Decarbonizing Public Sector Buildings

November 2020

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Finally, as this is an update to a previous report, NEEP would like to take this opportunity to reiterate acknowledgement of the original authors and contributors of previous versions of this report, which continue to serve as the foundation upon which this update is based.

About NEEP

NEEP was founded in 1996 as a non-profit whose mission is to serve the Northeast and Mid-Atlantic to accelerate regional collaboration to promote advanced energy efficiency and related solutions in home, buildings, industry, and communities. Our vision is that the region's homes, buildings, and communities are transformed into efficient, affordable, low-carbon resilient places to live, work, and play.

Disclaimer: NEEP verified the data used for this white paper to the best of our ability. This paper reflects the opinion and judgments of the NEEP staff and does not necessarily reflect those of NEEP Board members, NEEP Sponsors, or project participants and funders.

Executive Summary

This report is an update to a 2012 report entitled Greening the Public Sector, Maximizing Energy Efficiency. The original report provided recommendations and exemplars for how public sector buildings could achieve higher levels of energy efficiency. Some of the recommendations that remain relevant include reducing cost barriers for constructing energy-efficient buildings and schools, increasing workforce training and education, and establishing the goal of zero energy for all public buildings.

However, while zero energy was considered a long-term goal for public sector buildings in 2012, it is now a proven performance target for many buildings today. States in the NEEP region have become leaders by building zero energy public buildings that demonstrate long-term cost and energy savings while supporting overall building decarbonization goals in the state. As a building strategy, **decarbonization** combines energy efficiency, strategic electrification, and renewable energy to help buildings reduce their carbon emissions and energy usage.

Zero Energy Buildings

NEEP defines Zero Energy Buildings as "ultra-low-energy", combustion-free buildings that sources 100% of their annual energy from additional renewable energy sources. Ultra-low energy buildings utilize various techniques to maximize lower energy use, making the addition of renewables more cost effective. Combustion-free buildings rely on electrification for space heating and hot water and do not burn any onsite fossil fuels except for back-up/emergency systems.

This report will focus on updated recommendations to help states implement strategies to rapidly decarbonize public sector buildings and demonstrate how building decarbonization can drive market transformations in the overall building sector. The recommendations are:

1. Benchmark all public buildings and establish performance standards that promote continual efficiency improvements;
2. Remove cost barriers to energy efficiency and zero energy through funding programs for public buildings;
3. Promote electrification efforts and cost-effective deep energy retrofits for existing public buildings;
4. Develop and adopt zero energy stretch codes that apply to all public sector buildings;
5. Expand workforce development and education opportunities to support high performance and zero energy building strategies for new construction and retrofits;
6. Assess the benefits of grid-interactive efficient buildings (GEBs) on public sector buildings and implement lead-by-example (LBE) strategies that can be scaled up.

In addition to incorporating these recommendations, NEEP encourages states to maintain strong partnerships for peer learning. Sharing knowledge and implementing strong policies based on lessons learned will help our region rapidly decarbonize and achieve carbon neutrality.

Introduction

Among the various building types, public sector buildings are often most recognizable due to the function they serve in our society. Public sector buildings are owned, funded, and/or operated by states or municipalities. These types of buildings include public schools, public housing, administrative buildings, courthouses, hospitals, correctional facilities, and others. People rely on public sector buildings every day for education, community gatherings, administrative functions, housing, transportation, and many other uses. Due to the important role they play in people's lives, strategies that aim to decarbonize the built environment must address public sector buildings at the forefront. Public sector buildings can demonstrate the cost and energy savings of decarbonization to the commercial and residential building sectors.

Many states have recognized this opportunity and implemented **lead-by-example (LBE)** programs (see Appendix). As the name suggests, LBE programs help state governments demonstrate leadership by promoting clean energy and sustainability initiatives in public facilities and state operations. LBE programs can include initiatives for reducing greenhouse gas emissions, increasing renewable and on-site energy generation, improving energy efficiency, clean transportation, and training.

Rhode Island Lead by Example Program

In 2015, the governor signed EO 15-17, which instructed the Office of Energy Resources (OER) to establish a LBE program that coordinated with state agencies to reduce energy consumption and greenhouse gas emissions. Some of the goals of the LBE program included:

- 10% reduction in overall energy consumption below FY 2014 levels by end of FY 2019
- Procurement of 100% electricity from renewable energy for state- owned buildings
- Energy efficiency standards for operations and maintenance of all state-owned facilities
- Voluntary stretch code to use for all state construction and renovation projects

The state's LBE program resulted in the establishment of a voluntary stretch code in 2017. The state also *highlights* annually public sector buildings that have achieved significant energy reductions.

In 2018, the Warwick School District implemented energy saving measures throughout ten schools, including LED lighting improvements, mechanical systems, energy efficient motors and variable speed drive installations and energy management system upgrades. The schools will save about $215,000 each year.

For many states in the NEEP region, 2030 is an important milestone. In the effort to achieve carbon neutrality, states have set benchmarks at 2030 to measure success. Furthermore, many statewide code adoption strategies around the region have also established 2030 as the goal for when zero energy codes should be adopted for new construction. This is the case in the District of Columbia, Vermont, and New York. By focusing on the public sector, states can implement decarbonization strategies for public buildings to demonstrate their effectiveness in statewide policy for all buildings.

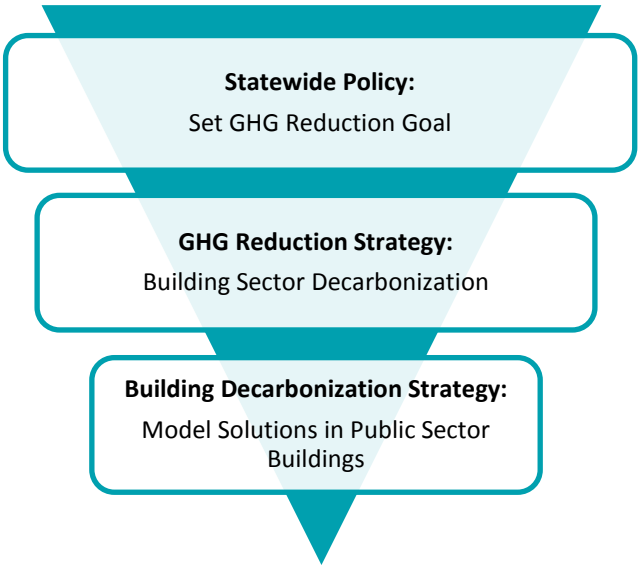
To achieve holistic building decarbonization, a combination of energy efficiency, renewable energy, and **strategic electrification** is needed. By comprehensively combining these three strategies, building decarbonization is a cost-effective solution that allows states to achieve carbon neutrality. While recognizing this approach to decarbonization as a proven strategy, it is also important to note that for some states there won't be an equal balance between energy efficiency, renewable electricity, and strategic electrification. For some states, rapid electrification of new construction and existing buildings is not a feasible near-term goal and a heavier focus must be placed on energy efficiency and onsite renewables. This is why it is essential to pilot cost-effective solutions in public sector buildings. They can demonstrate the feasibility of certain solutions and establish best practices for other sectors, which will ultimately help drive market transformation in the building sector.

Strategic Electrification refers to powering end uses of energy with electricity instead of fossil fuels in a way that increases energy efficiency and reduces pollution, while lowering costs to customers and society, as part of an integrated approach to deep decarbonization.

In 2019, NEEP published its Roadmap to Zero Energy Public Buildings which looked at the 13 states in the NEEP region and provided an overview of how far states have come and recommended next steps for achieving zero energy in the public building sector. The roadmap is a useful tool to measure progress compared to other states and determine feasible next steps.

Overview of State Policies and Goals in Northeast and Mid-Atlantic States

Before focusing on public sector buildings, states need to establish statewide greenhouse gas reduction policies. Ten out of the 13 states in the NEEP region have policies to achieve at least 80 percent carbon reduction by 2050 (see table below). By setting this target, states can then identify strategies for reducing carbon through interim goals and strategies. Buildings are a significant source of energy consumption and carbon emissions in the United States, therefore building decarbonization is necessary for states to reach their long-term carbon reduction goals. States can start tackling building decarbonization by modeling cost-effective and energy-efficient solutions in the buildings they own and operate. While public sector buildings only represent a small portion of overall energy use in most states compared to other buildings types, states have more autonomy and flexibility to pilot certain solutions to inform the private building market on the cost-effectiveness of decarbonization.



Exemplar: Massachusetts Campus Decarbonization Studies

In support of the Massachusetts net zero emissions by 2050 goal, several public institutes of higher education across the Commonwealth have begun looking for solutions to fully decarbonize their campuses. In 2020, three University of Massachusetts campuses and one state university launched studies to establish accurate energy baselines, calculate future energy demand, and recommend available technologies to move each campus away from onsite fossil fuel use. The forthcoming results of the studies will help to advance the Commonwealth's understanding of technology options, deployment approaches, and funding requirements necessary to successfully implement campus-wide transformations to a clean energy future.

State Carbon Reduction Policies

State	Baseline Year	Near-term Goal	Interim Goal	Long-term Goal	Source of Goal
Connecticut	2001	10% by 2020	45% by 2030	80% by 2050	Public Act 18-82
Delaware	2008	30% by 2030			Climate Framework for Delaware
Maine	1990	10% by 2020	45% by 2030	80% by 2050	LD1679
Maryland	2006	25% by 2020	40% by 2030		Greenhouse Gas Reductions Act- Reauthorization
Massachusetts	1990	25% by 2020		80% by 2050	Global Warming Solutions Act
New Hampshire	1990	10% by 2020	20% by 2035	80% by 2050	New Hampshire Climate Action Plan
New Jersey	2006	equal 1990 by 2020		80% by 2050	Global Warming Response Act
New York	1990	40% by 2030		85% by 2050 +15% CO2 capture	Climate Leadership and Community Protection Act
Pennsylvania	2005	26% by 2025		80% by 2050	Executive Order 2019-01
Rhode Island	1990	10% by 2020	45% by 2035	80% by 2050	§ 42-6.2-2
Vermont	1990	50% by 2028		75% by 2050	10. V.S.A. §578
Washington D.C.	2006	50% by 2032		100% by 2050	Clean Energy DC plan
West Virginia	N/A				

Recommendations

It is critical for states in the NEEP region to continue to evaluate and refine their public sector building strategies for new and existing buildings. The recommendations outlined in this section are meant to help public officials decarbonize their buildings while considering cost and long-term energy savings on the path to achieving zero energy. As stakeholders read through these recommendations, they may discover the need to strengthen existing programs by implementing additional measures to get better results, create new programs, or facilitate training for staff and building professionals.

Benchmarking and Building Energy Performance Standards

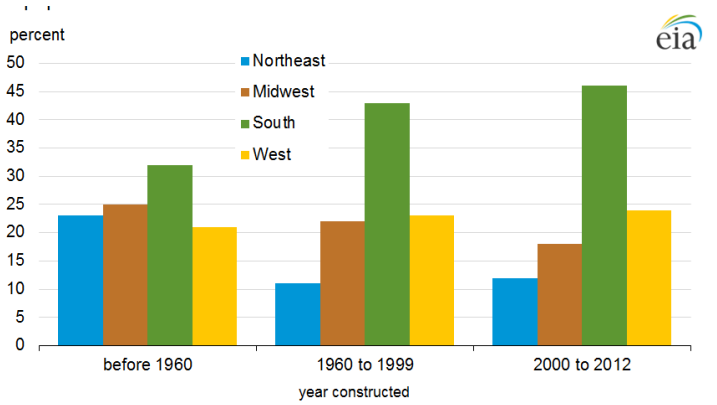
To decarbonize buildings, cities and states need to understand the energy use and GHG output of existing buildings. Therefore, jurisdictions should establish lead-by-example programs that include a combination of benchmarking and Building Energy Performance Standards (BEPS) for public sector buildings. Lead-by-example programs demonstrate the energy reduction potential of benchmarking and BEPS, and chart a path for the rest of the commercial sector.

Exemplar: Connecticut Benchmarking

In 2017 Connecticut implemented a web-based platform [EnergyCAP] to electronically capture and track state building energy use and cost by building, by facility, by agency, and statewide. In 2018 the major utility distributors began electronically flowing electricity and natural gas consumption data directly to the platform. This information allows Connecticut's lead-by-example team to identify where to strategically invest in energy efficiency upgrades to most effectively reduce energy use and cost, ultimately saving money for the state's taxpayers. The platform can connect data to U.S. EPA's ENERGY STAR Portfolio Manager, simplifying the data management that is essential to benchmarking.

Public sector buildings are often on the older end of the spectrum and many need renovations to improve their performance and energy efficiency. For instance, the average public sector building in New York City was built in 1953 according to a 2014 report published by the *Center for an Urban Future*. In 2017, the Rhode Island School Building Authority reported that the average age of school buildings is 56 years old. These older public sector buildings were constructed before the adoption of energy codes, meaning that without renovations and proper intervention they often perform worse in terms of energy consumption compared to newer buildings that use modern energy codes.

The median age of commercial buildings in the Northeast is 46 years according to the U.S. Energy Information Administration's (EIA) 2012 CBECS. Further analysis also shows that the highest percentage of commercial buildings in the Northeast were constructed before 1960.



Source: U.S. Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey

Benchmarking helps determine baseline energy efficiency for existing buildings by gathering and analyzing annual energy consumption data. ENERGY STAR® has an interactive map of benchmarking policies and voluntary programs around the country, tracked at both the city and state level.

Once a baseline is established, BEPS can be used to reduce the GHG emissions from the building by setting energy efficiency targets that increase in stringency over time. Benchmarking policies for public buildings must work in tandem with BEPS. By holistically incorporating both, public sector buildings can lead by example and demonstrate cost and energy savings over time as buildings increase in energy efficiency performance.

NEEP Resources

Benchmarking Dashboard

Building Energy Performance Standards Policy Considerations

Building Energy Benchmarking Policies in the Northeast and Mid-Atlantic

South Portland, ME Exemplar

Benchmarking: From Policy to Action

Benchmarking Toolkit

Additional Resources

ACEEE White Paper- Mandatory Building Performance Standards

Source: NEEP Benchmarking Toolkit

Exemplar: New Jersey Benchmarking Policy

In May 2018, Governor Phil Murphy signed an executive order that that directed the state to develop an Energy Master Plan (EMP) with the goal of achieving 100 percent clean energy by 2050. The state also enacted a Renewable Energy Bill (Assembly, No. 3723) which required 21 percent of the energy sold in the state be from Class I renewable energy sources by 2020; 35 percent by 2025 and 50 percent by 2030. It also established commercial benchmarking requirements:

- Within five years of enactment, benchmarking is required by all owners and operators of commercial buildings over 25,000 sq. ft. using Portfolio Manager.

New Jersey's Clean Energy Program has been providing ongoing assistance and resources for state and municipal buildings to access free benchmarking services for a number of years. In addition to tracking and reporting benchmarking data, the program also provides information on implementing energy-efficient technologies, including available financial incentives to lower project costs.

By providing these types of resources and best practices, the state was able to expand its benchmarking efforts and establish requirements for all commercial buildings.

Reduce Cost Barriers for Zero Energy Public Buildings

To transition to zero energy and decarbonize public buildings, states need to remove cost barriers to demonstrate the short-term and long-term benefits of building and retrofitting for zero energy. Ultimately, decarbonization of the built environment needs to drive a market transformation for the building industry. Public sector buildings can lead the way by implementing policies and programs for schools and other publicly-funded projects. Programs can also address existing buildings by removing cost barriers for deep energy retrofits.

One strategy that many states utilize is to create public funds that municipalities, commercial developers, and residential property owners can access for new construction and energy efficiency retrofits. These public funds are called green banks. A 2018 annual report by the American Green Bank Consortium tracks green banks around the country and outlines trends and opportunities for states to increase their capital investment in decarbonization.

In 2011, Connecticut became the first state in the country to pass legislation to establish a green bank called the Connecticut Green Bank. The Connecticut Green Bank uses limited public funding to attract private capital investment for projects aimed at decarbonization through energy efficiency, renewable energy infrastructure, etc. The green bank has been an effective tool for Connecticut, resulting in over $1.6 billion in capital for projects around the state. Project data recorded through 2019 also shows that for every $1 of public funds committed to the green bank, there is an additional $6 of private capital investment in the economy.

The Connecticut Green Bank has played a major role in removing cost barriers for decarbonizing public sector buildings by offering funding pathways for state and municipal-owned buildings. Programs like Solar MAP (Municipal Assistance Program) help municipalities access renewable energy to achieve energy savings by simplifying the process and removing some cost barriers associated with procuring solar for municipal buildings. Other programs like Energy Savings Performance Contracts (ESPCs) and C-PACE for Municipalities leverage Connecticut Green Bank assistance to help municipal-owned buildings decarbonize through energy efficiency upgrades. They also provide pre-qualified contractors and attract business investment, creating jobs. Many states have followed Connecticut's model and created funding strategies of their own for commercial and public sector buildings.

Other States in NEEP's Region With Green Banks:

State	Green Bank
New York	NY Green Bank
Maine	In development
Rhode Island	Rhode Island Infrastructure Bank
Washington DC	DC Green Bank
Maryland	Maryland Clean Energy Center
Regional (Northeast)	New York City Energy Efficiency Corporation

In addition to green banks, innovative strategies like public and private partnerships and matching programs can help raise capital for projects. States also use taxes and on-bill utility ratepayer charges to generate funds for zero energy projects and other decarbonization efforts. For instance, Massachusetts passed legislation to create the Renewable Energy Trust Fund in 1998. The trust is funded by a monthly on-bill system benefits charge ($0.0005 per kilowatt-hour) for electric utility ratepayers. The trust funds state programs like Massachusetts Clean Energy Center (MassCEC) which provides incentives and funding for both private and public projects. MassCEC also offers extensive resources and incentives to public sector buildings for renewable energy projects and retrofits. Programs like its Clean Heating and Cooling grant funds eligible projects like ground-source heat pumps.

Energy-as-a-service (EaaS) models can also help remove cost barriers for public sector buildings. The EaaS model allows building owners to access energy solutions without making large upfront capital investments. Instead, building owners often pay a subscription for the energy solution or service. Power Purchase Agreements (PPAs) for solar are a great example of this because they allow building owners to receive the electricity cost savings and environmental attributes of clean energy over a contract period (typically 10-15 years) without incurring the upfront cost of installing and maintaining the system. PPAs are a great solution for large public sector buildings, not only because of reduced upfront cost but also because onsite solar may not be feasible to meet the building's energy needs.

Deep energy retrofits and energy-efficient technology upgrades can also use EaaS to soften upfront costs of energy efficiency. Similar to PPAs, Energy Service agreements (ESAs) allow building owners to implement retrofits and install energy-efficient systems with no upfront costs. When a utility is the ESA provider, it can offer system upgrades to building owners and recoup the cost through a portion of the projected operational savings that would otherwise be passed on to the building owner.

Exemplar: New Jersey Pay-for Performance Program

The New Jersey's Clean Energy Program offers Pay-for-Performance (P4P) incentives for new construction and existing buildings projects. P4P is a way to achieve significant, larger-scale energy savings in the building stock and attract additional investments and financing models. This approach encourages long-term investment and provides cash flows for energy efficiency measures by metering energy and leveraging measured savings from constructing energy efficient buildings and making improvements to existing buildings.

The P4P Program may be used in conjunction with New Jersey's Energy Savings Improvement Program (ESIP). Government agencies can make energy related improvements to their facilities and pay for the costs using the value of energy savings that result from the improvements. Incentives must be deducted from the total project cost and the remaining balance financed by the building owner. Eligible buildings include local government facilities, K-12 schools, public higher education institutions, and state agency buildings.

For more info:
https://www.njcleanenergy.com/files/file/Pay%20for%20Performance/FY21/P4P%20FY21%20Program%20Guide%20Final.pdf

Electrification and Energy Efficient Retrofits

Energy efficiency retrofits and strategic electrification of building systems should be implemented in existing public sector buildings. Retrofitting existing buildings reduces operational cost, saves energy, and improves the health and comfort of buildings. Improvements to building ventilation and airtightness make buildings stabilize indoor temperatures and improve indoor air quality. In public sector buildings like schools, healthy indoor environments can increase academic performance and quality of life for both students and teachers.

As mentioned, strategic electrification in the building sector emphasizes the displacement and/or replacement of fossil fuel equipment used for space heating and cooling, domestic hot water, and other technologies. Strategic electrification enables electric loads to shift at various times of the day, which could help meet the growing need for flexible resources to manage the grid better and integrate renewable energy.

While public sector buildings vary in type, use, size, etc., determining how to electrify systems is a key part of the challenge. Electrification usually focuses on HVAC and domestic hot water systems by switching to heat pumps and other high-performance electric systems. It is recommended that states lead by example with deep energy retrofits like building envelope improvements, purchasing electric vehicle fleets, electric transit, and switching to heat pumps in public buildings. State agencies should rigorously assess and demonstrate the viability of these newer electrification technologies and related best practice approaches. They should also create a conversation within their communities. Both will help build market demand and capacities for quality productions and installation services.

Exemplar: Robinson Correctional Center Deep Energy Retrofit

Location: Enfield, Connecticut

Building Type: Correctional Facility

The Robinson Correctional Center facility was opened in 1985. In 2016, the facility completed a $275,381 deep energy retrofit to the rooftop HVAC system. The retrofit replaced the 24 existing HVAC rooftop units with high efficiency gas-fired rooftop cooling/heating units with return air enthalpy sensors. Following the completion of the project, the facility reduced energy use by 3,000 MMBtus, resulting in an estimated $143,000 cost savings.

For more info: https://portal.ct.gov/-/media/DEEP/energy/LBE/LBEREPORT2017CGS16a37uReducingEnergyManagmentatStateFacilitiespdf.pdf

In a 2019 report by Sierra Club titled Building Electrification Action Plan: For Climate Leaders, the group clearly outlines the various energy, cost, health and safety, and resiliency benefits of electrification around the country. A comprehensive National Renewable Energy Laboratory (NREL) study also explores the long-term impacts of

end-use electrification by measuring demand-side flexibility of buildings once high-performance electric technologies are installed.

In the lifecycle of any building, upgrades are necessary for ongoing operations and maintenance (O&M). One way to optimize a building's energy efficiency performance is to focus on energy efficiency retrofits during these lifecycle trigger points. Retrofits encompass electrification upgrades as well as improvements to ventilation through installation of high-performance windows and energy recovery ventilation (ERV) systems, improved insulation, and a focus on lowering thermal bridging. By making the building tighter through retrofits and electrifying HVAC systems, older public buildings can decarbonize and save money by consuming less energy.

NEEP Resources

Pathways to Decarbonize Existing Buildings

Local Government Leadership Building Electrification

Strategic Electrification Action Plan

Additional Resources

NY Power Authority's Build Smart NY Program

NYSERDA Clean Heating and Cooling Program

Exemplar: Linnaean Apartments Deep Energy Retrofit

Location: Cambridge, MA

Building Type: Public Housing

Size: 15,000 sq. ft.

The Linnaean Apartments is a 20-unit efficiency multifamily development in a low-rise building managed and maintained by the Cambridge Housing Authority. The building is a three-story wood frame, masonry and cast concrete building originally constructed in 1962. In 1981 the structure was converted into affordable elderly and disabled housing.

The development is looking to undergo a deep energy retrofit with the goal of achieving net zero. The deep energy retrofit is planned to include a new super-insulated enclosure, high performance windows, high efficiency heating/cooling, new domestic hot water systems, new mechanical ventilation, and if budget allows, a solar electric system to help offset energy consumption. The project has also established a goal of eliminating on-site combustion for thermal energy.

The project is currently in the study phase and the team includes ZeroEnergy Design (Architecture), Petersen Engineering (MEP/FP Engineer), and Cambridge Housing Authority (Owner/ Manager).

More info: https://zeroenergy.com/linnaean-apartments

Stretch Codes and New Construction Programs

Building energy codes are the most effective and uniform way to ensure that newly-constructed buildings become more energy efficient over time. Improved codes also have the benefit of making buildings healthier and more resilient. States in the NEEP region should improve building energy efficiency by adopting the International Energy Conservation Code (IECC), one of the national I-Codes.

The version of IECC that has been adopted varies from state to state, therefore varying minimum building energy efficiency. This means that new public sector projects that get built must only meet the minimum energy efficiency standard for the IECC version adopted by the state. New versions of the IECC are updated on a three-year cycle. Some states align with this three-year cycle to adopt the most current version of the IECC. However, other states have lagged significantly. States must implement policies to adopt the most recent version of IECC to drive continuous gains in building efficiency over time. The current edition of the IECC is the 2018 edition. However, IECC 2021 is upcoming and is expected to achieve significant energy savings to reach zero energy. The forthcoming version of the code will include two zero energy appendices for residential (NBI Zero Energy Residential Code) and commercial (Architecture 2030 Zero Code). These appendices may be adopted and implemented by states as stretch codes.

Stretch energy codes allow cities and towns to adopt above-code standards that go beyond the base code of the state. In the NEEP region, Massachusetts, Vermont, New York, Washington D.C., Maryland, and Rhode Island currently have voluntary stretch codes. These above-code standards can be required in public sector projects to ensure they achieve high efficiency levels beyond the state base code. For instance, Washington, D.C., adopted Appendix Z, which creates a pathway for all buildings in the District to achieve zero energy through high energy efficiency levels supplemented by a combination of onsite and offsite renewable energy. Washington, D.C. has committed to building all public sector projects to this standard. In Maryland, its commercial stretch code, the Green Building Council International Green Construction Code (Igcc) Supplement, applies to all state-owned and funded buildings and requires that they achieve 15 percent efficiency gain beyond the base code.

Code Recommendations

Use state and local authority to adopt building energy codes that require electrification and related deep efficiency in new construction and major renovation. Tools such as stretch codes can be used to support early market adoption and set requirements for public sector buildings.

In addition to stretch codes, states can also implement new construction programs that incentivize public sector projects to go beyond the building energy code and achieve zero energy. For instance, the Maryland Energy Administration (MEA) leveraged $9 million of utility funding to create the Maryland Net Zero Energy School Initiative Grant Program. The program provided funding for three new zero energy school projects in the Baltimore Gas and Electric Company (BGE) service territory. Eversource in Massachusetts will also be piloting a Zero Energy Schools Program. The program has not yet been launched but it will help incentivize zero energy

school projects in Massachusetts and provide best practices for communities looking to build zero energy schools in the future.

Exemplar: Wilde Lake Middle School

Location: Ellicott City, MD

Building Type: School

Size: 106,662 sq. ft

Total EUI: 13.8*

Completed in January 2017, Wilde Lake Middle School is the first net zero energy certified school in Maryland. The new school increased student capacity by 49 percent from 500 students in the original school building to approx. 760. Despite increased building occupant capacity, the new net zero building reduced energy consumption by 50 percent compared to the original school.

The school was built with financial support from the Maryland Energy Administration's Net Zero School Initiative Grant Program.

The building is powered by solar energy, the mechanical system is a highly efficient geothermal system with reduced HVAC usage, and the electric lighting is controlled and responsive to daylight. School and facility staff are trained in net zero building operations and maintenance, making the most of the energy efficient design.

The new Wilde Lake Middle School building is the first school to earn a U.S. Green Building Council LEED "Platinum" designation in the Howard County School District.

More info: https://www.hcpss.org/schools/net-zero-wlms/

*NBI's 2020 Getting to Zero Buildings Guide: https://newbuildings.org/wp-content/uploads/2020/09/NBI_GTZ-_List_2020.pdf

NEEP Resources

Building Codes for a Carbon-Constrained Era

Regional Energy Code Tracker

Construction Codes in The Northeast: Myths and Realities of Energy Code Adoption and The Economic Effects - 2018 Update

Energy Codes are Life Safety Codes

Code Adoption Toolkit

Massachusetts Zero Energy Stretch Code Adoption Process

Massachusetts is in the process of drafting a zero energy stretch code, which is expected to be adopted alongside the 10th Edition Base Code (based on IECC 2021) in 2022. Massachusetts municipalities that are part of the state's Green Communities Program are required to adopt the stretch code, which is very close to the current base code in terms of energy efficiency. The state has yet to determine the scope of a new stretch code. However, building professionals and energy efficiency experts have emphasized the importance of adopting a zero energy stretch code that sets ambitious energy efficiency targets that are supplemented by on-site renewable requirements and off-site procurement that meet the standards of Massachusetts' Renewable Portfolio Standard.

Massachusetts Zero Energy Stretch Code Proposals:

The state is looking at **Architecture 2030's Zero Code** submitted by AIA Massachusetts as a commercial stretch code proposal. NEEP has also submitted a zero energy stretch code proposal for consideration called the **Energy Zero (EZ) Code**. The EZ Code takes a prescriptive approach to achieve optimal levels of energy efficiency that are supplemented by electrification requirements and renewable energy that meets the standard of additionality.

The Department of Energy Resources (DOER) is also conducting a zero energy stretch code feasibility study for commercial and residential new construction. It will be making recommendations in 2021 which may include additional stretch code proposals.

Massachusetts is also discussing provisions for electrification that would include the elimination of on-site combustion for commercial buildings, like Appendix Z in Washington, DC. However, following a legal battle in Brookline over implementation of a "fossil fuel ban" ordinance in new construction, the state Attorney General's Office determined that such an ordinance would be in conflict with the authority of the building board, the plumbing board, and MA General Law.

The Attorney General's decision has led to implications that any combustion-free language in a stretch code proposal would fall outside of the purview of the Board of Building Regulations and Standards (BBRS). Therefore, electrification provisions that create combustion-free requirements would need to be addressed with the Department of Public Utilities (DPU) and implemented as a policy through state legislature.

Zero Energy Stretch Code Recommendation

States like Massachusetts that are looking at adopting a zero energy stretch code, should first establish a roadmap to zero energy through codes. Every state has unique factors that influence its code adoption cycle so it is important to determine how many code cycles it would feasibly take for the state to adopt a zero energy base code. Once that goal has been established, states can work backwards to determine the scope of a stretch code that would help them rapidly achieve its goal. If a zero energy stretch code is under consideration, states should focus on optimizing energy efficiency through a combination of prescriptive and performance metrics, and determine how electrification and renewable requirements are handled by either the code or legislation.

Many communities around the state like Somerville, Boston, and Cambridge have already taken steps to address decarbonization efforts for their public sector buildings and are advocating for a zero energy stretch code to address all buildings in the Commonwealth.

Workforce Training

The cultivation of an energy efficiency workforce is an essential part of driving market transformation in the built environment. States have a few key opportunities to lead by example and ensure that building projects incorporate high performance or zero energy features and are operated in a manner consistent with their design. For new construction projects, facility managers must be incorporated into all phases of building design and receive training on newly-installed systems. Additionally, building managers (i.e. facility directors, building operators, etc.) should always be equipped with digital and/or hard copies of manuals, user guides, and building schematics. Having these documents onsite also helps reduce issues when there is staff turnover in key building operator positions. These requirements should be written into state policies about publicly-funded buildings.

Maryland-*Clean Energy Jobs Act (2019)*

Built on the foundation of doubling Maryland's Renewable Energy Portfolio Standard (RPS) to 50 percent renewable electricity by 2030, the act would carve out 14.5 percent of the RPS for in-state solar and 1.2 gigawatts for offshore wind, opening up thousands of new in-state jobs. In order to ensure that the carve-out leads to in-state jobs, government agencies, labor groups, and clean energy stakeholders will work together to examine the best funding opportunities to invest in workforce training in the clean energy industry. There will be a focus on removing barriers to entry for low income communities, people of color, women, and veterans by increasing funding for capital loans.

Due to the complexity of building energy systems, (especially HVAC) building management systems, and advanced controls, facility personnel can greatly benefit from formalized training. There are several programs offered throughout the region that can provide necessary training. To help choose the appropriate level of training, the U.S. Department of Energy (U.S. DOE) has several resources on its Workforce Development Website. U.S. DOE worked in collaboration with the National Institute of Building Sciences to create consistency in credentialing programs across the country, which resulted in the Better Buildings Workforce Guidelines. A complete list of credentialed programs can be found here.

New York- *NYSERDA Clean Energy Workforce Development*

Through 2025, NYSERDA will commit $100 million to build New York's workforce through clean energy workforce development and training. The funding will provide opportunities for the following activities:

- Training building and operations staff to properly operate and maintain building systems
- Providing on-the-job training for new clean energy workers
- Supporting internships for students looking to gain hands-on skills at a clean energy company
- Enhancing curricula to meet the demands of clean energy employers
- Establishing a talent pipeline that can reduce business costs of hiring new workers

In general, workforce training is an extremely beneficial policy and program to implement. According to a joint report by E2 and Clean Jobs Count, jobs dealing with renewable energy, energy efficiency, and electric vehicles grew by 14 percent from 2017 to 2018. There are over two million energy efficiency jobs nationally and nearly 50 percent of clean jobs are in construction. Also, two states in NEEP's region (Massachusetts and New York) are in the top 10 for the greatest number of clean jobs.

Grid Interactive Efficient Buildings

As the electric grid continues to be modernized to support the integration of **distributed energy resources (DERs)** and to take advantage of cutting-edge technologies, measures will have to be put in place to accelerate the rate at which buildings currently integrate with the grid. Grid-interactive Efficient Buildings (GEBs) are buildings with a holistic and well-optimized blend of energy efficiency, energy storage, renewable energy, and load flexibility technologies enabled through smart controls. Their responsiveness to the grid allows them to reduce energy and emissions and be more adaptive to real-time changes in energy demand on the grid. Utilities are in the early stages of exploring and implemented GEBs programs, but the technologies that support them have been around for a long time.

Distributed Energy Resources*

A DER is a resource sited close to customers that can provide all or some of their immediate electric and power needs and can also be used by the system to either reduce demand (such as energy efficiency) or provide supply to satisfy the energy, capacity, or ancillary service needs of the distribution grid. The resources, if providing electricity or thermal energy, are small in scale, connected to the distribution system, and close to load.

Examples of different types of DERs include:

- Solar photovoltaic (PV)
- Wind
- Combined heat and power (CHP)
- Energy storage
- Demand response (DR)
- Electric vehicles (EVs)
- Microgrids
- Energy efficiency (EE)

*https://emp.lbl.gov/sites/default/files/4._coddington_stewart_oneil_ders_updated.pdf

To drive utility adoption of GEBs through the public sector, state public utility departments/commissions should work with their local utilities to address barriers to more widespread market adoption. Public sector buildings can implement GEBs strategies by retrofitting for energy efficiency and installing smart controls for building systems. Developing microgrids for essential public sector buildings like police stations, hospitals, and other building infrastructure can take the pressure off the utility grid. Pairing on-site renewables with energy storage is also a great way for public sector buildings to lead by example. In the event of outages, energy storage can provide power to essential buildings and drive resiliency. Public sector buildings can also demonstrate demand responsiveness by installing energy storage and smart monitoring technology.

In 2020, NEEP published its *Grid Interactive Efficient Buildings (GEBs) Tri-Region Status Report,* which looks at the barriers and opportunities for GEBs in the Northeast, Midwest, and Southwest regions. It is a great resource for states to look at current trends and establish best practices to assist their utilities in implementing GEBs strategies in the market.

NEEP Resources

Grid-Interactive Efficient Buildings (GEBs) Tri-Region Status Report

The Endless Possibilities of Grid-Interactive Efficient Buildings

Additional Resources

Department of Energy Grid-Interactive Efficient Buildings Resources

NASEO- GEBs: State Briefing Paper

Conclusion

From K-12 public schools to town halls, public sector buildings are an important part of our lives. As states move towards the goal of carbon neutrality and zero energy buildings, states need to use all the tools at their disposal to lead by example through the public sector.

For existing buildings, benchmarking helps states establish an energy baseline for their building stock. Without a baseline, efforts to decarbonize and reduce energy consumption would be disjointed and ineffective. Once that baseline is established, performance standards can require or help incentivize building owners to take certain measures to reduce energy usage over time. Cost barriers often prevent building owners from taking proactive measures to decarbonize. Providing funding strategies like green investment funds, public/private partnerships, and utility incentives can help remove these barriers. Once cost barriers have been removed, proven decarbonization strategies like strategic electrification and deep energy retrofits give building owners a range of options for how to reduce energy and emissions.

For new construction, the best way to ensure that buildings are built as energy efficient as possible is through building energy codes. States can also adopt voluntary stretch codes that go further than the base code and are a great tool for communities and whole building sectors to require higher energy efficiency standards.

Following the adoption of a new code, a robust workforce is needed to design and build to the new standard. States can help prepare the workforce by offering training programs and economic development pathways to increase market transformations in the energy efficiency and clean technology industries.

Finally, states should work with utilities to implement strategies that increase the number Grid Interactive Efficient Buildings (GEBs) which helps improve grid resiliency and responsiveness as more distributed energy resources (DERs) come on to the grid.

The recommendations and exemplars throughout this report will help states implement strategies and establish best practices that have proven effective in other states. To decarbonize the built environment and drive market-wide transformation in the commercial and residential building sectors, states must work together and adopt proven strategies that can be piloted through the public sector.

Appendix

Regional Lead-By-Example Programs and Initiatives

State	Legislation	Lead By Example Program/Initiative	Program Description
Connecticut	Executive Order 1 (2019)	https://portal.ct.gov/DEEP/Energy/Lead-By-Example/Lead-By-Example	"Advances efficient energy management at state government facilities by driving initiatives that save energy and operational costs while reducing Connecticut's carbon footprint."
Maine	Executive Order 13 (2019)	N/A	"Maine state government will lead by example in investing in energy efficiency, renewable energy, and emissions reductions; promoting health and sustainability in the workplace; and building resilient infrastructure"
Maryland	"Maryland Leads by Example" Executive Order (2019)	N/A	"Initiative is to reduce energy consumption in state-owned buildings by 10% by 2029."
Massachusetts	Executive Order 484 (2007)	Leading by Example Initiatives	"LBE works collaboratively with state agencies and public colleges and universities to advance clean energy and sustainable practices that reduce the environmental impacts of state government operations."
New Hampshire	Executive Order 16-03 (2016)	State Government Energy Council	"State government continue to lead-by-example in energy efficiency, conservation, and renewable energy"
New York	Executive Order 166 (2017)	https://www.nyserda.ny.gov/All-Programs	"Affected State Entities are hereby directed to implement a portfolio of measures that may include but shall not be limited to no- and low-cost operational improvements, retro-commissioning, capital energy efficiency retrofits, and onsite renewable and high efficiency combined heat and power projects"
Pennsylvania	Executive Order 2019-01 (2019)	GreenGov Council	State agencies will reduce energy consumption, purchase EVs, procure renewable energy, and to high-performance building standards.
Rhode Island	Executive Order 15-17 (2015)	http://www.energy.ri.gov/policies-	"Oversee and coordinate efforts at State agencies to reduce energy

		programs/lead-by-example/	consumption and greenhouse gas emissions”
Vermont	Executive Order No. 15-12 (2012)	State Agency Energy Plan	Reduce total energy consumption by 20% by 2025, and by 25% by 2030. Meet 35% of the remaining energy need from renewable sources by 2025, and 45% by 2030. 40% reduction of greenhouse gas emissions below current levels by 2030