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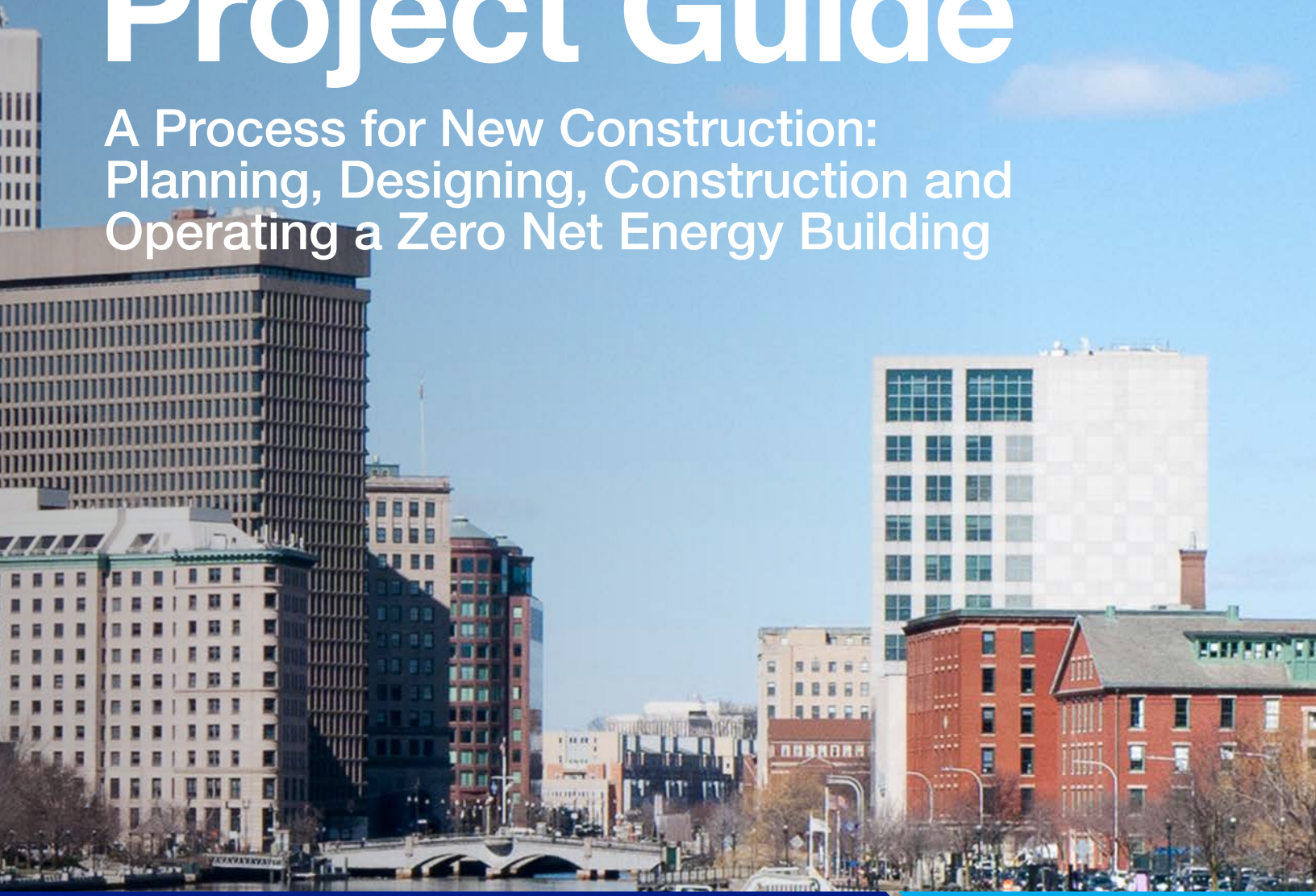
Zero Net Energy Project Guide

A Process for New Construction: Planning, Designing, Construction and Operating a Zero Net Energy Building



GETTING TO zero

APRIL 2021

Credit: Wikimedia Commons

Introduction and Overview

Zero net energy is achievable for many new commercial buildings. This project guide can help you design and construct them in a way that can save on both first costs and life cycle costs. The information is also applicable for any project that wants to deliver a healthy, energy-efficient or carbon neutral new building or major renovation.

A zero net energy (ZNE) building is an extremely energy efficient building designed and operated to consume only as much energy as it produces annually. These buildings are no longer solely demonstration projects and market outliers. Current projects in the New Buildings Institute Getting to Zero Buildings Database include a wide range of mainstream building and ownership types. The data also shows a trend toward zero net carbon (ZNC) with energy efficient, all-electric buildings. A ZNC building does not burn natural gas on-site. As clean, renewable energy (such as wind and solar) replaces carbon-based energy at electric power plants, all-electric buildings become even "cleaner" and less carbon intensive.

All-electric buildings offer several advantages over mixed-fuel buildings. Technology advancements have narrowed the price difference between gas and electric equipment so significantly that today, all-electric buildings generally cost less to construct than mixed-fuel buildings because they avoid the cost of gas mains, services, and meters not needed in all-electric construction.[1] The elimination of gas combustion also benefits indoor air quality and safety.

State and local jurisdictions are furthering demand for ZNE / ZNC buildings by adopting policies, updating building energy codes. They are also creating programs to reduce building energy use and increase the use of renewable sources. Rhode Island's Executive Order 17-06 reaffirms the state's

1 https://rmi.org/insight/the-economics-of-electrifying-buildings/

18% of all energy use in the United States come from commercial buildings.

U.S. Energy Information Administration, https://www.eia.gov/tools/faqs/faq.php?id=86&t=1

"Our Net Zero by 2050 Plan outlines our approach to exploring a wide range of solutions until we can deliver the affordable, reliable clean energy future our customers want and deserve—no later than 2050."

Badar Khan, President, National Grid US.

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commitment to reduce GHG emissions to 80% below 1990 levels by 2050. State and local leaders know they cannot achieve their GHG emission reduction goals without addressing buildings.

ZNE buildings, if done right, do not cost more to build than more traditionally designed buildings. This is especially true when energy efficiency is integrated into early design decisions and prioritized in the process. This guide can help those interested in getting to zero with buildings that prioritize strategies that reduce energy consumption, ensure occupant comfort, increase operational savings, and extend the life of mechanical and lighting systems.

The steps to success in getting to zero are different from a traditional building development process. This ZNE Project Guide explains those differences and provides a framework for planning your project. It includes resources at the end of each section and checklists to inform the process of getting to zero. This process is outlined on the next page and can be a reference for your project meetings.

THE STEPS TO SUCCESS

1 **gain stakeholder support**

2 **set an energy target and ZNE goals**

3 **select a qualified design team**

4 **manage an integrated design and construction process**

5 **leverage energy modeling results**

6 **harvest renewable energy sources**

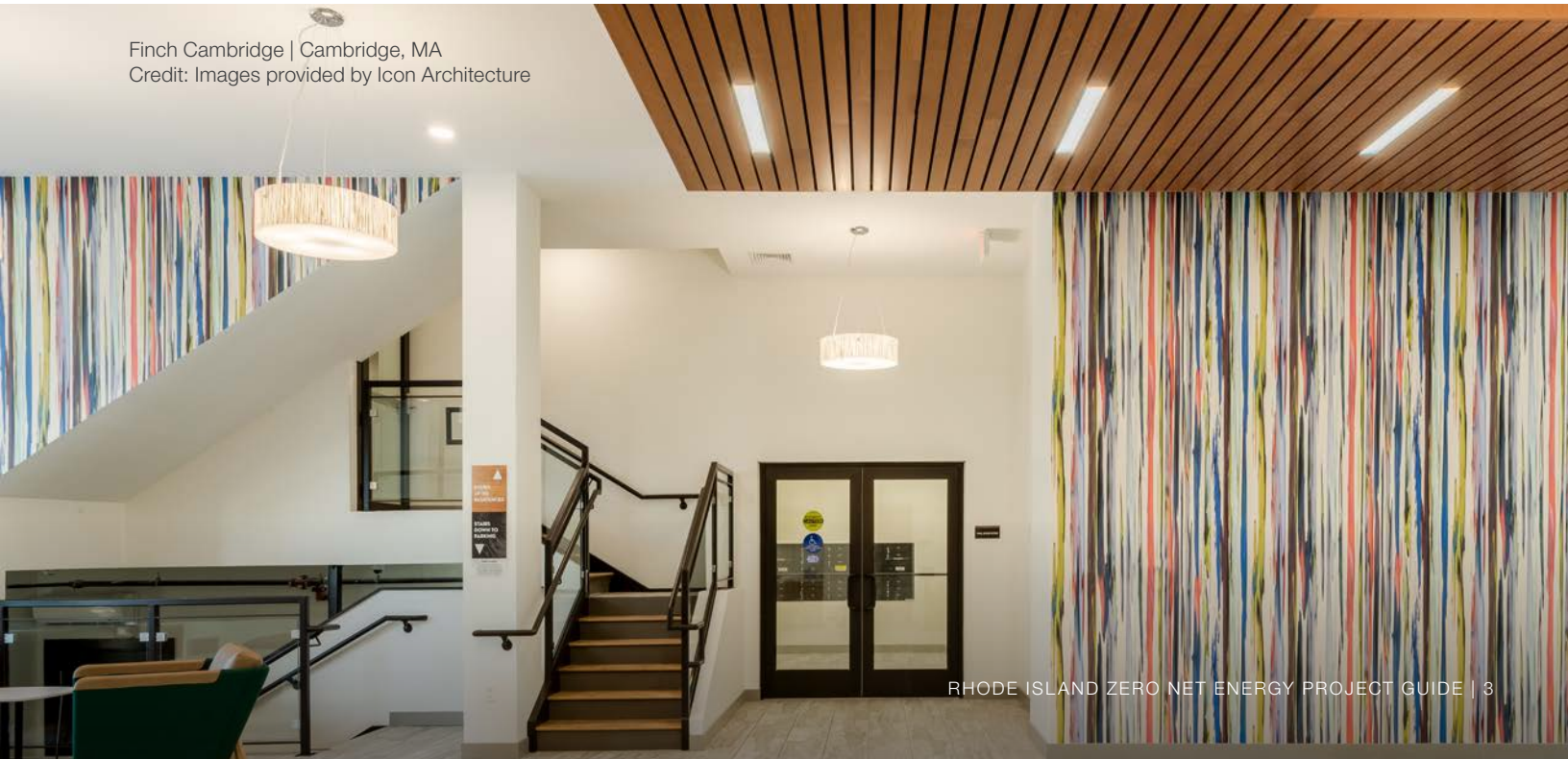
7 **occupy and verify a ZNE result**

Definitions

Zero Net Energy (ZNE) Building: A building that produces as much clean, renewable energy as it uses when measured over a one-year period.

Zero Net Energy Ready Building: Projects that are not able to add renewables on site right away but achieve the EUI Target set for the project.

Zero Net Carbon (ZNC) Building: A highly energy efficient building that produces on-site, or procures, enough carbon-free renewable energy to meet building operations energy consumption annually.



Finch Cambridge | Cambridge, MA
Credit: Images provided by Icon Architecture

Gain Stakeholder Support

One of the key ingredients to success in developing a ZNE project is an energy champion who will ensure energy is considered at every opportunity in the design process. The champion may be the client, but it is often a staff member, school superintendent, architect, engineer, or another committed individual. As the project moves ahead, the champion will participate in the eco-charrette, stakeholder meetings, check in with the progress of the design team. This check-in should happen at least at the end of each phase of construction. The champion should also participate in the value engineering process so that long term costs are considered in decision-making.

The champion often raises awareness and educates other stakeholders and decision-makers to gain widespread support. It is important that both internal and external stakeholders be engaged in the process. Creating a feedback loop to understand the priorities and drivers for each stakeholder can be helpful. For example, focusing on the health benefits and potential cost savings of energy efficiency in buildings may be a critical selling point, especially for stakeholders focused on the business or finance end of buildings.

The ZNE Communications Toolkit (listed in the resources) identifies likely stakeholders, their drivers, and compelling messages to build support. Sharing case studies and factsheets may help build momentum. Tours of regional ZNE buildings can be fun and have been helpful to other projects in gaining support from key stakeholders. Find one near you by using the Getting to Zero database which has an updated list of known projects that are pursuing or have achieved these ambitious goals.

Sharing case studies and factsheets is helpful to build momentum, as are tours of regional buildings that have achieved zero net energy and zero net carbon.

Resources

NBI's ZNE Communications Toolkit

Zero Energy Case Studies

NBI's The Vocabulary of ZNE: A Guide to Zero Net Energy Terminology

NBI's Getting to Zero Resource Hub

Douglas and Gates Elementary School. | Acton, MA
Credit: Images provided by Arrowstreet

Set Goals and Energy Targets

Successful ZNE projects have clear energy and sustainability goals for their project early, often even before design begins. Instead of "percent better than code" goals, these projects often use an absolute energy target—called an energy use intensity (EUI). An EUI is commonly expressed in kBtu/square foot/year. There are two types of EUI. A site EUI represents the total amount of energy use consumed on-site, within the property boundary. Whereas a source EUI is the total amount of raw fuel required to operate the building, including energy losses in transmission, delivery, and production. Source EUI varies depending on your location and grid fuel mix.

ZNE buildings have EUIs that are a fraction of the average building energy consumption in the United States. Energy targets vary slightly depending on building type and climate.

Mixed-Use Office Building Site Energy Use Intensity	**ZNE Mixed-Use Office Building** Site Energy Use Intensity
62 kBtu/ft^2/yr*	**23.2 kBtu/ft^2/yr**** before on-site renewable energy

*2012 Commercial Building Energy Consumption Survey (CBECS).
**The Advanced Energy Design Guide - Achieving Zero Energy Series for Climate Zone 5A.

A numeric energy target encourages a design team to maximize building energy efficiency. An EUI target should consider the balance between optimized building energy efficiency, on-site renewable energy generation, and cost-effectiveness. Buildings with traditionally higher loads (restaurants, grocery stores, labs, and hospitals) will find the ZNE EUI more difficult to achieve while lower energy load buildings (warehouses, single family residential, schools, offices) will be able to achieve the target more easily.

Energy goals can also be combined with carbon emission reduction goals or renewable energy goals.

Resources in this section include recommended new construction site and source EUI targets by climate zone for achieving ZNE in common building types in addition to the office building above suggested by the National Renewable Energy Lab (NREL) and ASHRAE.

Resources

ASHRAE's Advanced Energy Design Guide – Achieving Zero Energy series

NBI's Zero Energy Performance Targets for New Construction Projects

EIA's Commercial Building Energy Consumption Survey (CBECS)

NREL's Establishing Building-Level Energy Goals in Procurement Documents: Lessons Learned from Pilot Utility and Portfolio Projects

NREL's Realizing High-Performance Buildings Chapter 1 discusses energy targets

Architecture 2030's Zero Tool

An EUI target should consider the balance between optimized building energy efficiency, on-site renewable energy generation, and cost-effectiveness.

Energy Use Intensity (EUI)

is the total amount of energy used annually by a building per square foot of floor area. The lower the EUI, the less energy the building is expected to use.

When designing ZNE buildings, a critical first step is to set an EUI target and then use energy modeling software to help determine how to best achieve that goal. See Zero Energy Commercial Building Targets, by New Buildings Institute for more.

National Grid programs rely on site EUI calculations. See Financing and Incentives section for more information.

Procure the Right Project Team

Design and construction team commitment is essential for project success. Owners should utilize contractual approaches such as owners project requirements (OPR), and request for proposals (RFP) to explicitly call out what they wish their building to achieve. Projects pursuing ZNC should also specify an all-electric building.

The RFP might explicitly request a ZNE, all-electric building that achieves a particular energy target. This puts teams on notice of the goal and encourages them to think about energy performance even before the interview. Having these goals well understood before designers put pen to paper can help save on design costs, by avoiding the need for redesign.

Some projects incorporate energy goals such as EUI targets into the contract documents themselves. Referred to as a "performance-based procurement" approach, it sets a clear expectation with the design team and the building occupants on how the building should perform once it is occupied.

The OPR defines project goals, the building program, operational parameters, sustainability and energy goals, and financial expectations of new construction and major modernization projects. Developing an OPR with numeric EUI targets and sustainability goals before schematic design can provide direct guidance from the owner to the design team, stating how they expect the building to perform. The OPR should be clear about specific technical and programmatic requirements, operational patterns, schedules, plug load assumptions, and other activities in the building that influence energy consumption.

Prioritizing energy efficient performance early in the design process ensures that the project team will implement strategies that reinforce that goal throughout the design process. When selecting the team, consideration should be given to the contractual approach selected, whether it be design-build, design-bid-build, lease-leaseback, or integrated project delivery, Each has its own unique set of benefits and drawbacks for a ZNE project, as outlined in NREL's How to Guide for Energy Performance-Based Procurement (see link in the resources).

Although not all teams have ZNE experience, those that are committed to low-energy buildings should know the design and operating EUI of other buildings that they have designed. During the team interviews, ask for specific information that will help procure the ZNE outcome. The team interview questions in the sidebar and the Design Team Interview Questions resource below offers examples of what to ask the prospective design teams to gauge their experience and fit for the project.

Design and construction team commitment is essential for success in zero net energy and zero carbon buildings.

Example Team Interview Questions:

- What architectural, engineering, and construction principles do you suggest to achieve the energy target?
- How are your past ZNE or low-energy-use buildings performing? What have you learned from these buildings?
- What tools or processes do you use when estimating energy consumption?
- Are you aware of grants and incentives that may be available for the project?
- Have you stayed involved with previous projects after they were occupied? If so, how?
- How would you work with us during building operation to resolve a higher-than-predicted EUI?
- Have you worked on a project that utilized performance requirements such as an EUI or other?

Resources / example requirements

Design Team Interview Questions

Baltimore City Public Schools

National Renewable Energy Lab's (NREL) A Guide to Zero Energy and Zero Energy Ready K-12 Schools

DC DGS NZE Elementary School RFP

Fort Carson Example RFP

SFUSD Project Requirements

Address Costs, Financing, and Incentives

Research shows that ZNE buildings have been built with little to no increased cost and cost less to operate.[2] Other studies confirm that net-zero energy is a cost-effective investment.[3] Early planning and thoughtful design are key to managing costs. Integrated building system design uses a whole-building approach to maximize energy savings and manage construction costs. For example, a tight building envelope decreases the need for heating and cooling, which allows for a smaller capacity system. This can reduce first costs as well as ongoing energy costs. These energy and financial cost control strategies, along with financial incentives, are key to making the business case. This has been outlined by NREL in their Cost Control Best Practices for ZNE study.

ZNE buildings can unlock financial incentives not available to other projects. Additional funding sources may include:

- Community solar programs
- Utility incentives
- Tax credits
- Low-interest loans
- Commercial Property Assessed Clean Energy (cPACE)
- Low Income Housing Tax Credit (LIHTC) programs provide non-competitive 4% LIHTC to affordable housing developers.

National Grid provides **incentives** for projects targeting ZNE or ZNE Ready. The customer must engage program before 50% Schematic Design and target 28 EUI or less. (Exceptions considered). See next page for details.

PACE

Commercial PACE allows local and state governments to fund the up-front cost of energy improvements on commercial properties and allow repayment by the property owners over time as part of the tax bill. PACE programs address an owner's need to finance large upfront costs and allows the cost of the investment to transfer with the property owner. The Rhode Island Infrastructure Bank has a commercial PACE program.

The Rhode Island Infrastructure Bank has a commercial Property Assessed Clean Energy (PACE) program which is a potential source of funding for ZNE buildings.

Many of the projects on the Getting to Zero database have used traditional sources of financing for ZNE buildings. For example, school projects have used state and local bonds to finance construction of ZNE schools. For school projects, including ZNE in the bond costing bid process is helpful to ensure funds are allocated for specifically for energy efficiency projects.

Rhode Island also has robust solar program offerings with options for all types of buildings. Community solar allows community members the opportunity to share the benefits of solar power even if they cannot or prefer not to install solar panels on their property. Individuals or businesses subscribe to a community solar project and get credit on their electric bill for the solar energy generated off-site.

2 Cost Control Strategies for Zero Energy Buildings: https://www.nrel.gov/docs/fy14osti/62752.pdf
3 Zero Energy Buildings in Massachusetts: Saving Money from the Start: https://gettingtozeroforum.org/zero-energy-buildings-in-massachusetts-saving-money-from-the-start/

Follow the path to zero net energy with National Grid

In Rhode Island, National Grid offers commercial building owners and design teams financial incentives and technical assistance to offset the incremental construction and design service costs associated with zero net energy construction.

Path 1: Zero Net Energy (ZNE)/Deep Energy Savings

Zero Net Energy/ Deep Energy Savings (for buildings over 20,000 sf) offers comprehensive technical expertise throughout the entire process and financial incentives for commercial ZNE, ZNE Ready, very low EUI projects, and Passive House projects. Projects must engage with National grid before 50% of schematic design, design to and achieve a site EUI of 28 kBtu/sf/year (or a negotiated exception target), have year-round occupancy and undergo enhanced commissioning.

Technical Assistance

- ZNE Expert provided
- National Grid covers 50% of the cost for ZNE expert (up to $10,000)

Financial Incentives

- Pre-approval at end of design
- Design team incentives
- Construction incentives *offered at the end of construction and one year post occupancy*
- Post occupancy incentives
- Optional verification incentive
- Certification incentive

Post Occupancy

- 1 year post occupancy period
- Final incentives based on building performance

National Grid offers **additional paths** to support upgrading to more energy efficient equipment and systems. Whether your project is large or small, new construction or major renovation, National Grid offers a range of paths you can take to elevate building performance, comfort, health and, of course, long-term energy savings.

Solar installations have other financial incentives. The federal government currently provides a 30% tax credit for renewable energy (including photovoltaics, wind, geothermal). The credit reduces from 26% in 2022 to 22% in 2023 and 10% in 2024. Public buildings and schools may need to partner with a taxpaying entity through a power purchase agreement (PPA) to capture these benefits. Caution, PPAs may create complications with renewable energy certificates as the U.S. Department of Energy explains in the Federal On-Site Renewable Power Purchase Agreements.

Resources

National Grid Incentives and Rebates

- Commercial & Industrial Rebates/Incentives
- Services and Rebates
- Verification Incentive
- Residential rebates and incentives

Similar offerings are also available in MA, CT, and NH.

Federal Investment Tax Credit for Solar Photovoltaics

Rhode Island Housing: State of Rhode Island 2020 Qualified Allocation Plan

Solar incentives from the State of Rhode Island Office of Energy Resources

State of Rhode Island Office of Energy Resources, Community Solar

Rhode Island Commercial PACE

NREL Cost Control Best Practices for Net Zero Energy Building Projects

National Association of State Energy Officials (NASEO) resources ('Financing' section)

DSIRE

Utilize an Integrated Process

Achieving ambitious energy goals for any new construction or deep renovation project requires a design team commitment to integrating building systems. Design teams should optimize the interrelationships between the building orientation and its systems, surroundings, and occupants to efficiently and effectively use resources such as free daylighting, cooling, and other passive strategies.

An integrated design charrette is essential to align the vision among all stakeholders. A charrette is an interactive, facilitated discussion where relevant team members, including owners, the design team, building occupants, and facility maintenance staff, review priorities and agree on shared project goals. Charrettes are most effective when they happen early in schematic design. Feedback earlier, rather than later, in the design process can still be easily and inexpensively incorporated into the design.

Another important step early in design is the finalization of the basis of design (BOD). The BOD is the primary document that translates an owner's needs into specific building approaches such as building envelope, mechanical, electrical, plumbing, security systems, building automation system, etc. Essentially, this is the design team's response to how the details in the OPR will be achieved. Post charrette, the owner may want to update the OPR with updated performance goals or include additional details such as thermal comfort ranges that might have been discussed and agreed to during the charrette. The commissioning agent will use these documents to ensure the building will meet the owner's expectations. (See more about commissioning in the next section.)

The design team and construction team should continue to keep the project goals and OPR in mind throughout the entire design and construction process. When project finances get tight, efficiency strategies may be "value engineered" out of the final design due to having a long-term payback period and comparatively high first cost. However, this can result in unexpected ramifications to building performance. When systems are properly integrated, each component is critical to achieving the goal. Both first costs and ongoing lifecycle costs should be considered during the process of value engineering.

The NBI Integrated Design Charrette Toolkit includes an explanation of the charrette process, a list of suggested charrette participants, planning checklists, sample agendas, presentations, and reports for the team to use and modify as necessary.

National Grid can lead or take part in the integrated design charrette.

National Grid also provides a design team incentive to help offset the added cost of setting and working toward the EUI goal.

Resources

NBI Integrated Design Toolkit

NBI's Zero Energy Commercial Building Targets

Zero Carbon Commercial Construction: An Electrification Guide for Large Commercial Buildings and Campuses

Building Envelope Thermal Bridging Guide

Solar estimator tools

- National Renewable Energy Lab's PV Watts© Calculator
- HelioScope
- Aurora Solar
- PVsyst

Design and Construct to ZNE

Ultimately, integrating key design and construction approaches minimizes the use of fossil-fuels, maximizes clean renewable energy generation, and reduces strain on the power grid through use of distributed energy resources. Here are some tips to consider along the way.

National Grid can cost-share a ZNE Expert to provide guidance and analysis.

Energy Efficiency

Energy efficiency can be optimized through passive design strategies, efficient systems for lighting and end-use equipment, and highly integrated controls. A properly sealed envelope is critical to managing air infiltration. In buildings with very low energy use intensities, the level of envelope performance goes well beyond code requirements. Programs and standards such as Passive House Institute U.S. (PHIUS) can lead to significant mechanical load reductions.

Understanding occupancy and use patterns help to ensure that electrical and mechanical equipment is sized appropriately. Accurate plug loads assumptions are important because they represent 30-50% of the load in very efficient buildings. Reducing loads allows for smaller mechanical systems, which can save first costs and ongoing operational costs. Once all loads have been reduced and served with high-performance equipment, the remaining loads can be offset with renewable energy. This reduces the cost of a photovoltaic system, as fewer solar panels will be needed to meet the lower demand.

Energy Modeling

Iterative energy modeling should happen throughout the design process. Modeling should begin early in the schematic design phase with climate, site, and solar simulations to provide feedback, which can be incorporated into fundamental design decisions. Comparing relative savings associated with various design options uncovers those that are more advantageous in a particular building.

Iterative energy models can then begin to factor in building systems. They may also help prevent oversizing mechanical systems, thus reducing upfront costs. Design teams should designate check in points during the design and construction process that require updates towards goals and to check if models need to be updated.

PHIUS is a stringent building design and construction standard that requires very air-tight and well-insulated building envelopes as well as properly sized and balanced HVAC systems. Buildings that meet the PHIUS+ standard use 40-60% less energy for space conditioning than conventional buildings. PHIUS certification includes a thorough design verification protocol with stringent quality assurance and quality control performed on-site by specialized PHIUS+ Raters.

Lifecycle Cost Analysis (LCCA) Tools

LCCA tools provide insights into upfront and long-term operation and maintenance costs to evaluate the total project cost and the value of upfront investments. Using the tool early, combined with energy modeling, can facilitate the selection of the best equipment for the project by evaluating the initial costs compared to the operating and replacement costs. The analysis supports the integrated design process by considering the trade-offs with all team members, including future building operators and finance departments. Failure to consider lifecycle costs may result in unnecessarily large systems or equipment that demands high energy use, more maintenance, or even early replacement.

When project finances get tight, efficiency strategies may be “value engineered” out of the final design due to having a long-term payback period and comparatively high first cost. However, this can result in unexpected ramifications to building performance. When systems are properly integrated, each component is critical to achieving the goal. Both first costs and ongoing lifecycle costs should be considered during the process of value engineering.

Controls

The design of controls and systems for easy metering are important considerations during design. Some teams hire a “controls integrator” to improve operational efficiencies and on-the-ground diagnostic capabilities through the proper inclusion of energy sub-meters. This professional can assist with the layout, access, and format of the lighting, HVAC, plug load meters, and control considerations.

Renewables and Storage

On-site, grid-connected renewable energy systems should be right-sized after the building load has been reduced to avoid over producing. Battery or thermal energy storage can help achieve harmonization of the building’s energy load profile with the power grid through active demand management, electric vehicle (EV) charging and discharging, and demand response.

Bristol Community College John J. Sbrega Health and Science Building | Fall River, MA
Credit: Photograph provided by Sasaki

Commissioning

Building systems commissioning is a process that ensures a building is delivered according to the OPR. It can streamline the construction process, leading to fewer change orders. Buildings that have been commissioned, operate more efficiently, are more comfortable, and have lower operations and maintenance costs. Commissioning agents should be brought into the conversation early to encourage efficiencies from the beginning and throughout the process.

Commissioning can also extend throughout construction and into post-occupancy. Post-occupancy and ongoing commissioning is important to help identify and resolve unexpected operational issues after move-in. Engaging a commissioning agent is worth the investment, especially when National Grid has incentives to support.

Customers participating in Paths 1 or 2 of National Grid's program are eligible to receive a 50% cost share (up to $10,000) as a technical verification incentive. The program offers commissioning services and control sequences reviews at a two, six, and 12-month interval to ensure a building is operating as designed during its first year of occupancy. (See more in the Resources section in the Cost, Financing, and Incentives section.)

Commissioned buildings operate more efficiently, are more comfortable, and have lower operations and maintenance costs.

Customers participating in Path 1 of National Grid's program commit to commissioning their building. Customers are eligible to receive a 50% cost share (up to $10,000) as a technical verification incentive. The program offers funding for a commissioning services scope of work that includes control sequence and energy data reviews at a two, six, and 12-month interval to ensure a building is operating as designed during its first year of occupancy.

Resources

National Grid Rhode Island incentive program for new construction and major renovations

Building Commissioning Association

ASHRAE Advanced Energy Design Guides

National Grid's Benefits and best practices of building commissioning

NBI Technical Resource Guides: Daylighting Pattern Guide Daylighting Guide for Office Interiors Plug Load Guide

Zero Net Energy Technology Application Guide: Luminaire Level Lighting Control

Radiant Heating and Cooling + Dedicated Outdoor Air Systems

ZNE Building Controls: Characteristics, Energy Impacts, and Lessons

Passive House Institute (United States)

Whole Building Design Guide, Building Commissioning Building Commissioning Association

Athena Impact Assessment

Manage Project Hand Off to Operations

While design characteristics significantly impact long-term building energy use, building maintenance, operation, and occupancy strategies are critical to long-term success. A Sensitivity Analysis by New Buildings Institute shows that occupancy characteristics impact energy just as much as many design decisions on building energy use. This research confirms just how critical it is to engage building operators, occupants, and tenants in any long-term strategy to manage and improve building energy performance.

Project turnover is a critical point in a ZNE project. Building occupants and facility staff may not be familiar with passive approaches or new equipment, yet these individuals must understand the systems—and how their interaction with these systems drives energy consumption—to achieve a desired result. Strategies such as daylighting, natural ventilation, or lighting and HVAC systems can be easily disabled of left on by occupants. Below are four approaches to ensuring occupants are well versed in their new spaces.

Turning the project over to the owner and operator is a critical point in a ZNE project.

Interactive energy data displays such as touchscreen dashboards or online platforms can help educate and familiarize occupants and visitors with the impacts of their behaviors on energy use. Systems can engage occupants and allow them to see the effects their behaviors have on building energy consumption.

Trainings and operations manuals should be developed for facility operations and maintenance staff by the design team and commissioning agent to learn about the building systems, controls, and automation systems before taking over maintenance responsibilities. Operations manuals might include information such as set points, equipment data forms, and warranty information.

Collaborative troubleshooting by the contractor, architect, and/or engineer should be undergone for any lingering performance issues early in occupancy. They should provide as-built drawings that show changes that may have been made during the construction process to assist in future renovations and upgrades.

A close-out meeting should be conducted to recap and reflect on the successes, challenges, and solutions developed for this ZNE project. Creating lessons learned and developing case studies can influence future projects for this team and others.

Boston University Center for Computing and Data Sciences | Boston, MA
Credit: KPMB Architects

Operate, Maintain, and Verify ZNE Performance

Ongoing tracking and review of energy performance with a building management system, energy dashboard, or EnergyStar® Portfolio Manager helps to understand energy performance and renewable energy production. Facility staff can compare actual energy consumption to predicted performance to identify if systems are operating as expected. Uncovering irregularities through frequent data review can help to promptly correct issues.

One full year of energy consumption and production data is necessary to verify performance. In researching these buildings, NBI has learned that buildings that successfully produce as much energy as they consume over the course of a year may not achieve this level of performance during the first twelve months of operation. Instead, it often takes longer to meet the target. After twelve consecutive months, ZNE performance can be verified by submitting energy data to third party organizations and programs including:

- New Buildings Institute (NBI)
- International Living Future Institute (ILFI)
- United States Green Building Council (USGBC) LEED Zero

If the building is not meeting the target, the design team, building operators, and commissioning agent should coordinate to review the data, calibrate the equipment, and engage the occupants to ensure the performance meets goals.

Success in ZNE should be shared broadly. Tours of these high-performance buildings are motivating to other prospective building owners. Other ways to share your story include speaking at conferences, publishing case studies, and/or explaining lessons learned.

National Grid Offers incentives toward ZNE & PHES certification.

National Grid provides a Post Occupancy Incentive for buildings verified to meet its target EUI.

Resources

Getting to Zero Registry, Buildings List, and Database

BOMA International Green Lease Guide

ILFI Net Zero Certification

US Green Building Council LEED Zero

NEEP Regional Operations and Maintenance Guide

The Path to Net Zero: A Shout Out to Building Operators

Discovery School (Arlington, VA) Energy Dashboard by VMDO and CMTA

King Open Cambridge Street Upper Schools | Cambridge, MA
Credit: Arrowstreet

ZNE Project Checklist

This ZNE Project Checklist below outlines some of the key action items for easy reference.

Stakeholder Awareness:

- ❑ Identify a champion
- ❑ Identify stakeholders, drivers, and messaging
- ❑ Distribute case studies
- ❑ Schedule tours (if practical)

Energy Goals and Targets:

- ❑ Benchmark existing building performance (for existing buildings only)
- ❑ Evaluate building pipeline for energy reduction opportunities
- ❑ Draft Owners Project Requirements (OPR)
- ❑ Set energy target Energy Use Intensity (EUI)

Team Selection:

- ❑ Incorporate energy targets in Request for Proposal (RFP) and Owners Project Requirements (OPRs)
- ❑ During team interviews, ask about experience with ultra-low energy buildings and renewable energy systems
- ❑ Understand the implications of various contractual structures (design-build, lease-leaseback, integrated project delivery, etc.)

Finance and Incentives:

- ❑ Connect with National Grid efficiency program administrators to identify available incentives
- ❑ If tenants will be in the building, consider a green lease with energy budgets
- ❑ Consider tax credits and solar incentives

Early Design/Pre-Design:

- ❑ Host an integrated design charrette
- ❑ Conduct early design phase modeling
- ❑ Develop and update the OPR and BOD
- ❑ Evaluate building orientation options for passive opportunities

Design and Construction:

- ❑ Review passive and active technologies:
  - ❑ Envelope and sealing
  - ❑ Heating and cooling
  - ❑ Ventilation
  - ❑ Lighting, daylighting, and controls
  - ❑ Design for ease of metering
- ❑ Evaluate on-site renewables
  - ❑ Location
  - ❑ Structure
  - ❑ Pre-wiring for future installation
- ❑ Conduct iterative energy modeling
- ❑ Identify how energy data will be shared with tenants
- ❑ Engage a commissioning agent and controls integrator
- ❑ Ensure the contractor understands the project goals and coordinates with the commissioning agent
- ❑ Do a mock up early in construction to demonstrate a continuous air barrier
- ❑ Conduct envelope and systems commissioning
- ❑ Include renewables as an “add alternate” throughout the design and construction process

Project Hand-Off:

- ❑ Train facility and operations staff
- ❑ Provide as-built drawings
- ❑ Conduct close out meeting
- ❑ Conduct occupant training

Operations and Verification:

- ❑ Benchmark energy performance
- ❑ Share energy use with occupants
- ❑ Commission the building systems
- ❑ Create a project case study
- ❑ Celebrate!

Credit: Wikimedia Commons

New Buildings Institute (NBI) developed this guide on behalf of National Grid.
For more resources, visit gettingtozeroforum.org/resource-hub

nationalgrid

National Grid is an electricity, natural gas, and clean energy delivery company serving more than 20 million people through our networks in New York, Massachusetts, and Rhode Island. We offer technical assistance, financial incentives, and other support to accelerate market uptake of zero net energy and zero net energy ready buildings. In Rhode Island, our Commercial & Industrial New Construction Program offers support to all new commercial buildings or major renovations regardless of project size, complexity or function, to help achieve the greatest energy efficiency possible.

Learn more at nationalgridus.com/RI-Business/Energy-Saving-Programs/New-Construction-Major-Renovations

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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.