Better Climate CHALLENGE
U.S. DEPARTMENT OF ENERGY

Action Plan

BETTER BUILDINGS TOOLKIT

A Guide for Creating a Building-Level Action Plan to Improve Energy Efficiency and Reduce Carbon Emissions

Prairie Trails School is the first zero energy renovated school in the United States that also meets the PHIUS+ Source Zero standard for using 40%–60% less energy than conventional buildings.[1] Photo from FGMArchitects @PeterMcCulloughPhotography

Click to download the
Action Plan worksheet
https://www.nrel.gov/docs/fy23osti/85708ActionPlanWorksheet.doc

[1] https://www.fgmarchitects.com/post/prairie-trails-school-first-in-nation-on-key-sustainability-benchmark

Low Carbon Pilot Partners

The U.S. Department of Energy recognizes the partners in the Better Buildings Low Carbon Pilot for their valuable contributions to this work. These partners provided significant input for the action plan guide based on their expertise and experience creating and implementing decarbonization strategies in their buildings.

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INTRODUCTION

Carbon dioxide equivalent (CO_2e) emissions include CO_2, methane, nitrous oxide, and other greenhouse gases (GHGs). Reducing the emissions that result from your building operations requires a planning process that begins with a goal or target (see HOW TO USE THIS GUIDE, page 6). Many organizations have set corporate-level goals to substantially reduce their carbon footprint, and many of these goals incorporate time frames.[2] Examples include:

- Reduce scope 1 and scope 2 emissions[3] by 50% in the next ten years
- Achieve carbon neutrality by 2040.

Scope 1 and scope 2 emissions are directly tied to the energy consumption of individual buildings.[4] In particular, significant reduction of scope 1 (direct consumption of fossil fuels in a building) requires eliminating or substantially curtailing the energy source responsible for the emissions, depending on your organization's environmental goals. There are a few broad strategies to consider as you work to reduce your buildings' CO_2e emissions.[5]

Develop an action plan. You can begin reducing CO_2e emissions by developing building-level action plans that identify and reduce operational CO_2e emissions from both on-site combustion and electricity consumption (Figure 1). The goal is to achieve low or no carbon status. It does not happen overnight, and often requires making a series of strategic decisions about how the building is operated and maintained. These action plans may include pathways to electrification to reduce or eliminate on-site fossil energy use as well as strategies to reduce embodied carbon.[6]

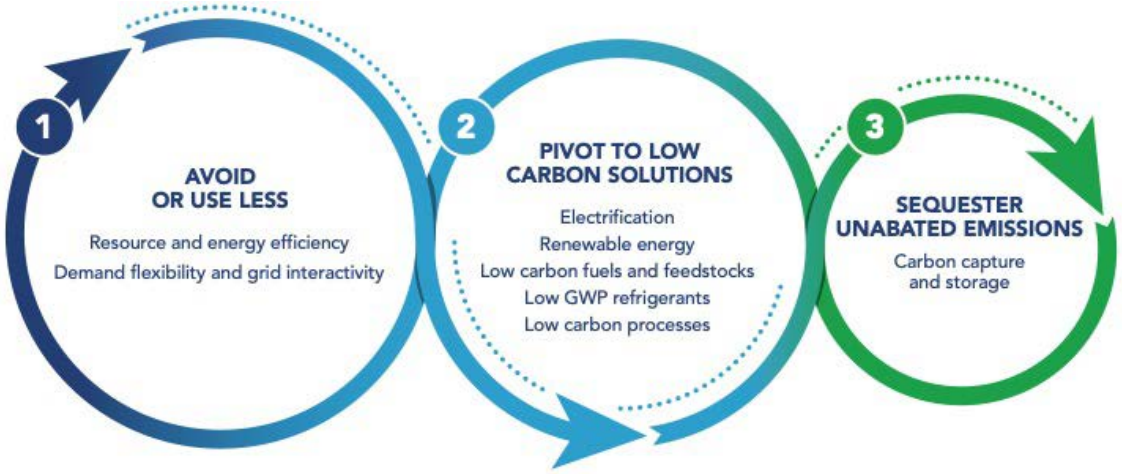


Figure 1. Reaching low carbon goals

Credit: U.S. Department of Energy

Once you establish an action plan with a goal or target, here are a few pathways to help you meet it.

[2] https://betterbuildingssolutioncenter.energy.gov/carbon-hub/erp
[3] https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance
[4] https://www.nrel.gov/docs/fy22osti/81670.pdf
[5] https://www3.epa.gov/carbon-footprint-calculator/tool/definitions/co2e.html
[6] https://www.nrel.gov/docs/fy22osti/83204.pdf

Increase energy efficiency. Making your building extremely energy efficient reduces CO_2e emissions by reducing the amount of fossil and other energy required to provide services such as lighting, heating, cooling, ventilating, and refrigeration. Improving energy efficiency also provides non-energy benefits, which include reduced energy costs, improved occupant comfort and productivity, and reduced operations and maintenance costs.[7] Suggestions for goals that encourage commercial building energy efficiency include:

- Reducing energy use by 40%–60% compared with a typical commercial building[8]
- Establishing energy use intensity targets that exceed an energy efficiency standard such as ASHRAE 90.1-2022[9]
- Measuring energy efficiency performance against targets in resources such as ENERGY STAR® Portfolio Manager[10] or the Advanced Energy Design Guides[11]
- Adopting and showcasing best practices.[12]

As Figure 2 indicates, the top priority in your carbon emissions reduction effort is improving the building's energy efficiency. Energy efficiency is usually the most cost-effective and least disruptive strategy for reducing energy use and carbon emissions and it enables other strategies.

For example, if you reduce a building's consumption by 50%, that doubles, on a percentage basis, the impact of the renewable energy you generate or purchase. If you're meeting 20% of your building's energy load with renewables and reduce that energy load by half through energy efficiency improvements, the renewables will now provide 40% of your energy without adding any more renewables.

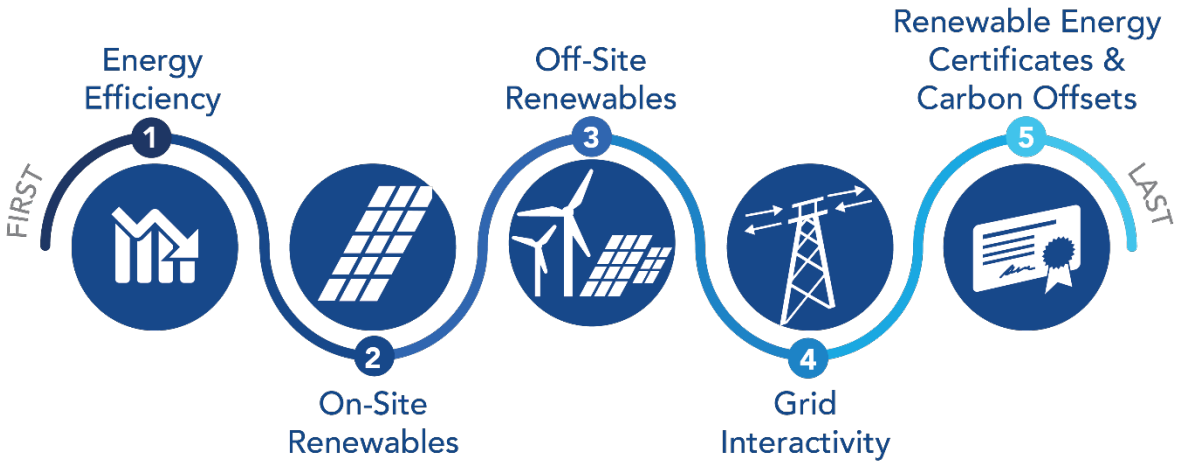


Figure 2. Priorities for achieving carbon emissions goal

Credit: Marjorie Schott, National Renewable Energy Laboratory

[7] https://energyefficiencyimpact.org/co-benefits-with-energy-savings/#Section11
[8] https://www.nrel.gov/docs/fy10osti/49213.pdf, https://www.nrel.gov/docs/fy20osti/77415.pdf
[9] https://www.ashrae.org/technical-resources/bookstore/standard-90-1
[10] https://www.energystar.gov/buildings/benchmark
[11] https://www.ashrae.org/technical-resources/aedgs
[12] https://www.epa.gov/climateleadership/ghg-reduction-programs-strategies

Pepper Construction's headquarters in Lockland, Ohio, is housed in a renovated historic building constructed in 1917. Designers incorporated sustainable design strategies that resulted in a zero energy and zero carbon office space. Photo from CMTA.

Choose low or no carbon energy supplies. Purchasing electricity from the grid often has carbon implications. While calculating the carbon impact of purchased electricity can be complex because it varies with time of day, total grid demand, and weather, there are opportunities to choose some low carbon energy supplies:[13]

- Providing low or zero operational carbon energy such as solar, wind, biomass, hydrogen, and generation with carbon capture. Ideally electricity is generated close to the site.
- Matching building energy consumption with renewable generation
- Purchasing new renewable energy through a utility or a bilateral contract[14] with an independent power producer; priority should be on directly purchasing renewable power that causes more renewables to be brought on to the grid—a process called additionality
- Using low carbon energy sources, carbon mitigation strategies, or offsets that create clear additionality.[15]

Become a grid asset. The carbon intensity of electricity from the grid varies by time of use, so buildings can reduce CO_2e emissions by interacting with the electric grid, being responsive to the availability of carbon-free electricity, and helping to minimize grid congestion. Opportunities include:

- Using storage that enables dynamic demand management
- Shifting loads away from peak power and carbon-intensive times
- Feeding renewable and other low carbon electricity onto the grid during high demand periods.

[13] https://www.cell.com/joule/fulltext/S2542-4351(19)30214-4
[14] https://www.sciencedirect.com/science/article/pii/S0167923621000245
[15] https://www.cambridgema.gov/-/media/Files/CDD/Climate/NetZero/2021planupdate/NZAP_5yr_update_draft_20211021.pdf

HOW TO USE THIS GUIDE

This is a guide to develop an action plan—feel free to adapt it to the needs of your audience, which may be owners and designers. The objective is to look at every building as an opportunity for carbon reduction and to create a plan to accomplish that reduction. The guide is divided into six steps:

1. Provide organizational profile and highlights

2. Set and track building-level goals

3. Select a building

4. Prioritize CO_2e emission reduction strategies and report data

5. Identify barriers

6. Develop CO_2e emission reduction implementation strategies

6.1 Energy efficiency

6.2 On-site renewables

6.3 Off-site renewables

6.4 Grid integration

6.6 Power purchase agreements and utility offerings

6.6 Offsets

The first section, **INSTRUCTIONS** (page 7) includes information, guidance, and examples of answers to help you fill out the blank **WORKSHEETS** in the second section (page 22)**.** A customizable Word file of the blank worksheets is also available (see link on cover page).

Don't worry about fields that are not relevant to your buildings or circumstances; just provide the information that pertains to your situation. In each worksheet, colored text is part of the worksheet template; black text is information about the selected building.

Energy efficiency is one of the most cost-effective, least disruptive sources of carbon and energy reduction. The **Prompt Questions for Completing Step 6.1. Energy Efficiency** can help you identify and prioritize energy efficiency upgrades.

If you are unfamiliar with or would like to know more about the terms and concepts used in this guide, please consult the **Glossary** as well as the sources in the footnotes**.**

INSTRUCTIONS

Step 1. Provide Organizational Profile and Highlights

Date: April 2023

Organization Name: ABC Investment Trust

Point of Contact (name, email): Jane Smith, Jane@ABCInvestmentTrust.com

Step 2. Set and Track Goals

What are your organization's carbon-related goals?

Provide your goals here. For example, "achieve a 50% reduction in carbon (equivalent) emissions by 2030."

More information on setting portfolio and organizational goals can be found on the Better Buildings Emissions Reduction Planning webpage.
https://betterbuildingssolutioncenter.energy.gov/carbon-hub/erp

What methods, tools, processes, and reporting platforms does your organization use to track progress toward these goals?

Describe your methods, tools, processes, and reporting platforms here. For example, you can use ENERGY STAR Portfolio Manager to measure and compare your building's energy use to similar buildings, past consumption, or a reference performance level.

How do these goals translate into facility-level improvements or targets; what are your implementation strategies?

Describe your implementation strategies. Step 6 will help answer this question.

Are there any other questions—and answers—that you think are important for framing the discussion about developing a low carbon action plan?

Add other questions and answers here that can help frame the discussion about a low carbon action plan.

Step 3. Select a Building

Briefly describe the building(s) you've selected. Note that you may focus on part of a building or a collection of buildings. Typically, the boundary of the building is defined by metering (either utility or owned by the organization). Meters may be for electricity, natural gas, or other services. For example, sometimes metering is based on fuel added to a propane or fuel oil tank. To identify issues and measure progress, it is important to measure all purchased energy flows.

Step 3. Select a Building Example

BUILDING	1 Front Street, Temperate Climate City, USA
YEAR BUILT	1975
BUILDING AREA (ft²)	620,000 ft^2 (32 stories)
BUILDING USE	Office, leased (all energy is billed to building—no tenant submetering)
ADDITIONAL INFORMATION DESCRIBING THE BUILDING'S HISTORY/NOTABLE CHARACTERISTICS	Already purchasing 100% renewable for electricity, sourced through utility sourcing program. Have scope 1 emissions[16] through on-site gas-fired boilers. Have large capital improvement plan to replace/rebuild chillers, and so this project could be used as an avenue to explore new technologies or approaches for eliminating the boilers and chillers and replacing them with heat pumps. These ideas could then be replicated in other buildings in the portfolio.

Briefly describe the building(s) you're using. Note that you may focus on part of a building or a collection of buildings.

Step 4. Prioritize CO_2e Emission Reduction Strategies and Report Data

There are many ways to reduce CO_2e emissions, notably improving energy efficiency, sourcing renewable energy, and purchasing carbon offsets. Energy efficiency is a strategy that owners and designers directly control and one that has a high impact on emissions.

To prioritize the different pathways for reducing CO_2e emissions, you can quantify possible carbon and energy savings in your building(s) by listing them as indicated in the example worksheet below. You can also include information such as energy data from the last year or other content that helps inform your current state of reducing energy use and CO_2e emissions in "Other."

[16] https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

Step 4. Prioritize CO_2e Emission Reduction Strategies and Report Data Example

CATEGORIES IN PRIORITY ORDER	SOURCE OF CARBON/ENERGY REDUCTION	STRATEGY	CARBON/ENERGY REDUCTION GOAL (%)
Avoid or use less fossil energy	**Energy efficiency improvements**	**See Step 6.1. Energy Efficiency Example**	**30%**
Adopt low carbon/energy strategies	Beneficial electrification[a]	Heat pumps replace chillers/boilers	10%
	On-site renewables (owned)	50 kW of photovoltaics (PV) covering 50% of roof	1%
	Off-site renewables (owned)	3.1 million kWh after electrification of heating (with heat pumps) and energy efficiency[b] improvements	39%
	Grid integration, load shifting, and storage		N/A
	Power purchase agreements (on-site or off-site)		N/A
	Utility offerings		N/A
	Other		N/A
Offsets			**5%**
Total carbon/energy reduction			**85%**
Unmet carbon load			**15%**

Broad categories for reducing carbon/energy

The percentage of carbon/energy reduction attributable to adopting low carbon/energy solutions in the example building

Possible sources of carbon/energy reduction with an emphasis on energy efficiency

Specific strategies for carbon/energy in this column

Purchasing offsets is a strategy when efficiency and renewable energy techniques are not sufficient to meet goals.

The remainder that cannot be met by renewable and carbon free sources or offsets.

It may be possible to offset some of the remaining load by purchasing carbon offset credits. Each of these transferable instruments represent an emission reduction of one metric ton of CO_2 or an equivalent amount of other GHGs.[17] Ideally, other reduction strategies would be used first. If offsets are used, they should be reevaluated over time as new technologies and strategies could be deployed to improve energy efficiency or electrify systems. In addition, the grid's carbon emissions will change with time.

Finally, the "unmet carbon load" is the remainder that cannot be met by renewable and carbon free sources or offsets.

Often one category influences another. If you improve your building's energy efficiency and already have renewables, for example, the impact of those renewables increases as energy efficiency reduces energy use. If, for example, you're meeting 20% of your building's energy load with renewables and you reduce that energy load by half through energy efficiency improvements, the renewables will now provide 40% of your energy without adding any more renewables. Electrifying all gas loads also produces some emissions reductions and enables those loads to be met with off-site renewables.

In this example, on-site renewables only meet a small fraction of the load because the available roof space is small compared to the floor area and the building's energy efficiency hasn't been optimized. If the owner improves the building's energy efficiency, the fraction of the load met by renewables would increase. The percentage contribution of off-site renewables can be estimated by determining the building loads and then meeting some of that load with purchased or owned off-site assets. Other low carbon solutions (grid integration, load shifting, storage, power purchase agreements, utility offerings, and others) are listed to raise awareness of these strategies, but their contributions to the overall carbon/energy reduction is difficult to calculate and not included in this example (listed as N/A).

Table Notes:

[a] Beneficial electrification includes strategies that support the goal of reducing CO_2e emissions such as replacing heating, ventilating, and air conditioning (HVAC) systems with electric heat pumps.

[b] Requires heat pumps to be used for heating. The owner is currently purchasing 3.9 million kWh. Electrification using heat pumps will increase the electrical load, but energy efficiency will more than offset this increase, resulting in a decrease of purchased energy from 3.9 million kWh to 3.1 million kWh.

Include information such as energy data for the last year or other content that helps inform your current state of reducing energy use and CO_2e emissions.

[17] https://www.offsetguide.org/understanding-carbon-offsets/what-is-a-carbon-offset/

Step 5. Identify Barriers

On a scale of 1–5, with five being a major barrier and one being a minor barrier, select the barriers that your organization faces when implementing low carbon strategies. In the comments field, provide details about your organization's top two or three barriers. To get you started, here are common barriers identified by partners when implementing low carbon strategies.

Step 5. Identify Barriers Example

BARRIER	HIGH LOW RATING (1–5)	COMMENTS
Financing	2	Combine investments beyond the energy project
Access to data and information	1	Have comprehensive energy data through up-to-date utility data on ENERGY STAR Portfolio Manager[18]
Data analysis and reporting	1	Use ENERGY STAR Portfolio Manager and measurements for data quality checks and analysis
Measuring carbon reductions	1	Use ENERGY STAR Portfolio Manager's provided emission factors to calculate scope 1 and scope 2 emissions[19]
Engaging employees, occupants, and customers	3	Need to discuss and convince the asset managers of buildings
Partnering with utilities	2	Utilities can help by providing incentives, but program rules should be carefully followed.
Operational challenges	3	Comfort issues are always a concern, as is maintaining balance in the HVAC system due to the high static pressures
Moving to electrification	5	Technology options appear to be limited due to the size of the existing HVAC system.
Adding renewables	3	Need a strong case for on-site renewables, as it would be a very small fraction of the total building load
Other (add rows as appropriate)		

Minor barrier

Major barrier

Provide details about your organization's top barriers.

[18] https://www.energystar.gov/buildings/benchmark
[19] https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

Step 6. Develop CO_2e Emission Reduction Implementation Strategies

Please provide details about your implementation strategies in the Step 6 worksheets, which relate to energy efficiency, on-site renewables, off-site renewables, grid integration, power purchase agreements and utility offerings, and offsets. The energy efficiency example (Step 6.1) details the specific strategies that yield the high-level percentage totals in **Step 4. Prioritize Carbon Reduction Strategies and Report Data** (page 9) worksheet. In this section, you can address how to identify and incorporate the strategies most relevant to your situation.

6.1 Energy Efficiency

How do you plan to incorporate energy efficiency measures into your low carbon strategy? One way to identify energy efficiency opportunities is to look for existing building issues (the third column in the Step 6.1 worksheet) and then develop a solution that reduces energy consumption (the fourth column in the Step 6.1 worksheet). Fill in column 3 (BUILDING PROBLEMS OR ISSUES) first, then provide a potential solution in the next column followed by a next step. If the solution is unknown, however, the next step might be to hire a consultant to investigate solutions that solve the immediate problem and reduce energy consumption at the same time.

For example, if occupants report cold and drafty conditions near windows and walls (column 3, BUILDING PROBLEMS OR ISSUES), consider the solution of sealing areas of high infiltration (column 4, POTENTIAL SOLUTIONS). This resolves the issue and improves the building's efficiency and comfort. Finally, provide a high-level description in column 1 (STRATEGY). The second column can be used to prioritize the list, if desired. It is possible to create this list in a spreadsheet and copy to a document.

An energy efficiency strategy does not need to address an issue in the building to be included in the worksheet. Some strategies may include upgrading equipment that is fully serviceable; the strategy may be implemented for the sole purpose of reducing energy consumption.

In general, envelope issues are addressed first, followed by plug and lighting loads. Daylighting can be considered to reduce lighting energy use. After loads are reduced, HVAC systems can be evaluated based on a load calculation with the building improvements, which will make it possible to size the system properly.

Here is an example of energy efficiency strategies cited by other partners to get you started.

Step 6.1. Energy Efficiency Example

STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
Improve thermal characteristics of windows	High	Existing window film is failing; thermal comfort issues from single pane windows	Install insulated glazing panels inside existing windows with permanent tinting (for example, low-e coatings)	Investigate insert panels' cost and ability to solve overheating and save energy (energy analysis)
Reduce window-to-wall ratio	Low	High window-to-wall ratio leading to elevated heating and cooling loads, reduced thermal comfort, and glare	Add opaque, high thermal performance (R-20) insert panels in lieu of all transparent inserts; insulate interstitial spaces to improve thermal performance	Investigate cost of opaque insert panels and examine interstitial spaces to determine ability for adding insulation; probably most cost-effectively done during a tenant fit-out
Insulate roof deck when replacing roof	Low	Roof membrane installed in 10/2003 with an estimated 25-year lifespan (target replacement in 2028)	Insulate roof deck to R-30 and design to accommodate ballasted PV system if structure allows	Retain a design firm for replacing roof including R-30 insulation and membrane; investigate whether concrete roof structure will allow ballasted PV system installation considering the wind loading for a tall building
Reduce infiltration	High	Occupants report cold and drafty conditions near perimeter windows and walls	Identify and seal areas of high infiltration, such as building corners and where unlike materials join	Commission a blower door test, even for a few select floors, during tenant fit-out to identify infiltration levels; determine cost of providing envelope air sealing and implement; document infiltration savings such that this information can be used to size HVAC equipment
Create plug load management program	Medium		Work with tenants to create incentive programs to save energy through plug load management	Examine daily plug load usage profiles including sleep modes and unoccupied power usages. Identify realistic plug load peak densities. This information is also important to carry forward into sizing HVAC system equipment when equipment replacement is necessary.
Create computer purchase policy	Medium		Move to all laptops with ENERGY STAR settings enabled.	Work with IT to determine policy criteria and timelines for effective implementation; create a plan to replace all systems within 3 years with laptop computers with ENERGY STAR setting enabled

STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
Reduce interior lighting power density (LPD)	High		Replace all lamps with LEDs and minimize the LPD	Calculate the current LPD and compare with the current *Advanced Energy Design Guide*[20] guidance for office buildings; evaluate lighting levels to confirm consistency with Illuminating Engineering Society[21] recommendations; create a plan using LED lamps and consider financing opportunities with an energy service company through utility billing

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

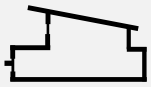
If financing is a barrier, visit the Better Buildings Financing Navigator[22] to explore financing options. Use the "Ref" columns in the worksheets for your own abbreviations or sequential numbering to cross reference strategies.

Prompt Questions for Completing Step 6.1. Energy Efficiency

Reducing energy consumption in buildings requires a look at many different building subsystems. Creating the worksheet in Step 6 requires a long list of ideas, and energy audits can help uncover items of interest. Many audits are performed by energy auditors who use a standard form for evaluating a building. ASHRAE Standard 211 is a consensus-based standard that can provide meaningful direction to determine the pathways for reducing energy consumption. An ASHRAE Level 2 audit is a good starting point and can be tailored to provide pathways for decarbonization. More detail can be found in the Audit Checklist.[23,24]

Here is a set of prompt questions to help you identify the energy-saving opportunities in your building.

[20] https://www.ashrae.org/technical-resources/aedgs
[21] https://www.ies.org/standards/
[22] https://betterbuildingssolutioncenter.energy.gov/financing-navigator
[23] https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Emissions_Reduction_Audit_Checklist.pdf
[24] https://buildingenergyscore.energy.gov/

Building Topic	Prompt Question
Envelope 	Are there any window issues? What are the thermal characteristics of the windows (include number of glazing layers, reflective coatings, low-e coatings, etc.)? Compare with current ENERGY STAR window specifications.[25]
	What is the construction of the walls? What is the level of insulation in the wall system? What percentage of the exterior wall area do windows take up? Can the window area be reduced without substantially impacting daylighting or views?
	Does the roof insulation meet or exceed current codes? What is the level of roof insulation?
	Has the building had a blower door test? Is there a strategy to reduce infiltration? Does the building feel drafty?
Plug Loads 	If the space has tenants, are there mechanisms in place to educate occupants and encourage plug load savings?
	What type(s) of computers do occupants use? Do they have the ENERGY STAR settings deployed? (Note that the same question applies to other equipment and appliances in the building, including copiers, refrigerators, etc.)
Lighting 	Are light fixtures 100% LED or are the LEDs more than 10 years old? What is the LPD of the building (or zones in the building) and how do they compare to current energy standards?
	Do lights automatically turn off in the building? Do motion sensors have false triggering?
Controls 	Does the building effectively "set back" during unoccupied hours?
	Is daylighting available in areas within 15 feet of a window or skylight? When the building is vacant are the lights off?
HVAC 	Do you use natural gas in the building? (If so, do you have a list of natural gas appliances?)
	Are the HVAC run times (especially maximum run times outside of morning warm-up/cooldown) known?
	Is outside air controlled by CO_2 or occupancy levels? This would be in addition to economization for "free" cooling.
	What is the temperature of the supply water used for heating? What is the loading of the coils and heating plant? (What is the hourly profile of heating provided by the heating plant? Can you determine the maximum heating load at each zone?)
	Are fossil fuels used for heating? Have all the heating sources been identified? Create multiple lines for each heating device and identify what is needed to switch to heat pump solutions.

[25] https://www.energystar.gov/products/residential_windows_doors_and_skylights/key_product_criteria

Building Topic	Prompt Question
	What is the cooling plant? If chilled water, is the tower wet or dry? What temperature is needed for supply? Does this temperature reset with outside temperature?
	Can fossil fuel heating load be reduced with heat pumps?
	Are pneumatics used for controlling actuators? What is the condition of the pneumatic system? Can electric actuators be considered as a replacement?
	Are there any direct expansion cooling systems installed, including mini-splits? What is the refrigerant? Do the systems have refrigerant leaks—i.e., have they been recharged? Is there a plan to retire refrigerants with a high global warming potential or that contribute to ozone depletion?
	Is there other HVAC equipment being used, including mini-splits, dehumidifiers, humidifiers, etc.?
	What is the outside air and/or exhaust delivery system? Is it controlled by occupancy levels?
	What is the configuration of the air system? What documentation is available on the sequence of operations?
	How can the static pressure of the air system be reduced?
	What is the configuration of the water system? What documentation is available on its sequence of operations?
	Does the building have any circulator pumps for heating or cooling?
Domestic Hot Water 	What type of hot water system does the building use?
	Does the building have a recirculation hot water system? If it does, is it necessary?
	Does the building have low flow shower heads that meet the U.S. Environmental Protection Agency's WaterSense[26] requirements?
Plumbing 	Are all toilet fixtures WaterSense compliant?
Storage 	Do you currently use energy storage (thermal, battery, etc.) to reduce peak demand? If not, how could storage be incorporated into the building?

[26] https://www.epa.gov/watersense

Building Topic	Prompt Question
Renewables 	Do you have on-site renewable power? If not, has the site's renewable power potential been evaluated, especially for solar PV?
	Do you currently purchase renewable power?
Electric Vehicles 	Do you have electric vehicle charging stations? If yes, are they able to charge at different rates based on signals from the utility or the building automation system, i.e., are they "smart"?
Other	What changes can you make as part of a tenant improvement allowance, refurbishment for a new tenant, etc.?
	How will legislation impact your strategies? This may prompt additional strategies or a fresh look at some previous questions.

Step 6.2. On-Site Renewables

How do you plan to incorporate on-site renewables into your low carbon strategy? For guidance, visit the Better Buildings Renewable Energy Resource Hub.[27]

Here is an example of on-site renewables to get you started.

Step 6.2. On-Site Renewables Example

Ref	STRATEGY	PRIORITY	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
PV1	Roof-mounted PV	Low		Install PV on 10,000 ft^2 of roof area for roughly 50 kW	Investigate cost system and determine if concrete roof structure will allow ballasted PV system installation

Use the "Ref" columns in the worksheets for your own abbreviations or sequential numbering to cross reference strategies.

Step 6.3. Off-Site Renewables

How do you plan to incorporate off-site renewables into your low carbon strategy?

Here is an example of off-site renewables to get you started.

[27] https://betterbuildingssolutioncenter.energy.gov/renewables

Step 6.3. Off-Site Renewables Example

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
	Off-site PV	Low	Renewable energy certificates involve financial outlay without any actual return on investment	Own a local PV farm to provide renewable electricity at a cost less than or equal to purchasing renewable energy certificates and electricity	Investigate what possibilities are available through a solar developer and whether the prices are competitive with the utility offering, including any tax incentives and other utility rebates

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Step 6.4. Grid Integration

Grid integration can refer to the ability to shift building loads to minimize fossil fuel usage. Examples include controls that shift the use of equipment to off-peak times or use energy storage for shifting when the building requires electricity from the grid. How do you plan to use grid integration and/or storage in your low carbon strategy?

Here is an example of grid integration strategies to get you started.

Step 6.4. Grid Integration Example

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
	Precool building	Medium		Precool building to shift load and reduce peak demand as well as carbon impacts	Program energy management system to drop temperature a few degrees when low carbon power is available on the grid (typically 10 a.m. to 2 p.m.) and increase the set point later in the afternoon to reduce peak demands; note that needs to be coordinated with any reheat
	Add thermal storage	Low		Provide hot water tanks and water/ice storage for chilled water	Increase temperature on domestic hot water tanks when either low carbon power is available or when building demand is low; same for charging chilled water tanks

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
	Use existing thermal storage	Medium		Set electric water heaters to only heat water between 10 a.m. and 2 p.m. to coincide with renewable generation	Study building load to identify when the building's peak demand occurs (include any renewable energy generation on the customer side of the meter. This could also be controlled by the utility for load shifting. Ideally the peak load would coincide with solar generation as a carbon free energy source for heating water.)

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Step 6.5. Power Purchase Agreements and Utility Offerings

How do you plan to use power purchase agreements or work with your local utility to reduce CO_2e emissions?

Here is an example to get you started.

Step 6.5. Power Purchase Agreements and Utility Offerings Example

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
	Purchase renewable energy certificates and other contracted renewables	High			Currently purchase off-site renewables at around 3.9 million kWh annually; reassess post electrification of heating fuels (space heating and domestic water heating)

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Step 6.6. Offsets

How do you plan to incorporate offsets into your low carbon strategy?

Here is an example to get you started.

Step 6.6. Offsets Example

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR
	Purchase offsets	Low			Ideally, you would meet targets with other strategies. Offsets can be when few other options exist. Over time, they should be reevaluated as new technologies are developed.

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Acronyms

CO_2e	carbon dioxide equivalent
GHG	greenhouse gas
HVAC	heating, ventilating, and air conditioning
LPD	lighting power density
PV	solar photovoltaics

Glossary

additionality. Indicates energy sources that generate power from new renewable energy sources that would not have occurred otherwise and that can provide evidence of reducing GHG emissions.[28]

carbon dioxide equivalent. Carbon dioxide equivalent or CO_2e indicates the number of metric tons of CO_2 emissions with the same global warming potential as one metric ton of another GHG.[29]

carbon offset. A reduction in GHG emissions or an increase in carbon storage (by, for example, restoring land or planting trees) that is used to compensate for emissions elsewhere; a carbon offset credit is a transferable instrument representing an emission reduction of one metric ton of CO_2 or an equivalent amount of other GHGs.[30]

global warming potential. A measure of how much energy the emissions of 1 ton of a GHG will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2), which is used as the reference gas.

greenhouse gases. GHGs absorb energy and slow the rate at which the energy escapes into space, which has the effect of warming the planet.[31]

power purchase agreement. An arrangement in which a third-party developer installs, owns, and operates an energy system on a customer's property.[32]

renewable energy certificates. Tradable environmental commodities that can be traded separately from wholesale electricity markets.

scope 1 emissions. Direct GHG emissions that occur from sources that are controlled or owned by an organization.[33]

scope 2 emissions. Indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling.[33]

[28] https://www.cambridgema.gov/-/media/Files/CDD/Climate/NetZero/2021planupdate/NZAP_5yr_update_draft_20211021.pdf
[29] https://www3.epa.gov/carbon-footprint-calculator/tool/definitions/co2e.html
[30] https://www.offsetguide.org/understanding-carbon-offsets/what-is-a-carbon-offset/
[31] https://www.epa.gov/ghgemissions/understanding-global-warming-potentials
[32] https://betterbuildingssolutioncenter.energy.gov/financing-navigator/option/power-purchase-agreement
[33] https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

BLANK WORKSHEET

ENERGY AND CARBON ACTION PLAN FOR <building>

Red text is used in this document to show prompts for users. For your final action plan, this text can be deleted. Black text can be used as stock text and can be rewritten to meet your needs or deleted.

Step 1. Organizational Profile and Highlights

Date:

Organization Name:

Point of Contact (name, email):

Step 2. Energy and Carbon Goals

This section can be rewritten as a paragraph or can be answers to these questions. Feel free to expand and add your own questions.

What are your organization's carbon-related goals?

What methods, tools, processes, and reporting platforms does your organization use to track progress toward these goals?

How do these goals translate into facility-level improvements or targets; what are your implementation strategies?

Are there any other questions—and answers—that you think are important for framing the discussion about developing a low carbon action plan?

Step 3. Building Description

This section describes the selected building, and may focus on part of a building or a collection of buildings. Typically, the boundary of the building is defined by metering (either utility or owned by the organization). Meters may be for electricity, natural gas, or other services. For example, sometimes metering is based on fuel added to a propane or fuel oil tank. To identify issues and measure progress, it is important to include all purchased energy flows.

BUILDING ADDRESS	
YEAR BUILT	
BUILDING AREA IN SQUARE FEET (NUMBER OF STORIES)	
BUILDING USE	
ADDITIONAL INFORMATION DESCRIBING THE BUILDING'S HISTORY/NOTABLE CHARACTERISTICS	

Step 4. Pathway for Carbon Dioxide Equivalent Emission Reduction Strategies

There are many ways to reduce carbon dioxide equivalent (CO_2e) emissions, notably improving energy efficiency, sourcing renewable energy, and purchasing carbon offsets. Energy efficiency is typically the most cost-effective, least disruptive source of carbon/energy reductions. This section quantifies possible carbon/energy savings in the selected building.

CATEGORIES IN PRIORITY ORDER	SOURCE OF CARBON/ENERGY REDUCTION	STRATEGY	CARBON/ENERGY REDUCTION GOAL (%)
Avoid or use less fossil energy	**Energy efficiency improvements**	**See Step 6.1. Energy Efficiency Example**	
Adopt low carbon/energy strategies	Beneficial electrification[a]		
	On-site renewables (owned)		
	Off-site renewables (owned)		
	Grid integration, load shifting, and storage		
	Power purchase agreements (on-site or off-site)		
	Utility offerings		
	Other		
Offsets			
Total carbon/energy reduction			
Unmet carbon load			

[a]Beneficial electrification supports the goal of reducing CO_2e emissions; replacing HVAC and electric resistance heating systems with electric heat pumps, for example.

<additional text for explanations and further descriptions of table contents>

Step 5. Barrier Identification

This section includes barriers the organization faces when implementing low carbon strategies. The barriers are ranked on a scale of 1 to 5, with five being a major barrier and one being a minor barrier. Details on the top 2 or 3 barriers are provided in the comments field.

BARRIER	HIGH LOW RATING (1–5)[a]	COMMENTS
Other (add rows as appropriate)		

[a]5 indicates a major barrier and 1 indicates a minor barrier

Step 6. CO_2e Emission Reduction Implementation Strategies

Details about implementation strategies, which relate to energy efficiency, on-site renewables, off-site renewables, grid integration, power purchase agreements and utility offerings, and offsets, are provided in the sections below.

Step 6.1. Energy Efficiency

The top priority in the carbon emissions reduction effort should be improving the building's energy efficiency. Energy efficiency is usually the most cost-effective and least disruptive strategy for reducing energy use and carbon emissions and it impacts other strategies. This section details the specific strategies that yield the high-level percentage totals in the **Pathway**

for Carbon Dioxide Equivalent Emission Reduction Strategies worksheet. This section incorporates the strategies most relevant to the selected building.

STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTION	STEPS FOR THE NEXT YEAR

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Step 6.2. On-Site Renewables

This section describes how to incorporate on-site renewables to reduce CO_2e emissions in the selected building(s). The Better Buildings Renewable Energy Resource Hub provides guidance.[34]

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Step 6.3. Off-Site Renewables

This section describes how to incorporate off-site renewables to reduce CO_2e emissions in the selected building(s).

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

[34] https://betterbuildingssolutioncenter.energy.gov/renewables

Step 6.4. Grid Integration

Grid integration refers to the ability to shift building loads to minimize fossil fuel usage. Examples include controls that restrict the use of some equipment to off-peak times or switch to energy storage to reduce the amount of electricity the building requires from the grid during peaking periods. This section describes how to use grid integration and/or energy storage to reduce CO_2e emissions in the selected building(s).

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR

[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Step 6.5. Power Purchase Agreements and Utility Offerings

This section describes how to use power purchase agreements or work with the local utility to reduce CO_2e emissions.

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[a]Priority is defined as HIGH—immediate issues to solve; MEDIUM—good payback and other benefits; LOW—needs more study, higher cost/longer payback

Step 6.6. Offsets

This section describes how to incorporate offsets to reduce CO_2e emissions in the selected building(s).

Ref	STRATEGY	PRIORITY[a]	BUILDING PROBLEMS OR ISSUES	POTENTIAL SOLUTIONS	STEPS FOR THE NEXT YEAR

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