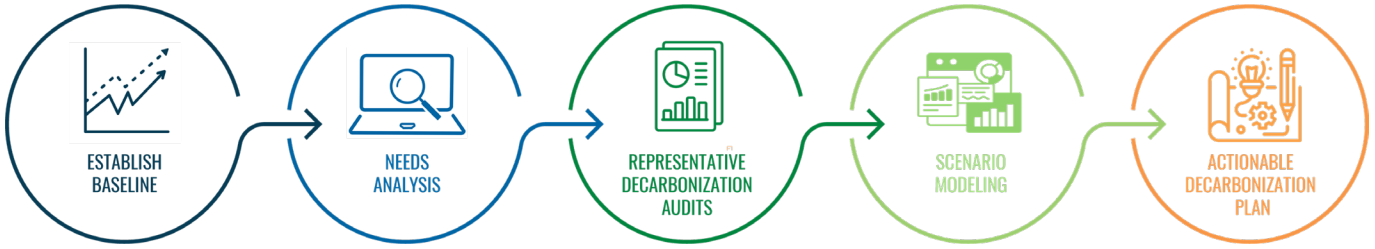
According to an IEA report, most of the reductions in CO_2 emissions through 2030 can be derived from technologies already on the market today. But through 2050, almost half the reductions come from technologies that are currently at the demonstration or prototype phase. While there is plenty that can be accomplished through emission reduction measures available today, we always must consider the role of future zero carbon solutions in our plans.

Keeping an open mind to available options at each stage of the decarbonization journey enables facility owners and operators to craft a solution best suited for their environment.

Assembling a Decarbonization Plan



Knowing where to begin is easily the biggest hurdle that organizations are facing right now. A comprehensive plan for reducing building emissions starts with a holistic review of existing building infrastructure and systems with a view towards adapting or upgrading major equipment over time. But with so many feasible options available, deciding which to prioritize can be a challenge. Establishing a baseline, analysis, measurement, and modeling will help to develop an actionable decarbonization plan.



Establish Baseline

The prerequisites for effective decarbonization planning include comprehensive information about building performance – such as historical energy consumption by utility type for each building (ideally at least three years' worth), a GHG inventory for scope 1 and 2 emissions, and a capital needs assessment covering deferred maintenance costs and projected lifecycles of building systems. This data is key to ensure effectiveness and needs to be developed before proceeding to the needs analysis. Establishing a robust GHG inventory from scratch takes time and a concerted effort among stakeholders, however, it is essential for formulating the baseline against which reductions will be measured.

Needs Analysis & Representation Audits

The purpose of data development and needs analysis is to categorize, benchmark, and prioritize the portfolio, enabling audits on a representative sample of buildings. This approach ensures that the audits reflect the entire portfolio. Once the representative buildings are agreed upon, then decarbonization assessments or audits can be conducted. These targeted audits will identify emissions reduction measures (ERM) that include and go beyond traditional energy conservation measures (ECM). The findings can then be scaled across the portfolio to similar building types or use cases.

Scenario Modeling

The next critical step involves the development and evaluation of several decarbonization scenarios to achieve both interim targets and long-term net zero goals. A scenario considers the packaging of measures and allows for the comparison of impacts, costs, and other key metrics for decision-making. The cost of decarbonization is an important consideration for building owners. The representative audits' findings can be assessed for deployment leveraging timely funding levers, or bundled and phased as building energy systems approach end of useful life.

Evaluating decarbonization solutions can be less polarizing when done within the context of scenario modeling. For example, while electrifying facilities is often perceived as an inevitable outcome, it is not always the most effective way to achieve emissions reduction goals. Hybrid or partial electrification can achieve significant carbon reductions at a fraction of the cost while continuing to leverage fuel-fired systems for peak demand events. A holistic approach considers all options and presents multiple scenarios to decision makers for consideration.

Deploying an Actionable Decarbonization Plan

Decarbonization plans typically span five to twenty-five years, depending on the organization's targets and commitments. The plan should be structured with "near term," "medium term," and "long term" stages and solutions. In the short term, the plan must be highly actionable, allowing facility owners and operators to make immediate progress on their goals and prioritize high-emitting buildings with the aforementioned levers. The medium to long term plan should present feasible and possible solutions, providing flexibility for technological adaptation and future changes.

Continuous engagement and iteration needs be integrated throughout each stage. Engaging both internal and external stakeholders ensures that social benefits or challenges are evaluated and captured alongside environmental and financial key performance indicators. Teaming with an expert partner can eliminate the guesswork and apply a systematic approach to bringing a decarbonization plan to fruition.

One remaining crucial element is communicating your efforts. Accurate data collection and transparent reporting are essential for tracking progress and demonstrating success. Data-driven reports that feature local benefits and community impact can assist other organizations in their sustainability journey.

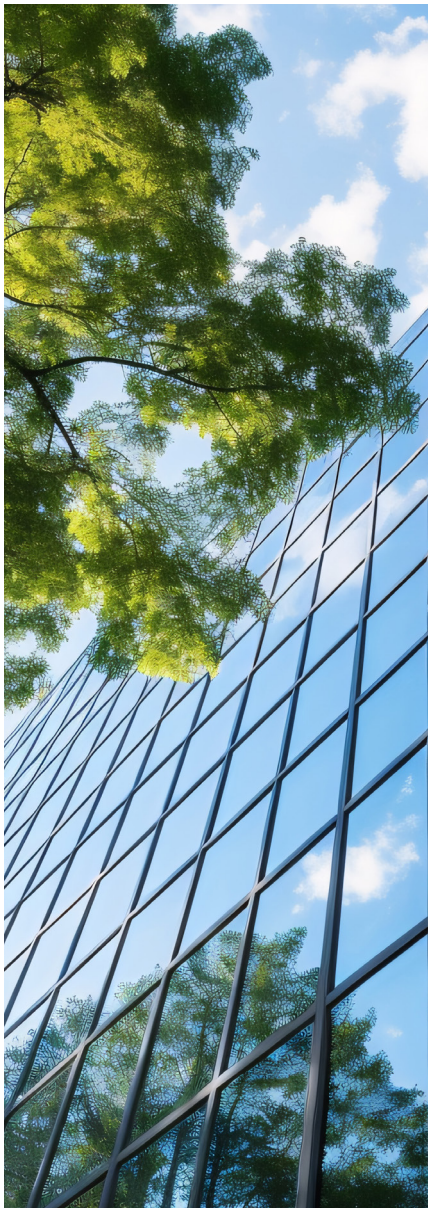
Field Tip #4

Recognize the ways in which projects create jobs, improve local air quality, contribute to community resilience.

Communicating these benefits can help build broader support for your initiatives and enhance the social value of your decarbonization strategy.

Regular reporting not only helps in assessing the effectiveness of your plan but also builds credibility and accountability with stakeholders.

Taking the Guide into the Field



This guide is meant to be exactly that – a reference guide for getting started with crafting a strategy to achieve net zero. As referenced, optionality is key when it comes to decarbonization planning. Data-backed decision-making and prioritization of resources are the crux of moving from a plan to action and progress. Remember: No two organizations' decarbonization plan will be the same given the many complex factors – from building age, geographic location, set of systems, net zero targets, supply and demand, to name a few.

It is critical that we keep options open for new developments in zero-carbon technologies and based on the continued monitoring of consumption, cost, and carbon data compared to baseline. In the meantime, consider these takeaways as you take your next step:

- **Set achievable goals**
- **Establish GHG inventory and baseline**
- **Understand the source of your GHG emissions**
- **Identify strategies to reduce consumption**
- **Switch to low-carbon energy sources**
- **Add renewables to your energy mix**
- **Build an actionable decarbonization plan**
- **Measure progress and continue to adapt and optimize your plan**

A successful decarbonization strategy is essential for any organization aiming to achieve sustainability goals andmake a positive impact on the environment and community. It is critical to identify a trusted partner in this journey, who stands ready to offer a comprehensive range of services tailored to meet an organization's unique needs at any stage of their decarbonization efforts. When provided with expert guidance, data collection and analysis, practical solutions, and a strong educational foundation, organizations are empowered to navigate the complexities of decarbonization with confidence.

Show the Way

Every organization's decarbonization strategy looks different but provides a clear and visual roadmap for data-based decision making. Navigating this journey is well suited alongside a partner who can assist in both crafting the roadmap and driving its solutions to completion.

Ameresco's approach to decarbonization is built on a foundation of client support across many industry verticals within the construction landscape. By meeting each organization where they are, engaging with them at any stage of the decarbonization journey, and providing tailored solutions to meet specific needs, a partner's guiding hand can offer the expertise and support throughout the entire decarbonization process, from initial strategy to project management to ongoing measurement.

As a full-service partner, Ameresco provides comprehensive services that cover every aspect of decarbonization, including strategy development, project execution, and continuous monitoring and adjustment. Our team of experts will meet you wherever you are in your decarbonization journey.

Get in touch today at www.ameresco.com/contact-us

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