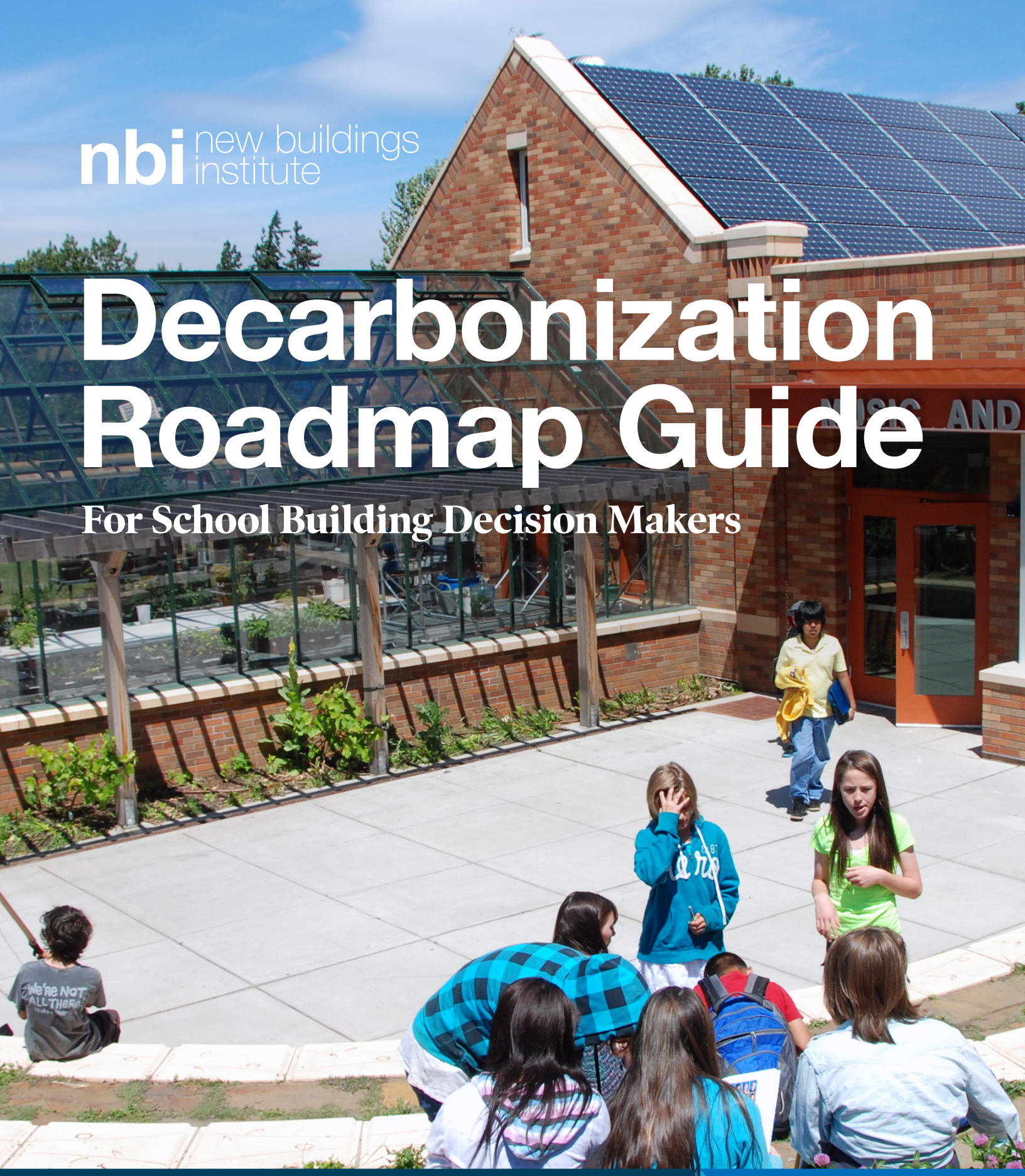
nbi new buildings institute

Decarbonization Roadmap Guide

For School Building Decision Makers



GETTING TO zero

APRIL 2022

Hood River Middle School Music and Science Building | Hood River, OR | Credit: Michael Mathers

Acknowledgements

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Introduction

We are witnessing the consequences of rapid, widespread, and intensifying climate change. Our students are demanding a more hopeful and sustainable future, starting with better environments than the aging, unhealthy, and underfunded school buildings where they currently learn.

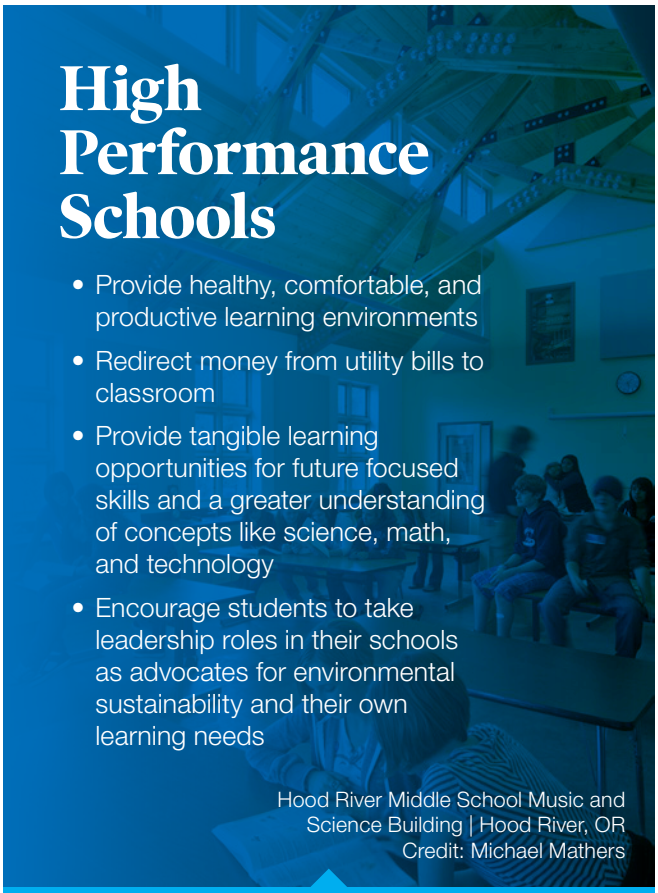
In addition, the COVID-19 pandemic has brought attention to aging HVAC systems and what is necessary to create healthy indoor environments without the penalty of increased utility bills. This combination of factors is inspiring school districts to address health, student experience, and carbon emissions from schools in a holistic way. As a major form of public infrastructure that spans buildings, land, and transportation fleets, school systems offer an opportunity for emissions reductions that also positively impact the health, wellness, and resiliency potential of entire communities.

The Benefits, Challenge and Opportunity in Schools

K-12 schools are the training ground for future leaders. Schools have the potential to shift mindsets towards sustainability and prepare youth to confront the climate challenges and opportunities of the future. One recent study found that if only **16 percent** of high school students in high- and middle-income countries were to receive climate change education, we could see a nearly 19 gigaton reduction of carbon dioxide by 2050.

Schools and educational facilities represent the **third largest sector of commercial building energy usage** in the United States. School building energy consumption costs K-12 school districts in the United States more than **$12.5 billion per year**. This results in emissions equivalent to **18 coal-fired power plants per year**.

Although school buildings are a significant opportunity, they often suffer from inadequate funding, competing priorities, and overburdened staff. Despite these challenges, an increasing number of school districts across the country have invested in energy efficient and healthy school buildings. These districts were able to dramatically improve energy performance, provide healthy indoor environments, and foster better academic outcomes for students. Long before COVID-19 increased awareness about the air quality inside our buildings, many experts have touted the **measurable benefits** of healthier indoor environments and thermal comfort present in these **high performing schools**.



High Performance Schools

- Provide healthy, comfortable, and productive learning environments
- Redirect money from utility bills to classroom
- Provide tangible learning opportunities for future focused skills and a greater understanding of concepts like science, math, and technology
- Encourage students to take leadership roles in their schools as advocates for environmental sustainability and their own learning needs

Hood River Middle School Music and Science Building | Hood River, OR
Credit: Michael Mathers

For research confirming the benefits of high performance schools, including a great summary article which can be shared with stakeholders, please see the Toolbox in the Stakeholder Engagement section.

What is a Decarbonization Roadmap?

A decarbonization roadmap identifies cost effective strategies and approaches to achieve net zero greenhouse gas emissions across a portfolio of buildings. A roadmap lays out a vision of how a school district will transition buildings in their portfolio to be healthy, efficient and carbon neutral. It outlines long term goals, sets interim targets, and explains how they will be achieved.

Carbon neutral schools are healthy, energy efficient buildings with no on-site gas combustion. Getting to zero over time at the portfolio level requires attention to decisions in individual buildings. Specific events in a building's lifecycle are seen as opportunities for improvement in a zero over time approach. Having a set of performance goals set in advance allows districts to take advantage of new construction, major modernizations, system retrofits and equipment replacement projects as they occur.

Getting to Zero Over Time

Getting to zero over time is a concept that ensures the district has the correct tools in place, such as goals or guidance documents, to address a building lifecycle event—such as new construction, modernization, or retrofits—in a way that aligns with the district's long-term energy and carbon reduction goals.

This approach can be customized for districts of any size, no matter where they are in the process. This Decarbonization Roadmap Guide and associated Roadmap Planner builds off the lessons of others to support and accelerate you through the process of getting to healthy, efficient, carbon neutral schools.

Many K-12 school districts are already implementing strategies and approaches commonly addressed in a decarbonization roadmap. More than a dozen districts have adopted and more are in the process of drafting formal resolutions that declare a climate emergency and an intention to be carbon neutral. You can find an updated list of these districts here. Other districts may not have a resolution, though they may be benchmarking performance, spearheading a carbon neutral or zero energy construction project, or publicly reporting energy performance of buildings. Many districts also tie healthy, efficient, carbon neutral facilities to education, using buildings themselves as tools in educating students. In some cases, students are driving the information gathering and analysis process, taking charge of the reporting to the school board.

FIGURE 1: DECARBONIZATION ROADMAP TO GET TO ZERO OVER TIME IN K-12 SCHOOLS

Specific events in a building's lifecycle are opportunities for decarbonization. Having a set of portfolio-wide goals set in advance allow districts to take advantage of new construction, major modernizations, retrofits and system replacement projects as they occur to assist in reaching their carbon neutral goals.

Finding Your Way to Resources that Support Roadmap Development

Other documents, templates and tools associated with this Decarbonization Roadmap Guide are available to support school districts in their effort to decarbonize. Each of these is described or referenced throughout the guide and identified through the icons below. These tools and resources include:

Roadmap Planner

Accompanying this guide is an interactive Roadmap Planner, available in Microsoft Excel format. The Roadmap Planner spreadsheet provides a place to organize a district's decarbonization efforts. It has detailed work plans that can be customized to guide the roadmap development efforts. The Roadmap Planner also includes spreadsheet reporting templates that make it easy to summarize and share results with stakeholders.

Sections specific to the Roadmap Planner in this Decarbonization Roadmap Guide will be indicated by the green roadmap wayfinding icon. This highlights a reference particular tab in the Roadmap Planner spreadsheet where checklists, data collection forms, and action plans can be customized.

Download the planner

Toolbox

The toolbox at the end of each section provides links to the resources mentioned in the section and may include other useful resources.

Templates

Accompanying this guide are **templates that districts can customize**. They include:

- Template Resolution to Establish Goals for Energy Efficiency, Clean Energy and Carbon Neutrality
- Template Owners Project Requirements
- Template Sustainability Checklist
- Template Building Energy Data and Characteristics Collection Form
- Template Bond Criteria for Healthy, Energy Efficient, Carbon Neutral Schools
- Template Team Interview Questions for Carbon Neutral Projects
- Template District Sustainability Report

Using the Decarbonization Roadmap Guide

This Decarbonization Roadmap Guide is designed for school districts stakeholders that are interested in healthy, efficient, carbon neutral schools. It lays out achievable goals and actionable steps to decarbonization in school district portfolios.

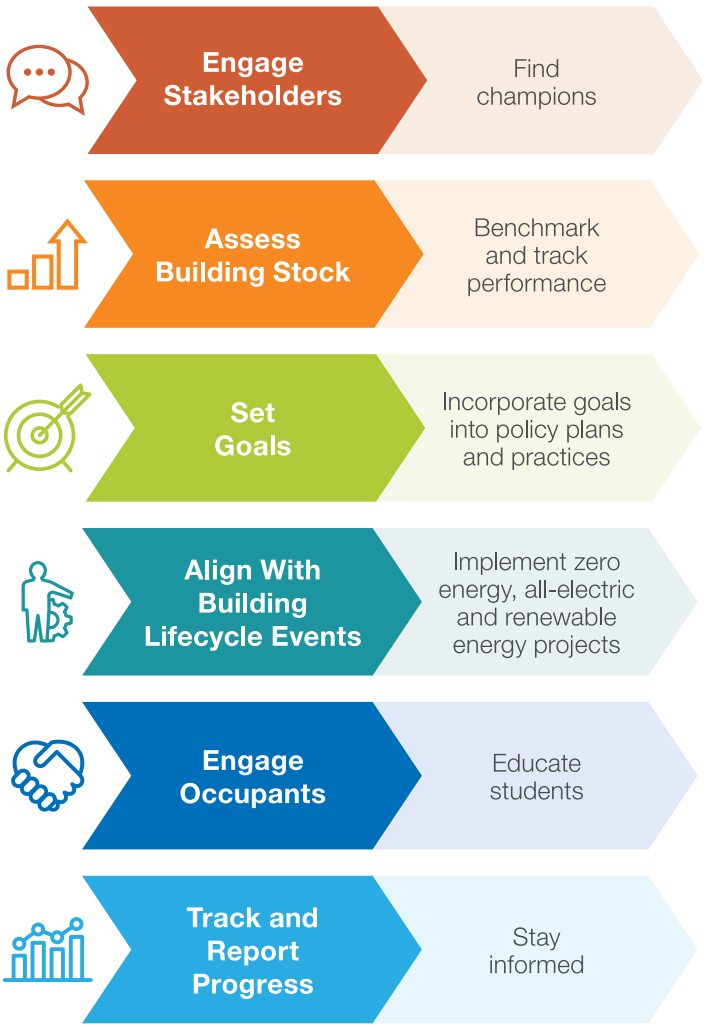
Since districts are likely to be at different phases on this path to carbon neutrality, the intent is to meet districts where they are, no matter where they are in the process. Common actions are not necessarily sequential, and they may take a slightly different order than what is laid out here. In addition, not all steps will apply to all districts.

While school districts have limited funds and bandwidth, they can use the framework outlined in this Decarbonization Roadmap Guide to set justifiable standards of performance, engage in actions to operationalize these practices across the district, and take proactive steps toward this ambitious goal. This guide and associated planner provide key elements for that roadmap, outlining goals and approaches to consider when key building lifecycle events occur.

This guide explains common actions that school district stakeholders take when implementing their decarbonization plan. They include the categories listed in Figure 2 at right.

Along with these common actions, this guide explains various plans and documents that should include references to carbon neutral schools, but often do not. These might include Board Resolutions, Facility Master Plans, Owners Project Requirements (OPRs), Request for Proposals (RFPs), and Operational Policies among others.

FIGURE 2: COMMON ACTIONS AND OUTCOMES IN SCHOOL DECARBONIZATION



Who Should Use this Guide?

This Decarbonization Roadmap Guide can be utilized by anyone interested in achieving carbon neutrality in a school district. It is written with public schools in mind, though it could be used for private schools as well. Different stakeholders within a district are likely to interact with this framework in different ways. For example:

- A **school board member** or **student group** might leverage the template resolution for carbon neutral facilities to establish a formal district policy regarding carbon neutral schools.
- District **sustainability managers** might use the goals to influence new construction and major modernization projects or customize the action plans in the Roadmap Planner to organize specific steps and actions to help the district decarbonize.
- **Facility managers** may use this guide and workbook to help benchmark buildings and inform goals. The Roadmap Planner will be helpful to collect, organize and store information about the district's facilities and equipment, including energy and emissions data.
- School **administrative staff** or **teachers** may use this guide to understand the STEAM (Science Technology Engineering Art and Math) opportunities associated with school buildings or they can use the Excel workbook to track and report energy performance in their own schools.

No matter what your role, we suggest you read through the steps below and identify where the district is and what parts of the process are most applicable for your circumstances.

A key outcome of a decarbonization roadmap is a portfolio of fully decarbonized buildings.

Passage of a resolution that formalizes declaring the district's commitment to healthy, carbon neutral facilities by a time certain date is a key first step in the process.

A template Resolution to Establish Goals for Energy Efficiency, Clean Energy and Carbon Neutrality can be found **here**.

Getting Started

The plans, policies, and practices discussed in this guide provide a useful framework for roadmap planning. Often, it is relatively inexpensive to include energy and carbon as parameters among other considerations during the facility master planning, building assessments, and procurement policies. Districts should consider what is already happening and how energy and carbon emission reduction can be integrated in routine district operations.

Before initiating the process of roadmap development, it is important to assess what has already been done by taking stock of current stakeholders, activities, and buildings in the district as they pertain to sustainability, energy, and/or carbon emissions. An initial data dive, sometimes called a "stock take", is helpful to uncover relevant plans, goals, and policies as they currently exist in the district. The stock take examines where the district is with energy and emissions in buildings, and what has been done to date. Documents to Inform the Stock Take includes a list of documents to that can be collected during the stock take to inform the roadmap.

Discovery Elementary School | Arlington, VA
Credit: VMDO

Customize the Roadmap

This Decarbonization Roadmap Guide offers sample action plans that can be customized based on where the district is in the process. For example:

If your district is just getting started:

- ❑ Take stock of what has already been done regarding energy and emission reductions in buildings
- ❑ Invite internal stakeholders to a decarbonization team meeting to discuss what you know about buildings and energy performance in the district's portfolio
- ❑ Benchmark performance and report back to school board
- ❑ Consider a carbon neutral resolution
- ❑ Establish decarbonization goals for the district if they don't already exist

If your district is constructing a new school or modernizing an old one—then be sure to:

- ❑ Establish and use individual building goals in the request for proposal for the design team
- ❑ Ask the design team how they will meet the goals in the interviews
- ❑ Have an owners project requirement document to guide the construction process

If your district is considering issuing a bond for construction:

- ❑ Estimate design and construction costs based on choices that consider decarbonization goals
- ❑ Create an owners project requirements or reference the ASHRAE K12 Zero Energy Advanced Energy Design Guide in estimating
- ❑ Establish a prohibition on fossil gas burning appliances and systems in new construction projects

If your district wants to link students to the building they are in:

- ❑ Provide them with access to building benchmarking accounts
- ❑ Teach them how to chart their progress toward individual building and portfolio goals
- ❑ Give them tours of the equipment used in the school
- ❑ Ask them to report what they have learned to the school board

Common Actions to Develop a Building Decarbonization Roadmap

While school districts come in all shapes and sizes, most have a set of common actions when engaging in decarbonization efforts. This guide explains those common actions and provides suggested action plans to support implementation efforts.

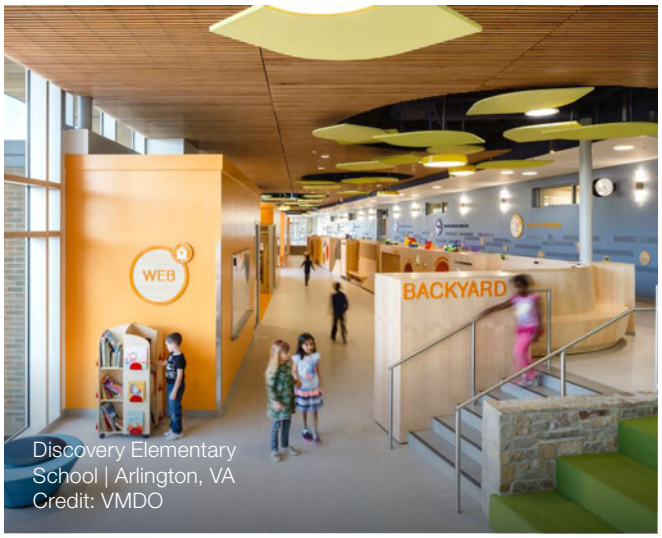
Redding School of the Arts | Redding, CA
Credit: TRILOGY Architecture

Stakeholder Engagement

Engaging with school district stakeholders raises awareness of the value of healthy, high performance school facilities. Understanding these benefits along with the drivers that motivate decision makers is helpful when communicating with stakeholders. While student educational outcomes are the primary driver of most school stakeholders, upon closer inspection, it becomes clear that each stakeholder has a unique perspective. Framing messages with their priorities, needs and perspectives in mind is helpful. For audiences that are not technical, focusing on outcomes, rather than the technological approach for achieving decarbonization, may be a more successful strategy.

Although stakeholders may vary slightly from district to district, and the final decision maker may change, they are usually a similar group of decision makers and drivers. Some examples of the stakeholders common to this process, their role in decarbonization process, and their drivers is below. You can find a full matrix of these stakeholder in **Appendix B: Common Stakeholders and Their Roles in Carbon Neutrality**. You can also find a robust set of relevant key messages for decarbonization that may be influential to various school district stakeholders in our Key Messages for Communicating About Carbon Neutral Schools.

Stakeholder engagement is a continual process and evolves over time. As school stakeholders change, new stakeholders will need to be introduced to the roadmap. Existing stakeholders who are already supportive will want to know how the plan is progressing toward its decarbonization goals.



Discovery Elementary School | Arlington, VA
Credit: VMDO

Roadmap Planner Table 2

Stakeholder Engagement Workplan. This sheet in the Roadmap Planner can help you develop a work plan for your stakeholder engagement activities.

Stakeholder engagement comes in many forms. Here are some activities to consider and some are described further.

- Identify champions and stakeholders.
- Establish a Decarbonization Team.
- Formulate key messages and share benefits of carbon neutral schools.
- Undergo a visioning process with stakeholders to envision their ideal carbon neutral school.
- Share state and local government policies related to decarbonization goals.
- Share case studies of healthy, energy efficient, carbon neutral buildings.
- Organize tours of efficient and zero energy schools nearby.
- Draft and present a carbon neutral school building resolution for School Board review. A template can be found **here**.
- Utilize local media to highlight carbon neutral resolution.
- Post information about carbon neutral schools, including the final resolution on the district's website. *Tip: Make it easy to find and visual! It is important that this information does not get buried too far in the district website.*

TABLE 1: SCHOOL DISTRICT STAKEHOLDERS, DRIVERS, AND MESSAGES FOR SCHOOL BOARD MEMBERS, SUPERINTENDENTS, AND CHIEF BUSINESS OFFICIALS

Role	Role in Decarbonization Process	Drivers
School board members, Superintendents, and CBOs are the primary decision makers and financial managers for school districts and school facilities. They routinely seek input from the community, students, staff, and a wide range of consultants in decision-making.	Votes of school board members and leadership from Superintendents and CBOs represent final decisions on many topics critical to school facilities including adoption of goals and resolutions for carbon neutrality, and final approval on construction budgets.	Excellence in education for every child at every level by focusing on quality instruction, educational outcomes, healthy school buildings, sustaining an equitable culture, and ensuring the financial health of the district.

Find Champions

A champion is someone who continually refocuses the team on health, energy, and carbon goals. The champion may be a staff member such as a Sustainability Manager, Facility Manager, or even a Superintendent—though they may also be a trusted consultant, architect, construction manager or even a committed board member.

The role of the champion is to generate enthusiasm and commitment among stakeholders for the district's energy and carbon emission reduction goals. The champion helps to raise awareness and educates other stakeholders and decision makers to gain widespread support for the getting to zero over time process. This person will be present or delegate representation for important meetings or events. They are there to ensure that energy and carbon considerations are included in decision making criteria and processes throughout.

It is helpful for the champion to be familiar with the benefits of healthy, efficient schools and can clearly communicate these to various stakeholder groups. Champions also highlight the local, state and federal policy context around carbon neutral buildings in their district.

Establish a Decarbonization Roadmap Team

The roadmap team is a subgroup of stakeholders, often including representatives from each department impacted by roadmap goals. This ensures that the perspectives, needs, and potential contributions of their department are considered. Over time, the team will work together to develop and implement the roadmap work plan.

Roadmap Planner Table 3

Champion and Team Members. This sheet in the Roadmap Planner spreadsheet can be used to track staff from each district department and their contact information.

Potential Decarbonization Roadmap Team Members

- Champions
- School Business Officer or Official
- Superintendent or Assistant Superintendent
- Facilities and Grounds
- Planning and Construction
- Maintenance and Operations
- Sustainability
- Information Technology
- Transportation
- Communications
- Kitchen and Nutrition Services

Regular meetings with the team provide an opportunity to incorporate input into the roadmap development, review information collected in the stock take, discuss projects, compare lessons learned, and share success stories across departments regardless of traditional operational or budgetary divisions. Establishing this formal mechanism for communications among departments and staff in the context of energy performance can lead to significant new initiatives, ideas, and approaches that support broad progress toward district goals.

Roadmap team members are an important group of stakeholders who will work together to learn more about healthy, energy efficient, and carbon neutral buildings. They are responsible for efforts to reduce energy use within their departments and spheres of influence. For example, those involved in facility management, renovations or new construction might share best practices that can be leveraged elsewhere in the school district. Involving the information technology group can lead to impactful reductions in energy consumption because networked devices, servers, and other computing equipment uses a significant amount of energy and may offer scalable efficiency opportunities. The presence of the finance department is critical to help establish criteria for investment and it may be where utility bills are sent. Each department brings its own purpose and perspective, and other departments can learn from those inputs and take those lessons to their own operations.

Many school districts have found that meeting monthly or quarterly is efficient and productive. In some cases, it may make the most sense to have a smaller group meet monthly and report out to a larger group quarterly or annually. When establishing meeting schedules and invitees, consider budget cycles and facilities master planning process timelines to ensure that energy is considered at the optimal time in the process to allow for effective implementation.

Roadmap Planner Table 4

Energy Team Workplan. The Roadmap Planner includes activities and a work plan to serve as a starting place for Roadmap Team activities.

South Tahoe High School | South Lake Tahoe, CA
Credit: LPA Inc.

A Tale of Two Stakeholder Timelines

School districts with different needs and priorities often take independent approaches to engaging stakeholders in their carbon neutral goals. Below are two examples of how districts of varying sizes and climate zones forged their own paths to carbon neutrality.

Salt Lake City School District went through several years of stakeholder engagement. Eventually, it was a student-led petition that finally encouraged the school board to unanimously pass a resolution. Set in 2020, the resolution establishes the goal of transitioning the school district to 100% clean electricity by 2030, and off fossil fuels by 2040.

In comparison, **Lake Tahoe Unified School District** adopted the 2021 LTUSD Energy and Carbon Goals Resolution over the course of a six month period. The LTUSD resolution pledges to achieve deep energy and carbon emission reductions in its school buildings. Subsequently, the District has adopted technical "Guiding Standards" to work towards achieving carbon neutrality in all construction projects going forward. LTUSD is currently developing a five-year plan with an energy services company to aggressively drive down energy consumption and carbon emissions in the portfolio.

Stakeholder Engagement Toolbox

Utilize these resources to help support Stakeholder Engagement.

- Key Messages for Communicating About Carbon Neutral Schools
- A Guide to Zero Energy and Zero Energy Ready K-12 Schools
- Getting to Zero School case studies
- Getting to Zero Buildings Database
- An Insider's Guide to Talking about Carbon Neutral Buildings
- Dreaming the Future: How Zero Net Energy Design Can Transform the School Environment

Assess the Portfolio

A portfolio assessment characterizes the buildings and facilities in the school district. Benchmarking involves tracking water, energy consumption, emissions, and cost in each building and facility. This data helps to establish a baseline from which to measure performance. A facilities master list is helpful to outline each building and where it is compared to its performance target as set in the goals section. By tracking and analyzing measured energy performance, benchmarking can lead to informed decision making.

Master Facility List

A master list of facilities inventories buildings owned or leased by the school system, number of students, program type (elementary, middle, high), physical characteristics, system types, and equipment update schedules. Ongoing tracking existing equipment, including age and condition, enables and streamlines the implementation of equipment efficiency and performance standards. A master facility equipment list can support decisions to replace equipment before it fails. Replacing units early can minimize maintenance and repair cost and avoids last minute expensive emergency equipment repairs and replacements. In addition, some programs provide financial incentives to replace and upgrade equipment that is near the end of its life, but not upon failure.

Roadmap Planner Table 5

Master Facilities List in the Roadmap Planner is where to start to track and continually update your facility equipment information.

The Kathleen Grimm School for Leadership and Sustainability | Staten Island, NY
Credit: SOM

Benchmarking

Benchmarking is the process of tracking a building's performance. This allows for comparison to its peers as well as to itself over time. For energy and emissions, this includes accounting for energy usage from sources such as grid-purchased electricity, onsite renewable generation, gas combustion, district energy, and delivered fuels. It should be done for individual buildings and at the portfolio level and is seen as a first step in taking action that leads to energy and cost savings for school districts.

At an individual building level, benchmarking is useful for comparison of a building's current and past performance to itself. Benchmarking in this way can identify and control performance issues, allowing district staff to uncover performance drift so it can be quickly remedied. Tracking building energy use over time can allow facility managers to identify the impacts of maintenance work, capital improvements, or operational changes such as set points or lighting controls. In addition, capital project managers will be interested to see a comparison of predicted versus actual performance in new construction projects.

The Kathleen Grimm School for Leadership and Sustainability | Staten Island, NY
Credit: SOM

Buildings benchmarked over a three-year period showed an average of 2.4% annual savings in energy, according to information from the U.S. Environmental Protection Agency.[1]

At the portfolio level, benchmarking is used to compare similar buildings, which can highlight opportunities for potential savings. Where one building has undergone an equipment replacement or retro-commissioning, those savings opportunities will become visible and may be a good fit for peer buildings.

Benchmarking must be based on consistent and accurate data sources. Collecting and organizing the initial data often takes more time than is expected, but once set up, benchmarking becomes a routine process. The champion or facility manager may be responsible for developing and updating the master list of facilities and doing quality control on benchmarking data. By working with individual department directors, this person can ensure that all buildings in the portfolio are listed, meters are appropriately accounted, and data are accurate.

Care must be taken to ensure that meters are associated with the correct building and that all meters are represented. Submetering may be necessary to inform how individual systems are using energy. The champion or another staff member can also coordinate with the local utility to collect bill information. This may also present an educational opportunity for high school students to help collect and input this information. Utility staff might be able to help in gathering and transferring utility bill data into tools like ENERGY STAR Portfolio Manager—some utilities have an automatic data transfer protocol.

ENERGY STAR® Portfolio Manager®

The U.S. EPA's ENERGY STAR Portfolio Manager tool is a free resource for tracking energy consumption. It can help assess baseline energy performance and track building energy data from individual school buildings and across the entire portfolio of buildings.

The following data for each school is necessary for benchmarking with ENERGY STAR Portfolio Manager:

- Property Name
- Property Address
- Total Gross Floor Area of Property
- Irrigated Area
- Year Built/Planned for Construction Completion
- Occupancy

1 EPA Energy Star Portfolio Manager Benchmarking and Energy Savings Data Trends available at https://www.energystar.gov/sites/default/files/buildings/tools/DataTrends_Savings_20121002.pdf

- Number of Buildings (for campuses)
- 12 consecutive months of energy data for all fuels
- High School Number of Workers on Main Shift
- Weekend Operation
- Cooking Facilities
- Percent That Can Be Heated
- Percent That Can Be Cooled

Relevant account information that should be tracked includes:

- Login and Password
- Data Update Cadence
  monthly, quarterly, annually
- Portfolio Manager Quality Control Staff
  This could be someone from the energy team or another district staff member. Sometimes it is even an administrative person as they may be the one who receives the actual energy bills.
- Portfolio Manager Data Entry Staff
  This could be someone from the energy team, administration, another district staff member, or even a student group!
- Data Source
  If the data does not come from your team, be sure to note who or where to get it from. For example, in some districts energy bills go to the financing department and in others they go to the facilities department. Some data also may come directly via an online platform from the utility.

After the energy tracking system is set up in ENERGY STAR Portfolio Manager, the district should commit to keeping the benchmarking and equipment list tracking updated. Roles, responsibilities, and expected timing should be clear.

Roadmap Planner Table 6

Benchmarking Account Information is where Energy Star Portfolio Manager, USGBC ARC or other relevant account information can be stored so that it is readily available to the team.

Establish a Baseline

A baseline defines a starting place. It leverages benchmarking data and documents energy performance and carbon emissions in the school district's facilities for a specific year. This baseline year is then used for future comparisons and to track changes over time. The baseline year ideally is a specified time in the past for which your district has a complete dataset on its buildings, but not 2020 or 2021 since the COVID-19 pandemic had a significant impact on typical operations for many school districts. The baseline is an important part of the goal setting process. This is discussed and utilized in practice in the Portfolio Goals section.

Benchmark and Tracking Toolbox

Utilize these resources to help support school district benchmarking and tracking.

Energy Star Portfolio Manager

U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) ARC Platform

U.S. Green Building Council Learning Lab

Template Building Energy Data and Characteristics Collection Form

Sample online dashboard

- San Francisco Unified School District
- Portland Public Schools
- Fairfax County Public Schools

Set Goals

Turkey Foot Middle School | Edgewood, KY
Credit: Piaskowy and Cooper

The primary mission of school districts is to educate students. While facilities are a means to this end, many districts have found ways to weave healthy buildings, energy efficiency and carbon emission reduction goals into their mission, even using the buildings themselves as learning tools. Having goals established in advance can save the district money. Across the country, ambitious zero energy and carbon neutral school construction is being **delivered on conventional budgets** and schedules thanks to upfront planning and target setting.

Goals might be documented in an internal policy, a school board resolution, or facility plan report. Goals set at the portfolio should also be reflected the individual building level. The baseline set in the portfolio assessment is useful to inform goals and targets, especially for existing buildings. A zero over time approach makes this achievable for any district.

Roadmap Planner Table 7

Building-Related Sustainability Goals, note any current building-related goals in your district, when they were passed, and where they are formalized or documented.

Sustainability goals can be written in a variety of ways.

For example, school districts might reference voluntary standards such as the **Sierra Club's 100% Clean Energy School Districts, National School Climate Standards**, the **USGBC's Leadership in Energy and Environmental Design**, or the **Collaborative for High Performance Schools** (CHPS). Decarbonization goals can be layered with these goals, often making it easier to achieve green building certification standards.

Getting to Zero Over Time

Getting to zero over time is a concept that outlines building goals and procedures in advance so that districts can capitalize on every project in the future as an opportunity for goal achievement. As buildings undergo lifecycle events—including large scale projects like new construction, modernization and retrofits, down to small scale projects like individual equipment replacements—they can use these goals to drive the design and construction process.

FIGURE 3: GETTING TO ZERO OVER TIME IN K-12 SCHOOL DISTRICT DECARBONIZATION GOALS

This is a summary of the high level building construction goals for the different building life cycle events described in more detail in the following section.

New Construction:

- Achieve LEED, CHPS, or another broad sustainability goal
- Be energy efficient and achieve a site energy use intensity of 17-25 kBtu/square foot/year
- Be all-electric and have no on-site fossil gas combustion
- Incorporate renewable energy sources to offset annual electricity use
- 5 total air changes per hour (ACH) for high indoor air quality
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete)
- Utilize low global warming refrigerants
- Integrate electric vehicle (EV) charging and fleet infrastructure
- Consider grid harmonization and battery storage

Major Modernization:

- Achieve LEED, CHPS, or some other sustainability goal
- Achieve a site energy use intensity of 25-35 kBtu/square foot/year or better
- 5 total air changes per hour (ACH) for high indoor air quality
- Eliminate on-site gas combustion or have a plan to eliminate gas by a target year signed off by the department director
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete),
- Utilize low global warming refrigerants

Retrofits:

- Improve the site energy use intensity by a minimum of 20%, targeting 50% from a YEAR *(decide on baseline year from benchmarking data. 2019 or 2018 suggested)* baseline.
- Include a written plan for future removal of all gas-combusting equipment, specify low global warming potential equipment and low embodied carbon materials

System Replacement:

- Phase out gas infrastructure where possible incorporate efficient, all-electric systems.

Documenting energy and carbon reduction goals in advance of events in a building lifecycle can save districts money.

Research has demonstrated that starting early with goals and clear energy targets is key to cost management. Decarbonization in new construction goes further, saving significant first costs by eliminating any extension to the gas infrastructure. Savings can be reinvested in the building's exterior shell and more efficient systems.

Decarbonization Goals and Targets

Decarbonization goals commit a school district to transitioning their portfolio of buildings away from fossil fuel combustion and toward healthy buildings served by 100% renewable electricity by 2045 or some year in the future. It requires that districts consider how actions at individual buildings, and systems within those buildings, contribute to the overarching portfolio goals. Achieving decarbonization in facilities will require attention to electrification—specifically addressing the elimination of equipment that burns fossil gas, often found in heating, water heating, and kitchen loads.

Long-term goals should have interim targets that break the long timeframe into realistic segments. This will allow for calibration based on progress toward the future goal. When operationalizing long term goals, targets can be set for specific building lifecycle events—new construction, major modernization, system replacement, or equipment replacement. Goals and targets can also be set for individual aspects of decarbonization, such as efficiency, electrification, renewable energy, and embodied carbon associated with materials.

Energy efficiency goals are often expressed in Energy Use Intensity (EUI) targets. Achievable EUIs are between 17-25 kBtu per square foot per year for new construction in individual K-12 school buildings. At the portfolio level, the calculated baseline provides a starting place from which to track improvement. Districts participating in the Better Building Challenge commit to improving the energy efficiency of their portfolio of buildings by at least 20% over 10 years. Often, savings of greater than 20% is possible with early goals and target setting. Evaluating this will require that benchmarking is updated regularly for comparisons.

Electrification goals address how fossil gas combustion will be phased out over time. This can be done by eliminating gas in capital projects and through a planned phase out over time. Ultimately, the goal of a decarbonized school district portfolio is the elimination of gas combustion over time.

Renewable energy goals can be incorporated into broader facility decarbonization goals. In major construction projects, it is recommended that photovoltaic systems are included as an "add alternate" in the design and construction process. During the design process, an add alternate is a direction to the design team to include considerations of future photovoltaic in the design, and the construction team to estimate how much it costs so the district can make an informed decision. This preserves the opportunity for future renewables at very little cost or effort to the district.

Each district has a different strategy and goals for renewable energy generation in the portfolio. Some districts have solar arrays that generate renewable energy. These projects redirect money spent on utilities, but they create maintenance needs, so they have an ongoing cost as well. Another option is a Power Purchase Agreement (PPA), where a third party develops, operates, and maintains a solar array on school property, while selling power back to the district at a fixed price. A PPA often has tax credits available to the developer. Stories about different approaches to solar in schools can be found on the Solar for All Schools website.

The life cycle materials in construction also creates significant carbon emissions in projects. In fact, building materials and construction accounts for 11% of global energy-related carbon emissions. As buildings eliminate onsite fossil gas and become more efficient, the embodied carbon in the materials used to construct buildings constitutes a growing share of life cycle carbon impact. Buildings can be required to be constructed with lower embodied carbon materials and with components intended to be reusable or recyclable at the end of their application in the building. You may want to consider developing goals for the high embodied carbon materials (like steel and concrete) and utilize low global warming potential refrigerants.

Portfolio Goals

Goals require clear ways to measure progress. The baseline leverages benchmarking data and documents energy performance and carbon emissions in the school district's facilities for a specific year. This baseline year is then used for future comparisons and to track changes over time. Ideally, it is a specified time in the past for which your district has a complete dataset on its buildings. For many of the example below we have suggested using a 2019 baseline.

Roadmap Planner Table 8

Portfolio Energy Tracking Template. This template spreadsheet tracks building energy and carbon emissions over time using standardized baseline. This can be used to develop charts and graphs to tell the story during meetings with stakeholders.

Kern High School District (KHSD) entered into a Power Purchase Agreement with a third-party provider to design and build 24.5 megawatts of solar power systems at 27 KHSD sites.

Since becoming operational in 2016, the District estimates that it will achieve $80 million in electricity cost savings over the next 25 years.

Roadmap Planner Table 9

School District Portfolio Roadmap Goals in your workbook can be used to document these goals and how they change over time.

TABLE 2: TRACKING PORTFOLIO ENERGY AND CARBON GOALS OVER TIME

The following is an example of portfolio tracking metrics using a 2019 baseline. Long-term goals can be broken down into interim objectives to ensure district is on target to achieve decarbonization.

	2019 Baseline*	2030 Target	2040 Target	2045 Target
Portfolio Metrics (see example below)				
Average Portfolio Site Energy Use Intensity target (kBtu/ft²/year)	Baseline = X	60% * (X-20)	20% * (X-20)	Goal = 20
Portfolio Greenhouse Gas Emissions (Metric Tons CO_2e/year)	Baseline = N	60% * (N)	20% * (N)	Goal = 0
Renewable Energy	0% of energy use from renewables	40% of energy use from renewables	80% of energy use from renewables	Goal = 100% of energy use from renewables
Embodied Carbon	Baseline	50% reduction embodied emissions	90% reduction embodied emissions	Goal = zero emission construction sites
Example Portfolio Goal of Carbon Neutral by 2045				
Average Portfolio Site Energy Use Intensity target (kBtu/ft²/year)	60	44	28	20
Portfolio Greenhouse Gas Emissions (Metric Tons CO_2e/year)	35,200	21,120	7,040	0

*Note that COVID-19 caused operational disruptions so 2020 and 2021 should not be used as baseline years.

Individual Building Goals and Targets

Having absolute energy goals measured as an EUI (as opposed to a percent better than code goal) in place early—before design even begins—is a helpful way to ensure buy in from the design team and manage costs. Use the Advanced Energy Design Guide for Zero Energy K-12 Schools (Table 3-1: Target EUI) to set climate-specific, new construction and major modernization EUI targets and goals. Appendix B in the Advanced Energy Design Guide for Zero Energy K-12 Schools can be utilized to identify the appropriate climate zone.

New Construction and Major Modernization

NBI's Getting to Zero list and database suggest that a numeric Energy Use Intensity (EUI) goal is common in successful zero energy building projects. According to ASHRAE, Advanced Energy Design Guide for Zero Energy K-12 Schools (Table 3-1: Target EUI), new construction and major modernization projects EUI goals should be between 17-25 kBtu per square foot per year, depending on location and climate zone.

In addition to being highly energy efficient, carbon neutral schools are also all-electric with no fossil fuel combustion on site.

The following list of goals can be used to guide new construction and major modernization projects.

1. All new construction projects will:

- Achieve LEED, CHPS, or another broad sustainability goal
- Achieve a site energy use intensity of 17-25 kBtu per square foot per year
- 5 total air changes per hour (ACH) for high indoor air quality
- Be all-electric and have no on-site fossil fuel combustion
- Utilize low global warming potential refrigerants
- Incorporate renewable energy sources as an add alternate in the design and construction process
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete)
- Integrate electric vehicle (EV) charging and fleet infrastructure
- consider grid harmonization approaches like battery storage to manage peak loads

Seattle Public Schools Resolution for Clean and Renewable Energy

Goal, Resolution or Document Name: Resolution 2020/21-18, Transitioning Seattle Public Schools to 100% Clean and Renewable Energy.

Date: February 10, 2021

Sustainability, Green or Energy Goal:

- Commits to transitioning the District off fossil fuels for all of its operations including heating, cooking, and transportation no later than 2040.
- 100% zero-carbon electricity, with the combined use of energy from Seattle City Light and renewable energy sources installed on District property, no later than 2027.

2. All major modernization projects will:

- Achieve LEED, CHPS, or some other sustainability goal
- Achieve a site energy use intensity of 25-35 kBtu per square foot per year
- 5 total air changes per hour (ACH) for high indoor air quality
- Eliminate on-site gas combustion or have a plan to eliminate gas by a target year signed off by the department director
- Utilize low global warming potential refrigerants
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete)

Existing Building System and Retrofit Goals

Setting goals for existing buildings or system retrofits takes a slightly different approach based on the level of impact to the building. If the project is on a smaller scale, setting an absolute EUI target may not be appropriate. In this case, we suggest that projects set goals based on a percent improvement from existing performance as set in the Baseline section of this roadmap. In carbon neutral schools, all replacement equipment should be all-electric with no combustion or will include a written plan to address removal of gas combustion by a target year.

3. All school facility retrofits will:

- Achieve Leadership in Energy and Environmental Design (LEED), Collaborative for High Performance Schools (CHPS), or some other sustainability goal
- Improve the site energy use intensity by a minimum of 20% from a 2019 baseline (or target year)
- Consider opportunities to remove gas-combusting equipment, specify low global warming potential equipment and low embodied carbon materials

Energy and Carbon Goals Toolbox

Utilize these resources to help support developing district energy and carbon goals.

EPA Energy Star Portfolio Manager

U.S. Green Building Council Leadership in Energy and Environmental Design (LEED)

Collaborative for High Performance Schools

Willie Brown Middle School | San Francisco, CA
Credit: San Francisco Unified School District

San Francisco Unified School District Carbon Neutral Schools Resolution

The San Francisco Unified School District (SFUSD) issued a Carbon Neutral Schools Resolution. SFUSD energy and carbon goals are:

- Carbon neutrality in all district operations by 2040.
- EUI of less than 20 kBtu per square foot per year in all buildings.
- Reduce gas usage 30% by 2020, 50% by 2030, and 100% by 2040 as compared to baseline data from 2016.

Incorporate Goals into District Plans and Practices

Starting early is key to success in achieving healthy, energy efficiency and carbon emission goals. By having plans and process steps in place before any building lifecycle event begins, districts can manage costs and be ready to take advantage of building life cycle events as they arise. Districts should consider how energy and carbon emission reduction goals can be integrated into activities that are already happening. You may find that it is not considered at all, even though it is relatively inexpensive to include these as parameters among other considerations during the process.

Below are specific ways that energy and carbon goals can be integrated into district policy and planning.

Carbon Neutral Resolution

Carbon neutrality requires that energy consumption by sources that release carbon dioxide into the atmosphere be reduced and eliminated. A carbon neutral board resolution is a statement about the district's commitment to carbon neutrality. Passing a carbon neutral resolution means that this issue is so important that the board wants a formal statement about it. A resolution is a document that stands as a record if compliance comes into question in facility operations.

In carbon neutral or resolutions, carbon is sometimes a proxy for broader greenhouse gas emissions which include refrigerants commonly found in HVAC systems. A carbon neutral resolution template to customize can be found here.

School Bonds

Bond planning often begins years before the referendum goes to voters. From the start, school districts should be clear with stakeholders about their aspirations for carbon neutrality. Many students are demanding action in the fight against climate change, and districts can describe how their upcoming bond accelerates the district's efforts to be carbon neutral by the district's target year.

Cost estimates are another key aspect of bond planning that should explicitly require attention to energy and carbon emissions reduction goals as outlined in the roadmap. Cost estimating in preparation of the bond should understand the decarbonization goals and have clarity on implications for construction. The district's Owners Project Requirements can be provided to the cost estimator to help guide their costing exercise in advance of bond issuance.

Facility Master Plan

The intent of the facility master plan is to identify existing facility conditions, past and future student enrollment, to review the district's educational program, to verify the ability of the existing facilities meet minimum state standards, and to identify new or replacement facilities required to meet the needs of the district. Facilities master plans are designed to be flexible planning tools to identify facility issues and programmatic needs to the community, parents, staff, and the board of education. They offer periodic input and revision as conditions change and new needs are identified within the district.

Considerations of indoor air quality, energy and carbon should be included in the facility master planning process. Any facility assessments should collect information about the electric and gas combustion equipment in the building.

Building Assessments

Sometimes part of the facility master plan process, building assessments carefully examine the school facilities, their physical characteristics, installed equipment noting which consumes gas and which are electric, opportunities for renewables, operational hours, occupancy patterns, and other operational practices. The assessment might also investigate opportunities for flexibility in the learning environment, how suitable spaces are to evolving learning styles, and how outdoor and public space can be used by teachers and the community.

Without specific reference to energy or carbon emissions goals in school needs assessments or facility master plans, there is a high likelihood that efficiency or renewable energy systems will not be considered for funding. Indoor air quality, energy efficiency and carbon emissions should be included as a core assessment areas. Leverage the EUI targets and consider how benchmarking data for each facility compares to the district goals and averages.

Checklist of Considerations for Building Assessments

According to the ASHRAE Advanced Energy Design Guide for Zero Energy K-12 Schools, considerations for facility and building assessments include:

- ❑ Operational schedules, expressed as a percent of occupancy, that account for daily and seasonal occupancy levels for various spaces in the building (multi-use areas, offices, classrooms, etc.); be sure to consider community use as well
- ❑ Comfort zone parameters, specifically indoor temperature and humidity levels (consider ASHRAE 55-2013 standard); consider whether different parameters can be used for different space types, like hallways which can have larger temperature ranges than classrooms
- ❑ Tasks in each space and the specific lighting levels needed for those tasks, being careful not to over-light spaces
- ❑ Plug load uses in each space, including audio-visual equipment, computers, etc; investigate opportunities to share resources like printers, staff refrigerators, and other equipment
- ❑ Information technology needs and spaces, along with the manufacturer specifications and set points for equipment; depending on the equipment, these spaces may not need to be conditioned as much as in was done historically
- ❑ Kitchen functions and needs; whether these can be served without natural gas
- ❑ Opportunities for regenerative elevators
- ❑ Equipment that can be turned off when the building is unoccupied, including computers, wifi routers, vending machines, etc.
- ❑ Opportunities and locations for potential solar installations

Technical Specifications and Sustainability Standards

Technical specifications ("tech specs") outline details of how educational specifications will be achieved in facilities. They often include detailed product performance requirements, though not all districts have updated technical specs. One benefit of a standard tech spec is that it promotes consistent equipment choices across many buildings in the portfolio. This can be helpful to facility operators, limiting a wide breadth of equipment that they need to understand.

Districts that do not have a tech spec can reference the ASHRAE Advanced Energy Design Guide for Zero Energy K-12 Schools to help set their own standards. Though the ASHRAE guide was developed for new construction, many elements also address existing building renovation.

Owners Project Requirements

Owners Project Requirements (OPRs) are a critical tool used by owners (in this case school districts) to formally outline objectives and expectations for a particular building construction project. They describe the project, budget considerations, functional space and use requirements (building program and occupancy patterns), design process expectations, sustainability and decarbonization goals, building component and equipment specifications and specific performance criteria. A template OPR document can guide overall district level objectives and then can be easily modified with requirements for a particular project. OPRs on a particular project often evolve over the course of a project and these modifications are carefully tracked during the construction process. A template Owners Project Requirement to customize for your climate zone can be found here.

Procurement

School district procurement practices should mandate efficiency. Having clear standards in place that allow for considerations of both initial and lifecycle cost of equipment is imperative. Initial cost, life cycle costs, quality, durability, running costs, management, energy consumption, carbon emissions and disposal issues all need to be assessed, and will all influence the final procurement decision.

Many procurement decisions have an impact on energy and carbon emissions. Requiring purchase of the most efficient ENERGY STAR equipment when available is a clear win because this equipment will save energy and money over time. Financial incentives may be also available, so procurement policies should investigate these programs.

Wall mounted heat pump system | San Francisco, CA
Credit: San Francisco Unified School District

Operational Policies

A building designed to high standards of performance relies on efficient operation to reach its potential. An operational policy across all buildings can help maintain a high standard of operations and keep performance drift in check. It is important to find the fight balance between energy efficiency and occupant comfort and productivity. Safe, healthy and efficient schools demand good temperature control, lighting and ventilation practices.

Typically, an effective operational policy covers the following categories:

- Temperature setpoints
- Ventilation requirements
- Plug loads
- Lighting
- Staff awareness recommendations and policies

Sustainability Checklist

Sustainability checklists are tools to easily reference and ensure all aspects of sustainability, energy efficiency, and carbon emissions are considered in every step a project. A checklist is a simple way to keep everyone on track and ensure goals are met. A template Sustainability Checklist can be found here.

NBI's Public Building Portfolio Management Implementation Guide provides useful guidance on how to set operational policies for each of these areas.

Plans and Practices Toolbox

Utilize these resources to help incorporate district goals into plans and practices.

Template Bond Criteria for Healthy, Energy Efficient, Carbon Neutral Schools

Public Building Portfolio Management Implementation Guide

DSIRE database of state incentives for efficiency and renewables

ASHRAE Advanced Energy Design Guide for Zero Energy K-12 Schools

ASHRAE Standard 55-2013: Thermal Environmental Conditions for Human Occupancy

Illumination Engineering Society Standards

Needs Assessment Organizing Manual
(This provides a detailed review of assessments, but it does not include specific mention of energy or carbon.)

Advanced Energy Retrofit Guide

Energy Master Planning Drives Energy Efficiency

Energy Savings Help Fund K-12 School's Facility Master Plan

National Council on School Facilities—Master Plan Examples

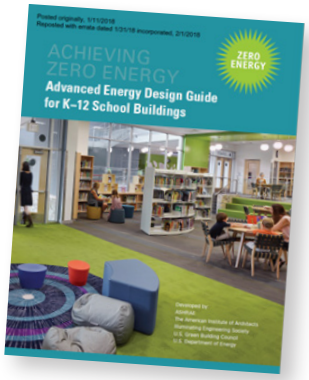
Submetering of Building Energy and Water Usage, National Science and Technology Council
(Information on energy assessments and audits.)

Align with Building Lifecycle Events

This section explains how to leverage building lifecycle events to improve performance. It also provides helpful technical resources to support district activities. Not all school districts have new construction or major modernization projects.

Districts can utilize building life cycle events such as those listed below as an opportunity to incorporate or improve upon goals set in the previous section.

New Construction and Major Modernization



ASHRAE's Achieving Zero Energy: Advanced Energy Design Guide for K-12 Schools details a prescriptive approach to designing and constructing new buildings. We previously mentioned this reference guide in the context of goal setting and technical specifications. Although the document is about new construction, most of the measures explained are useful in existing building renovations as well.

Major modernizations, sometimes called deep retrofits, often include alterations to existing buildings. However, these usually follow a similar process to new construction projects, with a full design and construction process that is guided by specific goals. One challenge with modernizations is that they do not offer the same first cost savingsas all-electric new construction, since the gas infrastructure already exists.

Documents such as Requests for Proposals and the sample Design Team Interview Questions would be useful in any new construction or major remodel project. Once the team is on board, consider hosting an Integrated Design Charrette and draft a OPR's to ensure the objectives are met.

Research has demonstrated that achieving aggressive energy and carbon goals is possible on a conventional budget when you start early in the process with the goal in mind. Average school cost by state ranges from $205 to $495 per square foot depending on location, and most zero energy schools studied by the National Renewable Energy Lab are within this range. However, the district must start early and take an integrated design approach.

> Districts can be clear of the decarbonization objective by incluing these goals in the request for proposal.
>
> This puts the design team on notice of the ambitious energy and carbon goals, even before they have been hired.

U.S. Department of Energy's Guide to Zero Energy and Zero Energy Ready K-12 Schools clearly outlines keys to success in design and construction of zero energy schools. These can apply to any project aiming for a high level of efficiency:

- Focus on the benefits to the learning environment
- Start early! Energy and carbon goals can be included in the bond language
- Incorporate energy and carbon goals into the Request for Proposal language to put prospective design teams on notice of energy and carbon goals
- Choose a committed design team. Ask them about their experience during interviews.
- Guide new construction and major renovation projects with owner's project requirements (OPR)

- Utilize an integrated design process and involve staff, students, and other key stakeholders in an eco-charrette to kick off the process
- Use high performance district sustainability standards to require all-electric systems and equipment
- Use early energy modeling in schematic design to compare potential design approaches and update the model with the latest design parameters in each phase of design
- Investigate passive approaches to minimize energy demand
- Incorporate best practices for ventilation and filtration to address indoor hazards and outdoor pollution (like wildfires or exhaust from a nearby highway)
- Utilize a mock-up of the building envelope to guide construction practices, and ensure a well-insulated and air-tight thermal envelope
- Include controls integrator to ensure building controls work smoothly together
- Incorporate commissioning starting in the design phase and including building envelope and renewable energy systems
- Ensure that any value engineering considers both first costs and life cycle costs
- Create check in points during the design and construction process that require checklist documentation of updates toward goals
- Carefully manage the hand off from the design and construction team to the building operator so any new systems are understood
- Educate occupants about the features of the new building
- Celebrate success

Roadmap Planner Table 11

Action Plan for Updating Design and Construction Protocols. List of suggested actions to prepare a district for incorporating considerations of energy and carbon into forthcoming construction activities.

Discovery Elementary School | Arlington, VA
Credit: VMDO

System Retrofit and Equipment Replacement

System retrofits and equipment replacement are important building lifecycle events that should be leveraged to improve health, reduce energy consumption, and eliminate carbon emissions. As opposed to new construction and major modernization projects, these retrofits may be funded by the operational budget, and may not go through the capital projects group. Therefore, a distinct set of stakeholders must be aware of the energy and carbon emission reduction goals to ensure they are considered.

Use the Database of State Incentives for Renewables & Efficiency (DSIRE) to investigate funding sources to offset incremental costs of efficient and all-electric equipment.

Ideally, retrofits will happen in accordance with plans outlined by facility assessments and/or facility master plans. Districts should move beyond "like-for-like" equipment replacement, instead moving to a "like-for-better" approach. This helps to manage overall costs for the district, replacing equipment with better equipment with a small incremental first cost that will save money over time. The district must decide how much time is acceptable for a return on the investment, with some districts allowing for a 15+-year terms to justify the costs.

Eliminating gas combustion equipment in modernizations where the gas infrastructure already exists in the building is more difficult than in new construction projects. Having a plan to replace gas equipment in place can ensure that energy and carbon emission reduction goals are considered in building and system retrofits. The plan should require an authorized representative of the district sign off on the purchase of the gas equipment and it should address how this system will be removed before the district's target year for carbon neutrality.

Many systems and equipment retrofit projects can utilize owners project requirements, sustainability standards, or technical specifications that have been updated with energy and carbon goals. Technical specifications should reflect current best practices and all-electric equipment. Any system should be fully commissioned to ensure it is working appropriately.

Roadmap Planner Table 12

Retrofit Action Plan. Provides a checklist and workplan to prepare the district to take advantage retrofit projects in decarbonization.

Design and Construction Toolbox

Utilize these resources to help design and construction to carbon neutral.

- ASHARE Advanced Energy Design Guide for Zero Energy K-12 Schools
- Guide to Zero Energy and Zero Energy Ready K-12 Schools
- NBI Zero Energy Schools Charette Toolkit
- Template Team Interview Questions for Carbon Neutral Projects
- Template Sustainability Checklist
- DSIRE Database of State Incentives for Efficiency and Renewables (Retrofit)
- Template Owners Project Requirements (Retrofit)

Engage Occupants and Operators

Occupant engagement in school buildings should include both occupants (students and teachers) and operators (facilities management staff). Facilities staff should understand the systems and how they operate to meet the energy and carbon goals. The design and construction team should train the operators on how to maintain systems that may be unfamiliar, and operators should know who to contact when a problem arises that they cannot fix.

A user manual that includes basic information about the systems should be a standard practice. Some districts are recording short training videos which are made available in a reference library for operators who might refer to them on demand.

Students and staff are critical to success in getting to zero. Occupant engagement has been a strategy to help ensure that healthy, energy efficient, carbon neutral buildings meet their targets. A student group might assume responsibility for monitoring behavior and ensure that the building performs efficiently. Some teachers may be interested to learn more and incorporate information about how buildings use energy and emit carbon and incorporate this information into their lesson plans. Students and teachers can also use the steps outlined in this workbook to learn more about energy use intensity targets and benchmarking activities.

Zero energy and carbon neutral schools create an incredible opportunity for the building itself to be used as a tool in teaching students. The A Guide to Zero Energy and Zero Energy Ready K–12 Schools has case studies about student engagement with their buildings as a learning tool. The U.S. Green Building Council (USGBC) has developed a program called "Building Learners" for educators to easily incorporate building science into their already established curriculum.

Roadmap Planner Table 13

Occupant and Operator Engagement Action Plan. Plan to ensure that all occupants are part of the building operations and maintenance process.

Suggested activities for occupant and operator engagement include:

- Developing a user manual for buildings *(you may need to have the design team support this process)*
- Training operators on new systems
- Developing a routine maintenance schedule and plan for implementation
- Adding building signage to inform occupants of energy and carbon saving features in building
- Training occupants about building energy efficiency and carbon emission reduction features
- Engaging a student club to help support efficiency goals
- Developing a work-based learning program

Work-based Learning Opportunity

Developing a work-based learning program focused on getting the district to carbon neutral can be an additional opportunity for districts looking to **engage students on a deeper level**. This approach presents internship opportunities for students that have interest in career-themed programs, such as engineering, environmental science, or any other aligned program. This allows students to be compensated for their time and develop a program that is continuously evaluated and updated by those most affected by the operation of the building. Alongside staff or other professionals, students (ideally as paid interns) can dive into aspects of this toolbox to develop their own roadmaps to carbon neutral. Through this process, students investigate their buildings, provide recommendations, and then develop work plans for suggested tasks that they identify. Some suggested tasks include:

- Conducting Operations and Maintenance team surveys to understand the history and systems of each building
- Conducting occupant surveys
- Benchmarking utility data for school sites in Portfolio Manager
- Establishing an existing EUI and GHG metric (metric tons CO_2e/year) for each school site
- Recommending energy conservation or efficiency measures for specific school sites
- Ongoing tracking and reporting of energy usage and greenhouse gas emissions after measures are implemented. This may include comparisons of total energy use, target vs. actual EUI, metric tons CO_2e/year, or solar production (if appropriate).
- Presentations of the students' work and data outcomes to key stakeholders at the school district.

Porterville High School Students meet with the School Business Official. Porterville Unified School District | Porterville, CA
Credit: Climate Action Pathways

Track and report progress

Reporting on progress is a great way to celebrate success and share progress on the efforts to get to zero over time. Developing an annual report with a presentation to the school board is a good way to do this. A simple fact sheet or one page overview explaining the status of the district's path to zero is another. Students are very effective in delivering this presentation, as we learned from the Climate Action Pathways program.

Roadmap Planner Table 10

Trajectory Graphs for Carbon Neutral Schools can be used to track this information graphically. A visual representation of your goals can be a useful tool for communicating with stakeholders.

FIGURE 4: PORTFOLIO EUI TRAJECTORY TO ZERO

Figure 4 tracks average portfolio EUI, starting from the baseline year. The target is 20 kBtu per square foot per year in the year 2045.

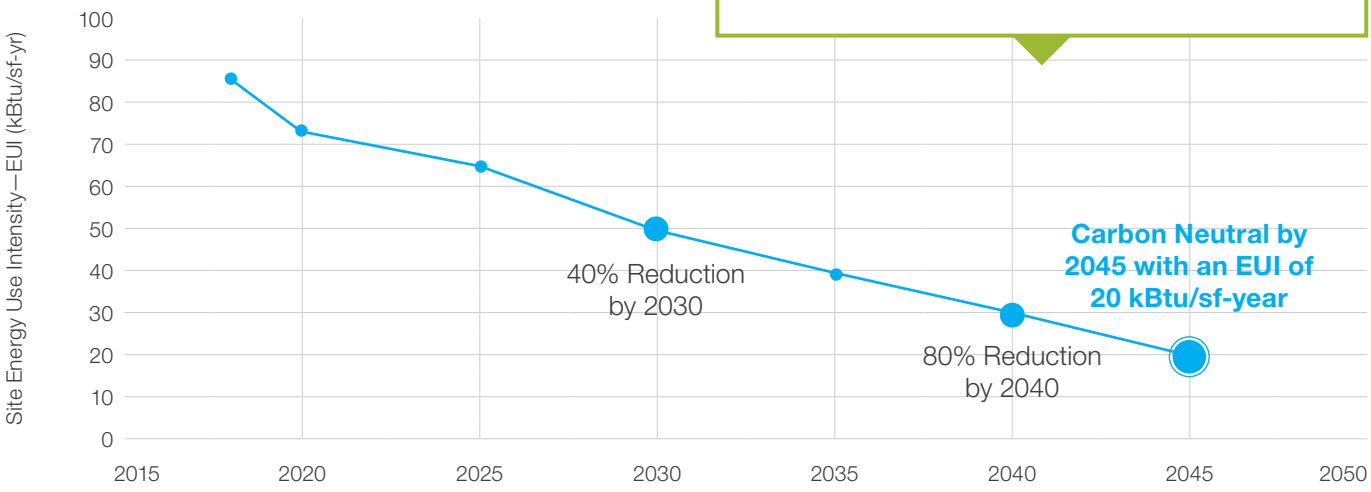
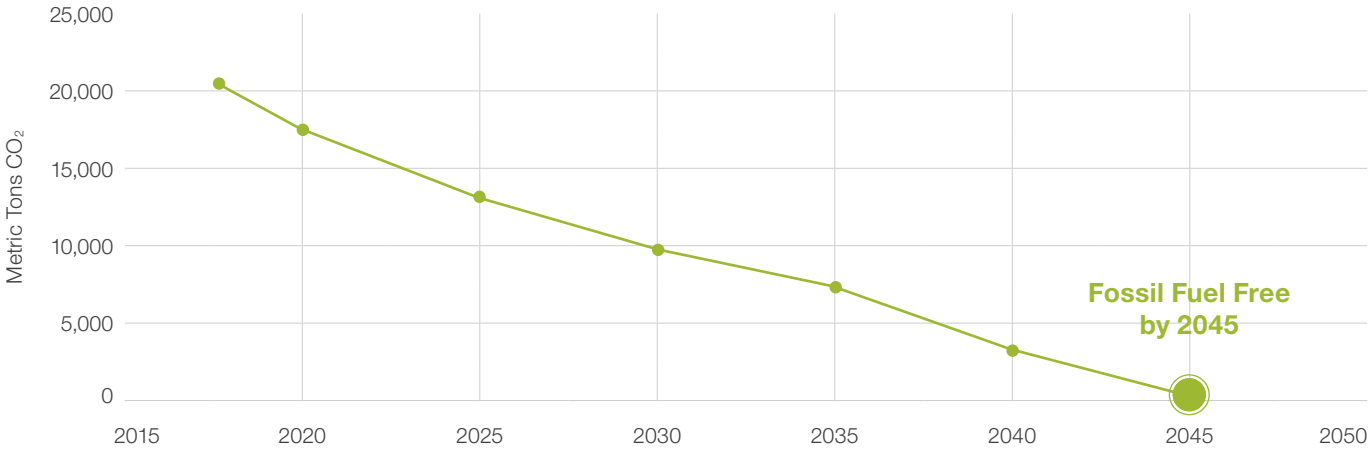


FIGURE 5: TRAJECTORY TO ALL-ELECTRIC PORTFOLIO

Figure 5 tracks the trajectory of a critical component of carbon neutrality: all-electric buildings. This aims for elimination of on site gas combustion from buildings by 2045.



Once data are entered, it can be used to chart progress over time. Charts and graphs can be cut and pasted into a presentation. The energy champion might decide a recurring due date and make arrangements for an annual progress report to the school board.

Some suggested activities to think about the best way to engage your occupants and report your success are included below. Be sure to consider which activities should be started right away, which could be additive later, and which will need annual updating.

Here are suggested activities for ongoing reporting:

- Decide on annual due date for progress reporting
- Use spreadsheets to chart energy data over time
- Utilize reporting template or develop your own report template to be utilized each year
- Collect key messages from stakeholder engagement section to use in the presentation
- Schedule annual briefing for school board and stakeholders
- Develop a fact sheet to explain zero over time efforts

Reporting Resources

Utilize these resources to help engage occupants and report progress.

Template District Sustainability Report

Climate Action Pathways Student Presentation to School Board

San Francisco Unified School District Sustainability Website

Boulder Valley School District Sustainability Progress Reports

Seattle Public Schools Resource Conservation Program

Fairfax County Public Schools Greenhouse Gas Emissions Reports

Appendices

Appendix A: Definitions

CARBON NEUTRAL: A carbon neutral school is a highly efficient building that has removed on-site fossil fuel combustion, most often used for space heating, hot water heating and in kitchens. These buildings maximize energy energy efficiency while providing a healthy indoor environment. They produce on-site, or procure enough carbon-free renewable energy to meet its building operations consumption annually.

GETTING TO ZERO OVER TIME: While getting to zero is a realistic goal, the path to healthy, efficient, decarbonized schools is a process that will take time to accomplish. Getting to zero over time takes a long-term, cost effective, and strategic approach to energy management. It leverages every opportunity for facility upgrades to continually improve energy performance. This process sets measurable goals for a portfolio and individual projects and uses policies and guidance documents to achieve these goals.

ENERGY USE INTENSITY (EUI): EUI is an indicator of the energy efficiency of a building's design and/or operations. Expressed as energy use per square foot per year, EUI is calculated by dividing the total energy consumed by the building in one year by the total floor area of the building. EUI can be expressed as either "site" or "source" (defined further below).

OWNERS PROJECT REQUIREMENTS (OPRS): The OPR forms the basis from which all design, construction and acceptance decisions are made. An OPR is an essential document to require and hold the project team accountable for energy and carbon goals. Typically, OPRs are utilized in the new construction or major renovation process but can also be utilized as a standard of design for equipment replacement or smaller projects when longer technical specifications are not available. OPRs can also define basic building parameters to be considered in the costing exercise that happens during bond planning.

REQUEST FOR PROPOSALS (RFPS): An RFP announces a project, describes it, and solicits bids from qualified design teams and contractors to complete the project. The RFP provides an opportunity to formally set the stage demonstrating the school district's commitment to getting to zero. In new construction projects, RFPs provide a pathway to select design and contractor teams with the required expertise to achieve the goals of a low energy use intensity and all-electric construction. RFPs for services such as facility master plan development (see below) can also integrate concerns of energy and carbon. This can set the stage and ensure that energy, carbon, and health goals are not forgotten in the master planning process.

SITE ENERGY USE INTENSITY (SITE EUI): Site EUI includes energy consumed (including heating, cooling, ventilation, domestic hot water, indoor and outdoor lighting, elevators, plug in equipment, etc.) on the building site as measured at the site boundary. Site EUI is calculated with the total energy use of the building at the meter, regardless of the source. Gas, electricity, and renewable energy are all converted to one unit (thousand British thermal units, or kBtu) and counted together.

SOURCE ENERGY USE INTENSITY (SOURCE EUI): Source EUI includes site energy plus the energy consumed in the extraction, processing and transmission of primary fuels. Source EUI takes into account the total upstream energy that the building consumes, which means it is always larger or equal to the site EUI. The exact difference between the site and source EUI is a function of the fuel mix delivered to the building, as well as the building's location. Different regions of the country have varying energy sources and transmission infrastructure.

TECHNICAL SPECIFICATIONS: A technical specification, or tech spec, is intended to provide uniform and consistent quality standards for design and construction of all district facilities. They set the district standard by outlining the minimum acceptable standards for products, materials, and systems used in all facility improvements, including new construction, renovation, remodeling, and maintenance. The Advanced Energy Design Guide for K-12 Zero Energy Schools by ASHRAE can be an effective starting place for an energy and carbon technical specification for both new and existing school renovations.

Appendix B: Common Stakeholders and Their Roles in Carbon Neutrality

TABLE 1

Role	Role in Decarbonization Process	Drivers
Stakeholders: School Board Members, Superintendents, Chief Business Officials (CBOs)		
School board members, Superintendents, and CBOs are the primary decision makers and financial managers for school districts and school facilities. They routinely seek input from the community, students, staff, and a wide range of consultants in decision-making.	Votes of school board members and leadership from Superintendents and CBOs represent final decisions on many topics critical to school facilities including adoption of goals and resolutions for carbon neutrality, and final approval on construction budgets.	Excellence in education for every child at every level by focusing on quality instruction, educational outcomes, healthy school buildings, sustaining an equitable culture, and ensuring the financial health of the district.
Stakeholders: Capital Projects and Planning Department		
The Capital Projects and Planning Department manages planning, design, construction and renovation of all facilities.	The Capital Projects and Planning departments lead and develop all plans for school construction projects. They may make the final proposals or decisions on contracting, design team members, and where and when energy and carbon are considered in the process.	To support the School District mission, Facilities Planning provides professional expertise to the Board, the Administration and to other departments within the District. The goal is to provide each student, faculty, staff and patron with a safe, comfortable and functional campus environment.
Stakeholders: Occupants: Principals, Teachers, Students, Parents		
As the main occupants of schools, teachers, staff and students provide insight into day to day operations and any issues that may be missed by stakeholders at the district level. They are champions for their own health and well-being in the design, construction and operation of a carbon neutral school.	The lives of students, teachers and parents revolve around these physical spaces. All occupants spend their days supporting the mission of education and developing our future leaders. Students in particular may have a lot of input on the needs of the school building and their environment. They are demanding climate action now and should be given the space to interact with the carbon neutral building development process.	To motivate, inspire, encourage, and support students by providing a safe and secure environment to educate them socially, emotionally, and cognitively so they can continue to build a foundation for life-long learning.

Role	Role in Decarbonization Process	Drivers

Stakeholders: School Support Staff: Kitchen and Nutrition Services, Janitorial Staff, Transportation, Facilities and Grounds

The operation and maintenance of safe, healthy and functioning schools is the responsibility of the Facilities Director. The Facilities Director may manage a group of staff that generally includes a team of Facilities Managers, Janitorial Staff, and Transportation Services. These staff are all deployed across the district to various facilities to address specific maintenance issues and custodians.

In a separate but related department, Kitchen and Nutrition services are important occupants and stakeholders at the district.

School support staff are committed to student educational outcomes and how the building impacts students. While they are interested in energy, they are more interested in maintaining healthy and safe schools. Their buy-in on new systems is critical to a carbon neutral result because these buildings must be operated and maintained correctly to achieve carbon neutral status.

School support staff are committed to providing exceptional customer service to the students, administrators, and community to facilitate student achievement and success by providing exceptional facilities conducive to quality learning.

Stakeholders: School Community: PTA, Voters, Community Organizations, Other Interest Groups

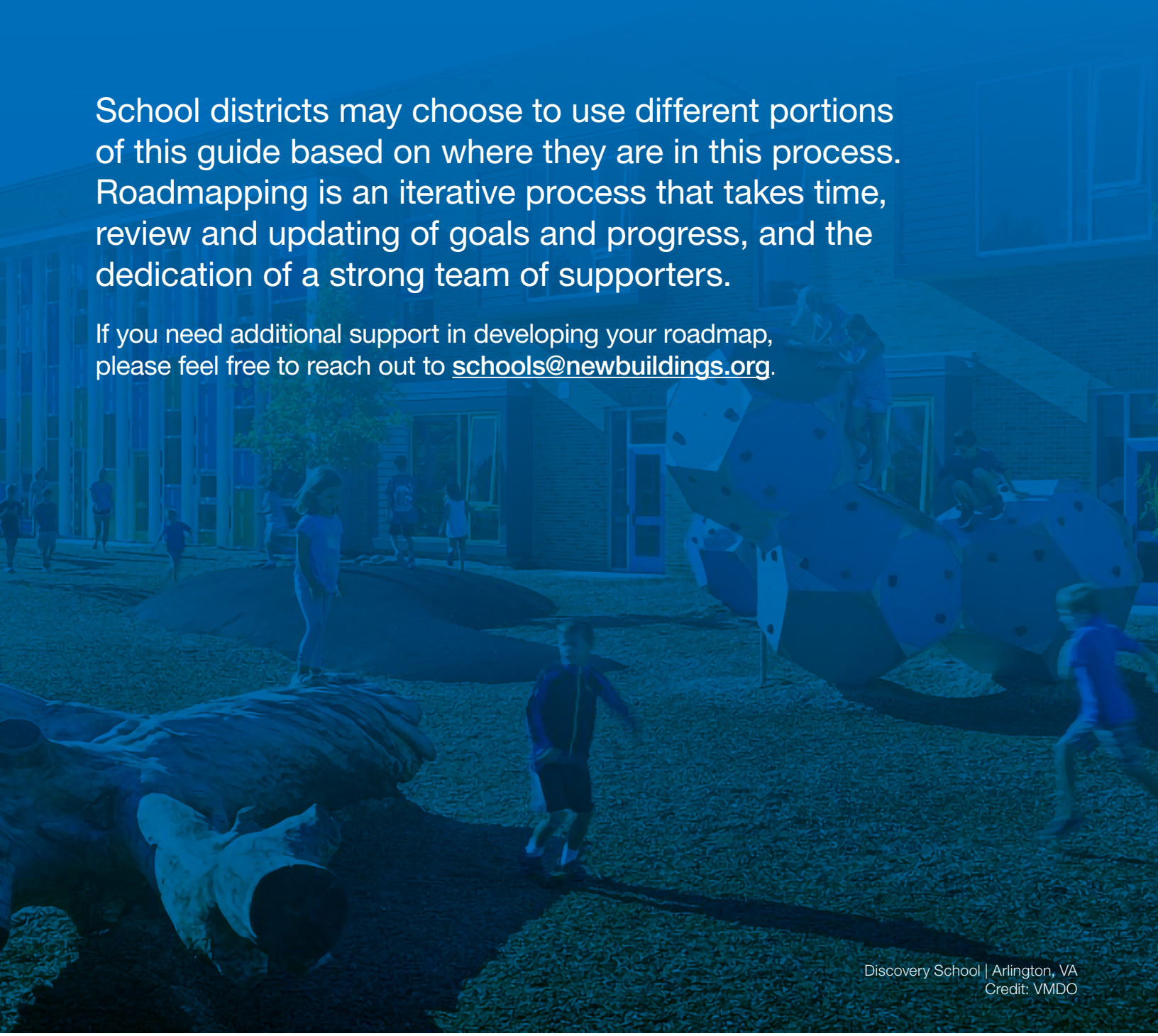
Community members provide key support as members can rally behind the needs of each school and demand higher standards than what are in place. They all play a key role in passing school bonds, identifying funding mechanisms, and provide new ideas to districts.

Although school community members may not have influence over actual decisions made at the facility level in a school or district—they are able to rally school community support over a common platform and may be helpful in gaining backing the carbon neutral vision. They can also be important in adopting school specific policies and practices and ensuring that bonds and other funding mechanisms gain support. Community organizations and other interest groups may be helpful as they may have experience in bringing all stakeholders to the table to rally around the common carbon neutral goal.

To make every child's potential a reality by engaging and empowering families and communities to advocate for all children.

School districts may choose to use different portions of this guide based on where they are in this process. Roadmapping is an iterative process that takes time, review and updating of goals and progress, and the dedication of a strong team of supporters.

If you need additional support in developing your roadmap, please feel free to reach out to schools@newbuildings.org.



Discovery School | Arlington, VA
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nbi new buildings institute

151 SW 1st Ave., Suite 300
Portland, OR 97204
503 761 7339
newbuildings.org

New Buildings Institute (NBI) is a nonprofit organization driving better energy performance in buildings to make them better for people and the environment. We work collaboratively with industry market players—governments, utilities, energy efficiency advocates, and building professionals—to promote advanced design practices, innovative technologies, public policies, and programs that improve energy efficiency. The Getting to Zero website houses over 300 curated resources including guidance, educational webinars, policy models, research, case studies, and more to help all buildings achieve zero energy. Visit gettingtozeroleadership.org to learn more.