MUNICIPAL OVERVIEW

High-Performance Building Essentials

High-Performance Building Procurement Toolkit

CONTRIBUTORS & ACKNOWLEDGMENTS

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builtenvironmentplus.org

sustainable-performance.org

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Why Build High Performance?

High-performance (HP) buildings are healthy, durable, long-lasting structures that operate with less energy, use fewer natural resources, and require less maintenance than traditional buildings, and they adapt easily to new uses for the future. Airtight but well-ventilated buildings with highly insulated enclosures are central to the HP concept. They are designed to be comfortable and resilient, even during power outages and despite the impacts expected from a warming climate.

High-performance buildings deliver better value and greater return on every invested dollar by reducing inefficiencies and utilizing smart building practices.

It is often assumed that high-performance projects are more expensive to build. In reality, the majority of HP design strategies rely on best practices like passive design, smart orientation and building system optimization that do not require expensive technology but do fundamentally improve the operating function of the building. Any additional upfront costs are generally offset by long-term operating and energy savings and provide additional sources of value. Note that the high operational and maintenance costs of traditional, less efficient buildings should be quantified in any comparison to the life-cycle costs of high-performance buildings.

BOSTON ARTS ACADEMY. BOSTON, MA.
PHOTO: WILSON BUTLER ARCHITECTS

Benefits of Building to High-Performance Standards

For Developers and Public or Private Building Owners

1 IMPROVED FINANCIAL PERFORMANCE

- Savings on utility and maintenance expenses
  - Lower energy bills
  - Lower water use
  - Simplified and "right sized" mechanical systems lower capital cost and maintenance
  - Potentially lower insurance premiums
- Increases employee productivity, wellness, and retention
- Increases resale value or rental rates and faster leasing (where applicable)
- Increases funding opportunities: Green building attributes are appealing to lenders and insurers.
- Ability to maintain higher occupancy in pandemic conditions with a focus on healthy indoor air quality
- Significant financial incentives and technical assistance are available at both design and construction phases, depending on location. Contact Mass Save® or the local municipal utility to learn more.

2 ENHANCED PUBLIC PROFILE

- Increased recognition and marketing possibilities
- Higher perception of brand
- Attract and retain talent or top market residential tenants

3 SUPERIOR OCCUPANT EXPERIENCE

- Excellent ventilation and indoor air quality
- Increased thermal comfort
- Reduced noise levels
- Optimized natural lighting

4 INCREASES RESILIENCE AND REDUCES ENVIRONMENTAL IMPACT

- Reduced risk of system failures and disruption of services
- Provides comfortable living conditions for longer during power outages or heating/cooling interruptions (Passive Survivability)
- Durability strengthens resilience to extreme weather
- Reduced energy demand and emissions of greenhouse gases and other pollutants
- Align with local and global decarbonization goals
- Stay ahead of evolving regulations that will require these features in the future

Benefits of Building to High-Performance Standards
For Municipalities and Communities

1 LEADERSHIP BY EXAMPLE

- Building High-Performing municipal projects shows the greater community what is possible and demystifies the solutions and strategies.

2 REDUCED ENVIRONMENTAL IMPACT

- Aligns with local climate action plans
  - Locally cleaner air
  - Conserves water use, which is important as drought conditions become more common and frequent

3 INCREASED COMMUNITY RESILIENCE

- Passive survivability: Durable building envelopes strengthen resilience and enhance public safety compared to code-compliant buildings.
- Mechanical and other equipment, safely located away from vulnerable spaces, is not threatened, damaged, or put out of use.
- Energy, water, and sewer infrastructure (when updated and designed for resilience) creates less demand on the aging energy grid or underground piping and is less vulnerable to long-term threats and the secondary hazards of failure.

WANT MORE INFORMATION?

Check out the following resources – reports, research, and current articles that support the cost and value of high performance as described above:

- Built Environment Plus: Zero Energy Buildings in Massachusetts
- Built Environment Plus: Massachusetts is Ready for Net Zero
- Institute for Market Transformation: High-Performance Buildings and Property Value
- New York Times: As Risks of Climate Change Rise, Investors Seek Greener Buildings
- STOK: Corporate Real Estate's Role in ESG: Scaling High-Performance Buildings by Leveraging an Effective Real Estate Program
- STOK: The Financial Case for High Performance Buildings: Why it Matters
- Phius: Cost Data

Massachusetts Incentives:

- Mass Save®: New Construction and Major Renovations
- Mass Save®: Passive House Incentives (multifamily)
- Check for other possible incentives with your Municipal Utility

Get Inspired with these examples of passive house buildings:

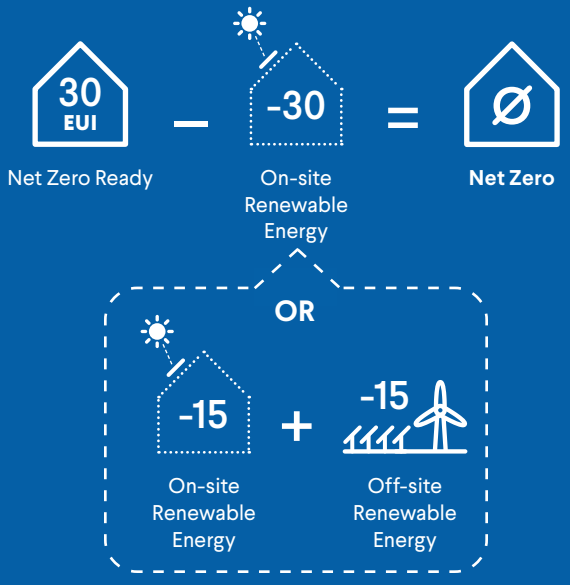
- High Performance Buildings Magazine: Case Studies
- Passive House International: 10 Passive House Buildings that are not houses

How High-Performance is Done

Numerous technical guides illustrate strategies for designing high-performance buildings, but successful outcomes rely as much on the process of design and decision-making as on the strategies that are ultimately chosen. That's why the first step is to select a design team that knows how to design high-performance buildings or at least is highly motivated to learn. This means that they have demonstrated experience achieving client goals and understands that a high-performance building can only be achieved through a highly collaborative process.

Even if you hire the best team, that team still needs you to set clear and ambitious goals. It is important to request a Net Zero option early on to assess what commitments can be made and what it would take to achieve the best value. From the outset, make sure that the project teams engage Mass Save® or the municipal utility to take advantage of financial incentives and/or technical assistance that support both design and construction. Municipalities may consider establishing special MOUs* (memorandums of understanding) with their local utilities to target incentives for special conditions they want to address in their communities.

BOSTON UNIVERSITY, CENTER FOR COMPUTING & DATA SCIENCES - THE LARGEST NET ZERO ENERGY BUILDING IN BOSTON . PHOTO: TOM ARBAN



A Net Zero building generates as much energy as it consumes on an annual basis.

To achieve zero energy a project first reduces energy use through efficiency measures and optimizes for renewables. Once Net Zero energy ready, the project requires renewable energy on-site and/or off-site to offset the remaining energy use.

Essentials of a High-Performance Building

SITE AND CONFIGURE THE BUILDING TO MINIMIZE ENERGY LOADS

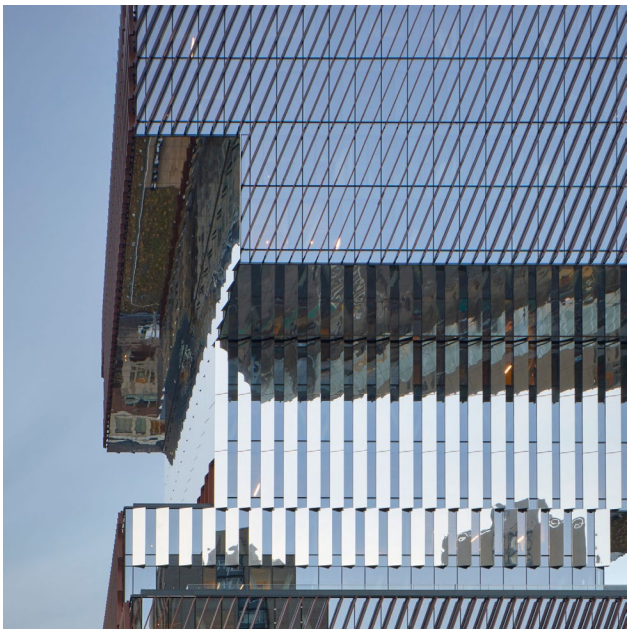
Take advantage of free energy! Siting, massing, and solar orientation will greatly influence energy use. This is called passive solar design. These strategies don't add cost, but they do save money! Taking advantage of free natural resources like light, heat, and natural ventilation means that mechanical systems will do less of the heavy lifting. The following strategies are often overlooked:

- Optimize glazing on southern elevations plus appropriate shading on these areas in summer.
- Limit north, east, and west windows to prevent heat loss and too much solar gain.
- Optimize natural lighting by separating view glass that is properly recessed or shaded from ambient light. Glass should be at the clerestory level where possible.

ANNIE E. FALES ELEMENTARY SCHOOL - THE FIRST NET-POSITIVE ENERGY PUBLIC SCHOOL IN NEW ENGLAND. WESTBOROUGH, MA. PHOTO: HMFH ARCHITECTS

PRIORITIZE BUILDING ENVELOPE

Building envelopes are durable and do not have moving parts – unlike mechanical systems that require frequent maintenance and replacement. Investing in the enclosure will lead to better value over time. Further savings are achieved when envelope, mechanical, and lighting strategies are considered together, instead of oversizing equipment or reducing redundant equipment. For example, well-insulated walls with highly insulated glass can eliminate the need for perimeter heating systems. Highly collaborative teams will analyze these trade-offs and their long-term costs to strike the best balance.



BOSTON UNIVERSITY, CENTER FOR COMPUTING & DATA SCIENCES - "TRIPLE-GLAZED CURTAIN WALL WITH FIXED EXTERIOR SHADES ELIMINATE THE NEED FOR PERIMETER HEAT AND REDUCE COOLING LOADS." - BR+A CONSULTING ENGINEERS. BOSTON, MA. PHOTO: TOM ARBAN

CONSTRUCT TO BE BEST-IN-CLASS

- Design according to climate zone and projected temperatures (not historical).
- Carefully assess the best insulation for the entire six-sided envelope (walls, roof, and foundation) to match Passive House standards per climate zone. As Passive House envelope standards are increasingly required in municipalities, you will be ready for regulatory requirements!
- Select triple-paned windows in wood or fiberglass frames.
- Prevent typical heat loss through the enclosure by using continuous insulation and an airtight barrier. Then conduct blower door testing where appropriate and envelope commissioning to make sure installations were done well and to catch any areas with breaches.
- Design a solar-ready building wherever there is viable solar exposure. Carefully consider the locations of roof penetrations to minimize interference with solar PV panels. Once those penetrations are set, they are impossible to change and can reduce solar generation potential by 30% or more! Whether solar panels are installed immediately or at some point in the future, ensure your building is solar ready!

FINCH CAMBRIDGE - THE FIRST AFFORDABLE PASSIVE HOUSE BUILDING IN MASSACHUSETTS. CAMBRIDGE, MA. PHOTO: ROBERT UMENHOFER

Passive House is a performance-based building certification that focuses on the dramatic reduction of energy use for space heating and cooling.

It is based on clearly defined metrics for energy performance that can be achieved through high-quality design and construction techniques.

HEATING, VENTILATION AND COOLING

- During the programming phase, consider space adjacencies that group highest energy intensive spaces near each other, when possible, for greatest efficiency.
- Provide a central natural air ventilation system that captures and reuses indoor energy, such as an energy/heat recovery ventilator (ERV or HRV)
- Do not oversize the mechanical system!

  - With a well-insulated envelope, the mechanical system needed is smaller– it will be less costly to purchase and operate.

  - Invest in energy modeling to anticipate true load (utility or municipal incentives can help).

- Use all-electric systems. Emissions associated with electricity from the grid are already lower than what on-site fossil fuel combustion would produce. Over time, grid electricity is getting cleaner..

  - Heat pumps (air or ground source) provide highly efficient, highly customizable solutions for heating, cooling, and domestic hot water needs.

  - Consider solar thermal for hot water heating.

CONCORD RIVERWALK - WITH VERY TIGHT BUILDING ENVELOPES, EACH COTTAGE ONLY USES AS MUCH ENERGY AS CAN BE PROVIDED BY ON-SITE SOLAR. PHOTO: UNION STUDIO ARCHITECTURE

BELMONT MIDDLE & HIGH SCHOOL - 100% ELECTRIC WITH A GEOTHERMAL WELL HEAT PUMP SYSTEM TO PROVIDE HEATING AND COOLING TO THE BUILDING.
PHOTO: PERKINS+WILL

ENERGY- AND WATER-EFFICIENT APPLIANCES AND FIXTURES

- Install LED and low-energy-use light fixtures
- Select appliances with Energy Star ratings
- Specify all plumbing fixtures with EPA Water Sense compliance
- Induction cooktops and ranges are catching on for both commercial kitchens and residences!

POWISSET NET POSITIVE BARN - APPLIANCES AND HIGH EFFICACY LED LIGHTING ENSURE EFFICIENT ENERGY CONSUMPTION.
PHOTO: ERIC ROTH

THEN... BE READY FOR RENEWABLE INFRASTRUCTURE.

Renewables come last. Once you've done the basics to reduce your energy demand and create the best insulated building possible, you are able to make the best economical use of renewable energy.

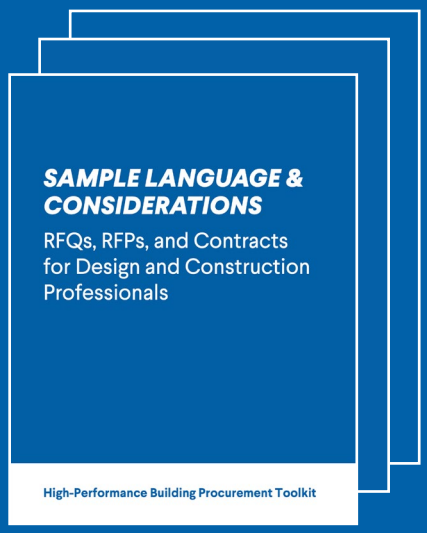
- Install solar panels on site or construct buildings to be "solar-ready"
- Provide EV charging stations or plan for future charging infrastructure
- Depending on the type of project, install (or be ready for) battery storage for resiliency or peak-shaving purposes

R.W. KERN CENTER- THE LARGEST LIVING CERTIFIED HIGHER-EDUCATION PROJECT IN THE WORLD AT THE TIME OF ITS COMPLETION.
PHOTO: BRUNER/COTT ARCHITECTS

CHECK OUT THESE RESOURCES FOR HELP!

Hire the best teams:

- BE+ CONNECTS - Find High Performance Pros with proven experience
- BE+ MassCEC: Additional High-Performance Building Procurement Toolkit documents



One-stop resource for all aspects of HP building:

- Whole Building Design Guide (WBDG)

Targeted resources:

- Williams College: Passive Solar Design
- Phius: Passive Building Principles
- Whole Building Design Guide (WBDG): High Performance HVAC
- RMI: Clean Energy 101: Heat Pumps
- MassCEC: Air-Source Heat Pumps

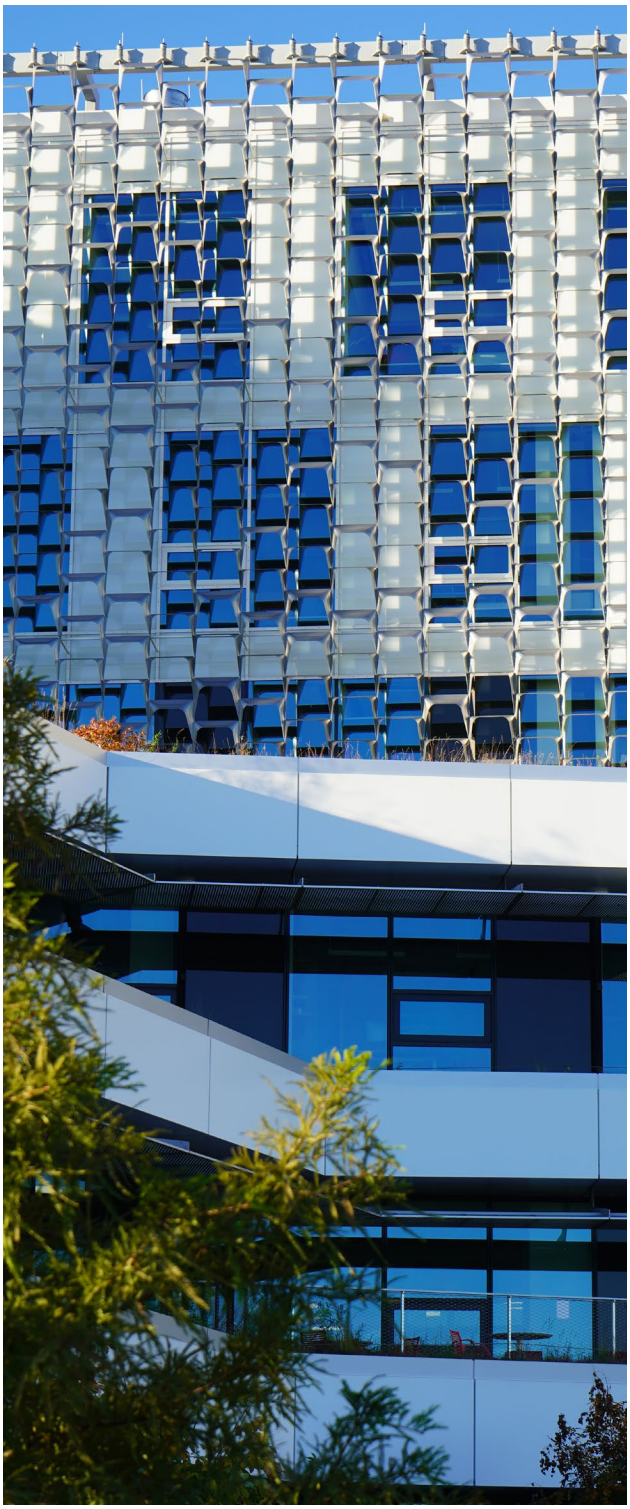
Incentives and Rebates:

- Mass Save®: New Construction & Major Renovations

Going Beyond Energy

Building projects provide opportunities to enhance communities and occupant health beyond the critical issues of energy and carbon. Other beneficial areas are exterior site and landscape and interior, building materials, and supply chain. These provide further opportunities to enhance the value of your assets, making them even more attractive to prospective tenants or owners.

- Low-impact development (LID) can reduce both up-front and maintenance expense for the site and its landscaping, while providing benefits to ecosystems, such as, collecting and storing rainfall for irrigation. Green infrastructure elements such as these decrease demands on over-taxed stormwater systems:
  - green roofs
  - Rain gardens
  - Bio-retention areas
  - Permeable paving
- Pay attention to your material choices to create healthy interiors, lessen waste, and reduce embodied carbon.
  - We spend 90% of our time indoors. Specify healthy materials with no/low-VOC (volatile organic compounds) levels and avoid "red-list" materials for better indoor air quality and human health
  - Select materials with low embodied carbon
  - Whenever possible, source materials that are available at shorter distances to the project site to reduce transportation impacts.
  - Investigate waste savings measures such as prefabricated and panelized construction, recycling, and construction material exchanges, including the local BE-Xchange.



HARVARD UNIVERSITY SCIENCE AND ENGINEERING COMPLEX - NAMED ONE OF THE HEALTHIEST, MOST SUSTAINABLE, AND ENERGY-EFFICIENT LABORATORY BUILDINGS IN THE WORLD

Achieving HP Capital Projects Within a Municipality's Portfolio

KING OPEN/CAMBRIDGE STREET UPPER SCHOOLS AND COMMUNITY COMPLEX. CAMBRIDGE, MA. PHOTO: ROBERT BENSON

To ensure your project has the best chance of hitting its performance targets, the most important step is assembling a great project team. Your team's buy-in and commitment and the quality of their design process contribute more to the success of the project outcomes than any other aspect, even money and technology. That's why it is critical for all project partners to be united on project goals and the steps needed to achieve them.

HP building goals are best achieved when the development, design, construction, and consultant teams are aligned from the very beginning. The ideal method for a goal-driven, highly collaborative process is called an Integrated Design Process (IDP). Be careful not to confuse IDP with Integrated Project Delivery (IPD). The latter is a formal contract structure that aims to legally distribute accountability across the team. It is important to know that you can require an IDP, an Integrated Design Process, without using an IPD legal contract structure.

An Integrated Design Process is one of close collaboration with, and consideration for, the other participating disciplines, starting from the design phase

Create a Project Roadmap

One of the most effective ways of keeping a team on track and motivated is to co-create a Project Roadmap that lays out the sequence of steps needed to achieve the project's goals. Without a roadmap, the typical result is lack of clarity, gaps or overlaps in scope with consultant activity, and deliverables that are compromised in quality or time.

The process of creating the Roadmap begins once the project's goals are set, the team understands which expert consultants are critical to achieve those goals, and the owner and key team members have discussed which analyses need to be done, by whom and at what point in time. For tasks that have multiple steps or iterations, the Roadmap clarifies when each step must happen. For each step, the group needs to map out who needs to give input, provide feedback, or approve final decisions.

The process of creating this roadmap achieves three important things.

1. It helps build buy-in and mutual accountability, which keeps the commitment from eroding later in the process.
2. It lays out when large group meetings (referred to as "charrettes") need to happen.
3. It clarifies for everyone, including the owner, the appropriate timing and scope for each consultant.

For these reasons, it is a good idea to have two phases of contracts: First, an initial short-term, early-stage contract with the architect and some consultants to clarify the actual, detailed scope. Second, the final contracts, when the owner and team have this clarity. Executing final contracts at this point will ensure that the scope for each consultant will reflect the best timing and input needed.

There are additional factors and key steps for municipalities to consider when managing their own projects, as well as factors to consider to influence private development projects through the permitting and review process.

- Define the building type and actual programmatic need.
- Define vulnerabilities, hazards, and desired level of resiliency.
- Set project-specific goals for Energy Use Intensity (EUI).
- Decide if you are committing to certification with one of the green building rating systems early on. Delaying this decision will cause problems and raise costs.
- Set clear goals and objectives for the project internally. Energy and carbon goals should be aggressive.
- Write a great RFP including Owner's Project Requirements (OPR); see HP Procurement Toolkit Sample RFP Language.
- Set clear expectations for the design team, including the IDP process.
- Require a Net Zero energy study be done early on to assess how close you can get and what it would take to achieve this level of performance.
- Conduct a project closeout process to discuss what went well and what could have been better, including an explicit "lessons learned" session to inform future projects.
- Track the performance of your projects over time.

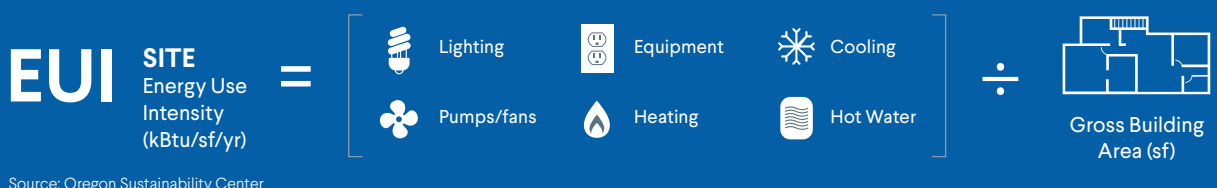
Energy Use Intensity is the amount of energy a project uses per square foot over the course of a year.

Permitting and Review of Private Development

PHILLIPS ACADEMY SNYDER CENTER. ANDOVER, MA. PHOTO: PERKINS&WILL

The permitting and review process is a prime opportunity to influence how your community is affected by projects for generations to come. Ideally, the objective is to align private development with community objectives, a climate action plan if it exists, and long-term health and resilience. This can be done through many different routes: from programs, including (financial or non-financial) incentives; regulations; and zoning and other policies.

Each community has different mechanisms in place, so consider the approaches below in the specific context of your community's scale, resources, and existing tools. It is important to consider targeting four kinds of activity: planning scale (neighborhood, campus, district), new construction, major renovations, and targeted energy upgrades for existing buildings. The following list includes a sampling of different approaches that may be appropriate in different scenarios and gives an idea of the kinds of actions a municipality can take to drive best practices in private development.



Source: Oregon Sustainability Center

ALIGN PERMIT AND REVIEW PROCESS AND EMBED NEW REQUIREMENTS

Aligning a municipality's existing review and/or permitting process with its energy and carbon goals involves attention both substance and process. A good first step for the municipality is to critically evaluate its current processes for compatibility with an IDP project delivery process and workflow.

- Do the municipality's required check-ins and deliverables align well with an Integrated Design Process (IDP)? This is especially important when energy or carbon analysis needs to happen to inform design decisions.
- If the processes don't align well, can the municipality's timelines be adjusted to better match a good development process?
- Are there other barriers that can be removed to facilitate better design and development?

Next, consider what may need to be added to the existing review or permit process. All projects should be required to have an energy goal. This is usually framed as a predicted Energy Use Intensity target (pEUI), or a prediction of energy use per square foot per year. This concept is similar to knowing the MPG of a car before deciding which car to buy. In addition, requiring a net zero energy feasibility study early on, after goal setting and before schematic design is finished, will help the team understand what is possible, especially if they have to justify their decisions in a review process.

A whole-building carbon assessment is another good analysis to request. This is different from energy, which focuses on power sources for building operations like heating, lighting, and power. Embodied carbon emissions are tied to the products used to construct the building, how they were manufactured transported, and installed. These emissions can have a bigger impact than the operation of your building over its lifetime. A whole-building life cycle assessment (LCA) could capture carbon emissions (global warming potential) over the building's entire lifespan, from material extraction to its end of use. In addition, the LCA would capture other impact categories like ozone depletion, human toxicity, water use, and more.

Lastly, consider requirements for analyses at different phases of the project. Energy and/or daylight simulations are prime examples. These may require more than one iteration, depending on the size and complexity of the project. This kind of work is often subsidized by the utilities, so encouraging developers and owners to take advantage of utility incentives very early on is important.

154 BROADWAY IS PURSUING PASSIVE HOUSE CERTIFICATION AND WILL MEET SOMERVILLE'S REQUIREMENT FOR A NET-ZERO READY BUILDING.
PHOTO: UTILE

Permitting and Review of Private Development - *continued*

INCENTIVES

Many effective incentives are non-financial. These can include fast-tracked permitting, Floor Area Ratio (FAR) bonuses, short-term tax abatement, or other similar means. For financial incentives, an easy step is to require project teams to prove that they have explored all possible Mass Save® or other utility incentives early in the review process. Note that some valuable Mass Save® incentives apply to the design phase.

It's also possible for a municipality to work with the utility to create a targeted Memorandum of Understanding (MOU) that focuses incentives on the municipality's specific goals. Some communities are mostly rural or suburban; others are denser, with a lot of commercial development. Rural communities would target MOU incentives to homeowners, whereas cities might target existing building upgrades for commercial buildings. Larger municipalities, and cities like Boston and Cambridge, have negotiated agreements with utilities to reinvest money that comes from those communities back into their own building stock to address existing building upgrades and other strategies that need direct financial support.

THE DISTILLERY - ONE OF THE FIRST MULTIFAMILY PASSIVE HOUSE BUILDINGS IN NEW ENGLAND, AND THE FIRST IN MASSACHUSETTS PHOTO: TRENT BELL

Permitting and Review of Private Development - continued

ZONING

First, it is helpful to ensure that existing zoning doesn't thwart your goals. For example, ensure that locating exterior equipment, like heat pumps, or adding exterior insulation won't be blocked by existing zoning requirements. Next, zoning can be a perfect opportunity to create overlay districts or areas to target low carbon or Net Zero energy. Certain areas lend themselves to infrastructure upgrades, microgrids, or other strategies beyond a single building that would enable individual parcels to "plug in" to a zone of higher performance.

Areas with more stringent requirements can serve as pilots for expansion in the rest of the community for any initiative that makes sense for the community, such as: energy upgrades to existing buildings, passive house level building enclosure requirements for new buildings, EV parking requirements, LED street lighting, bike lanes, and so forth.

THE KENZI - 50 UNITS OF SUPPORTIVE, AFFORDABLE HOUSING FOR OLDER ADULTS AND PART OF A FIVE-PHASE REDEVELOPMENT OF THE FORMER BUS YARD. PHOUTO: DREAM COLLABORATIVE

ORDINANCES AND OTHER POLICY LEVERS

The most important thing a municipality can do is adopt the "Stretch" building energy code, or better yet, the "Specialized" code! In addition, you can consider targeted initiatives such as eliminating overnight, whole-building lighting in office buildings, requiring LED lighting in buildings under construction, installing smart and responsive traffic light technology to reduce idling, requiring deconstruction (to avoid landfilling), and EV fleets for businesses.

Some communities are considering gas bans for new construction, which may require a longer process, but could have significant long-term benefits. Another tool, implemented by partnering with local Realtors, is to include energy performance information at the turnover of lease or sale of property. This strategy becomes a market driver, helping new tenants or owners factor that information in as part of their decision-making.

380 STUART STREET- DESIGNED IN ALIGNMENT WITH BOSTON'S PROGRESSIVE GREEN BUILDING AND CARBON-NEUTRAL GOALS. PHOTO: CBT ARCHITECTS

Permitting and Review of Private Development - continued

CONSIDER CREATING A BUILDING ENERGY USE BENCHMARKING PROGRAM

Building energy use disclosure programs are tools that provide insight into the energy usage of *existing* buildings and provide baselines against which to measure progress. Municipalities can establish such programs via ordinance. Take a look at two different programs in the Commonwealth: Boston's Building Emissions Reduction and Disclosure Ordinance and Cambridge's Building Energy Use Disclosure Ordinance. The data generated by such programs also provides an understanding of which properties need the most help, enabling you to target incentives (as with utility MOUs) to help them improve their performance.

325 BINNEY STREET - DESIGNED TO BE THE MOST SUSTAINABLE LABORATORY BUILDING IN CAMBRIDGE
PHOTO: ALEXANDRIA REAL ESTATE EQUITIES INC.

The stretch code, which emphasizes energy performance, as opposed to prescriptive requirements, is designed to result in cost-effective construction that is more energy efficient than that built to the "base" energy code. The Specialized code is formulated to ensure that new construction is consistent with Massachusetts greenhouse gas limits.

BERDO - Boston's building emissions reduction and disclosure ordinance sets requirements for large buildings to reduce their greenhouse gas emissions. The goal is to reduce emissions gradually to net zero by 2050.

BEUDO - Cambridge's building energy use disclosure ordinance requires owners of large buildings to track and report annual energy use to the city, which will publicly disclose the data.

UP NEXT

Find more High-Performance Building Procurement Toolkit documents at builtenvironmentplus.org/hptoolkit