NET-ZERO ENERGY
PROJECT GUIDE

A PROCESS FOR PLANNING, DESIGNING, CONSTRUCTING, AND OPERATING YOUR NEW NET-ZERO ENERGY BUILDING.

Net-Zero Energy Project Guide

The Pearl, luxury apartments in Silver Spring, MD, owned and managed by The Tower Companies

NZE buildings prioritize strategies that reduce energy consumption, ensure occupant comfort, increase operational savings, and extend the life of mechanical and lighting systems.

Net-Zero Energy Project Guide

Net-zero energy is possible for many buildings and this NZE project guide can help you on the path to net-zero and ultra-low energy buildings.

A net-zero energy (NZE) building is an extremely energy efficient building that is designed and operated to produce as much energy as it consumes over the course of the year. An ultra-low energy building exemplifies many of the same characteristics of NZE buildings, but may not have renewable energy systems. NZE buildings are no longer solely demonstration projects and market outliers. Existing NZE buildings including a wide-range of mainstream building and ownership types that reflect a universal trend toward NZE adoption.

Building energy consumption accounts for 74% of all greenhouse gas (GHG) emissions in the District of Columbia (the District). Mayor Bowser has pledged to make Washington, D.C., carbon neutral and climate resilient by 2050 and has recommitted to honoring the goals of the Paris Climate Accord. In addition, the Sustainable DC Plan (the Plan) outlines a commitment to making the District the healthiest, greenest, and most livable city in the United States. Specific goals in the Plan include:

- 50 percent reduction of district-wide energy consumption
- 50 percent of district-wide energy from renewable sources
- 50 percent reduction of district-wide carbon emissions

The Plan set targets to meet these goals by requiring NZE standards for all new construction projects and all retrofit commercial and multi-family buildings by 2026. The design and construction community must be equipped with the education and tools to achieve net-zero energy buildings to meet these targets as they become energy code in the future. This guide can help those on the path to zero.

Commercial new construction and major renovation projects in the District must comply with the Green Building Act. NZE design is a compliance path for the Green Code as are American Society of Heating and Refrigerating (ASHRAE) 189.1, Leadership in Energy and Environmental Design (LEED®) , Enterprise Green Communities, and the International Code Council (ICC) 700 National Green Building Standard.

> A net-zero energy (NZE) building is an extremely energy efficient building that is designed and operated to produce as much energy as it consumes over the course of the year.

NZE buildings prioritize strategies that reduce energy consumption, ensure occupant comfort, increase operational savings, and extend the life of mechanical and lighting systems. Given the technological and market advances in the last several years, high performance and net-zero buildings do not always cost more to build than more traditionally designed buildings. Cost-effectiveness is especially true when energy efficiency and integration of renewable energy systems is prioritized early in the design process.

The steps to achieve NZE are different from a traditional building development process. This NZE Project Guide explains those differences and provides a framework for planning any NZE project. It provides resources and checklists to inform a process of gaining stakeholder support, selecting a qualified design team, managing the design and construction process, occupying a NZE building, and verifying a NZE result.

One of the key ingredients to success in developing a NZE project is an internal champion or someone who is fully committed to the NZE vision and goal.

Discovery Elementary School | Arlington, VA
Credit: VMDO Architects

Stakeholder Awareness

One of the key ingredients to success in developing a NZE project is an internal champion or someone who is fully committed to the NZE vision and goal. The champion may be the client, but it is often a staff member, school superintendent, architect, engineer, or other committed individual. The NZE champion often raises awareness and educates other stakeholders and decision- makers to gain widespread support for a NZE project.

The NZE Communications Toolkit (listed in the resources) identifies likely stakeholders, their drivers, and compelling messages to build support for a NZE project. Buy-in from other stakeholders may be important to gather during the process. Sharing case studies and factsheets may be helpful to build momentum for NZE, as are tours of regional NZE buildings. Resources below also include factsheets and a current list of NZE projects to assist.

> Sharing case studies and factsheets is helpful to build momentum for NZE, as are tours of regional NZE buildings.

Resources

- NZE Communications Toolkit
- NZE Frequently Asked Questions and Terminology
- NZE Case Studies
- The Vocabulary of NZE
- 2018 Getting to Zero List
- NZE Stakeholder Messaging

Energy Goals and Targets

Successful NZE champions and project managers have clear energy and sustainability goals for their project early, even before design begins. Instead of "percent better than code" goals, NZE projects often use an absolute energy target—called an Energy Use Intensity (EUI) commonly expressed in kBtu/sf/yr. Energy targets vary slightly depending on building type and climate. They are a fraction of the average building energy consumption as defined by Commercial Building Energy Consumption Survey (CBECS). For example, CBECS 2012 states that an average site EUI for a mixed-use office building is 62 kBtu/sf/yr while a NZE mixed-use office building is commonly between 18-24 kBtu/sf/yr, before on-site renewable energy.

The NZE EUI range is based on existing NZE buildings and energy modeling analysis for many building types. As a target, it 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 NZE EUI range more difficult to achieve while lower energy load buildings (warehouses, single family residential, schools, offices) will be able to achieve the target more easily. Resources in this section include tables of typical site EUIs for common building types as well as low-energy targets as suggested by the National Renewable Energy Lab and ASHRAE.

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

The District, like the U.S. Department of Energy (DOE), uses "source" EUI and accounts for the total amount of raw fuel that is required to operate the building. Source energy incorporates all transmission, delivery, and production losses, thereby enabling a holistic assessment of energy use attributed to a building. Other lists state the "site" EUI which only accounts for the energy used within the property boundary and equates to the usage seen on a typical energy bill. Use a rough calculation to compare the two: site energy is 1/3 of source energy.

Site energy is the total energy used within the property boundary.

Source energy is the total amount of raw fuel required to operate the building. Source energy includes energy losses in transmission, delivery, and production.

For a quick calculation, source energy is about 3 times that of site energy.

Beyond new construction, existing buildings offer many opportunities for deep energy reduction and NZE. By measuring the energy performance with benchmarking tools like EnergyStar® Portfolio Manager, single building and portfolio owners can better understand the EUIs of their buildings. This information can help establish energy targets for existing building energy reduction. Advanced benchmarking tools, like the FirstView® Software Tool, uses this data to remotely diagnose both capital and operational opportunities across the portfolio. This process can help target limited resources for a walkthrough audit on those with the most potential for improvement.

Another way to set energy targets is based on renewable energy potential at the site. This is discussed further in the Early Design/Pre-Design section.

Resources

- Clean Energy DC
- Commercial Building Energy Consumption Survey (CBECS)
- Energy Targets
- NREL Setting WholeBuilding Absolute Use Targets for the K-12 School Retail and Health Care Sectors
- ASHRAE Standard 100-2015 Energy Efficiency in Existing Buildings Table 7-2
- EnergyStar® Portfolio Manager
- FirstView

Team Selection

Design and construction team commitment is essential for NZE project success. Owners should be clear about their NZE goals in their Request for Proposals (RFP), Owners Project Requirements (OPR) and contract documents. OPRs became popular with LEED® building commissioning but regardless of certification, developing an OPR before schematic design can provide direct guidance from the owner to the design team, stating how they expect the building to perform.

The design process is a series of choices. 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, integrated project delivery, or through an energy service company. Each has its own unique set of benefits and drawbacks for a NZE project, as outlined in NREL's How to Guide for Energy Performance-Based Procurement (see link in the resources).

Just as many owners include LEED goals in their RFP a NZE goal can be added to the RFP. For example, the RFP might request a LEED Gold building that achieves NZE or a particular energy target, this puts teams on notice of the goal and encourages them to think about energy performance even before putting pen to paper.

> Design and construction team commitment is essential for NZE project success.

Although not all teams have NZE 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, consider asking for information about sustainable design goals, predicted EUIs, and actual performance in completed projects. The NZE team interview questions below offer examples of questions for the prospective design teams to gauge their experience and fit for the project.

Another tool in the team selection and contracting process is called the OPR. The OPR define project goals, the building program, operational parameters, sustainability and energy goals, and financial expectations. Most of the time OPR are done in layman's terms for individual building projects. However, NZE OPR can be more sophisticated and can detail the requirements of envelope; lighting, heating, cooling, and ventilation; hot water; controls; and other energy using systems. OPRs should be clear about specific programmatic requirements, operational patterns and schedules, plug load assumptions, and other activities in the building that influence the energy consumption. "Template" language in an OPR can be modified for individual projects, and teams should carefully track changes over time.

Once a team has been selected, and they are committed to a NZE result, consider incorporating an EUI target range into the contract documents. This "performance-based procurement" approach sets a clear expectation with the design team and the building occupants on how the building should perform once it is occupied.

Resources

- DC DGS NZE Elementary School RFP
- Fort Carson Example RFP
- SFUSD Project Requirements
- How to Guide for Energy Performance-Based Procurement, National Renewable Energy Laboratory

Example NZE Team Questions:

- What architectural, engineering, and construction principles do you suggest to reach NZE performance?
- When do you consider them in the design process?
- How are your past NZE or low-energy-use buildings performing? What are their EUIs? 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-designed EUI?

Finance and Incentives

Research shows that NZE buildings have been built with little to no increased cost.[1] Other studies suggest that net-zero energy is a cost-effective investment.[2] Early planning and thoughtful design are key to managing costs in NZE building.

Success in NZE buildings requires a committed team, a specific energy goal, and integrated building system design and attention to ongoing operations. Integrated building system design uses a whole building approach to maximize energy savings. For example, a tight building envelope decreases the need for heating and cooling system, and allows for a smaller capacity system. This can reduce first costs as well as ongoing energy costs.

NZE teams manage construction costs with carefully integrated systems and then serve the remaining loads with renewable energy. These energy and financial cost control strategies along with financial incentives are key to making the business case for NZE, as outlined in by the National Renewable Energy Lab in their Cost Control Best Practices for NZE study.

Energy efficient and NZE buildings can unlock financial incentives not available to other projects. Sources of additional funding may include utility energy efficiency programs, community solar programs, tax credits, low-interest loans, or commercial Property Assessed Clean Energy (PACE). Low Income Housing Tax Credit (LIHTC) programs provide non-competitive 4% Low Income Housing Tax Credits to affordable housing developers.

Commercial PACE is a mechanism for energy efficiency and renewable energy financing. 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. Two regionally available PACE programs, Mid-Atlantic PACE Alliance (MAPA) and DC PACE are included in the resources section.

1 http://eecoordinator.info/california-zero-net-energy-buildings-cost-study/
2 https://www.efficiencyvermont.com/Media/Default/docs/white-papers/efficiency-vermont-net-zero-energy-feasibility-study-final-report-white-paper.pdf

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NZE design is a compliance path for the Green Code.

Utilities are one important source of funding for NZE projects. The Database of State Incentives for Renewables and Efficiency® (DSIRE) database can help identify policies, tax credits, and financial incentives. In the District, DC Sustainable Energy Utility (DCSEU) offers rebates on lighting, motors, HVAC, refrigeration, and food service and vending. Utility programs must be involved early in design in order to qualify for financial incentives.

The District has among the highest financial benefits for solar of any jurisdiction in the US. The Renewable Portfolio Standard (RPS) Expansion Amendment Act, promotes renewable energy and set a required percentage of renewable energy. To meet the RPS the district must supply 50% renewable energy and 5% solar by 2032.

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. A renewable energy project can apply to become a community renewable energy facility (CREF) and sell their credits to provide solar to others in the community.

Solar installations have other financial incentives. The federal government currently provides a 30% tax credit for renewable energy (including photovoltaics, wind, geothermal). The credit is available through 2019 (reducing to 26% in 2020, 22% in 2021, and 10% in 2022). Public buildings and schools may need to partner with a tax-paying entity through a Power Purchase Agreement (PPA) in order to capture these benefits. (Caution, PPAs may create complications with Renewable Energy Certificates as the US Department of Energy explains in the Federal On-Site Renewable Power Purchase Agreements.)

Non-financial incentives may include height bonuses (and other structural or zoning incentives), tax abatement, and expedited permitting. Incentives constantly evolve so every project team should investigate the opportunities to capture as many as possible.

Resources

- NREL Cost Control Best Practices for Net Zero Energy Building Projects
- DC Green Code
- DC Sustainable Energy Utility
- Pepco Community Energy
- Solar for All
- DSIRE
- Federal solar tax credits
- DC Green Bank
- Accelerating the Commercial PACE Market
- Mid-Atlantic PACE Alliance
- DC PACE
- B21-0650 - Renewable Portfolio Standard Expansion Amendment Act of 2016
- Community Renewal Act of 2013
- Green Building Act of 2006
- Renewable Energy Development Fund

DPR Office | Reston, VA
Credit: Hoachlander Davis Photography.

Early Design/Pre-design

An integrated design charrette is essential to align the NZE vision among all stakeholders. A charrette is an interactive, facilitated discussion where relevant team members, including owners, architects, engineers, contractors, building occupants, and facility maintenance staff, review priorities and agree on shared project goals. Time on the agenda should allow for a focused discussion about achieving NZE and energy targets.

The 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.

> Early design is also the appropriate time for the design team to calculate the solar potential on the site.

Integrated design charrettes build consensus, streamline the design process, and set the team up for success. Charrettes are most effective when they happen early in Schematic Design to allow key stakeholders like owners, facility managers, and building occupants to share their perspective and ideas about the project at a time when their feedback can still be easily—and inexpensively— incorporated into the design. The charrette also provides design team members an opportunity to share their early design schematics and experiences on other projects. Post charrette, the facilitator should provide a summary of the event, including next steps. At that time, the owner may want to update the OPR with new performance goals or include additional details such as thermal comfort ranges that might have been agreed to during the charrette.

Early design is also the appropriate time for the design team to calculate the solar potential on the site. Solar budgets are a function of the location, available space on the site for photovoltaics, and the production capability of the system. The Mapdwell Solar System DC is a tool that helps define the solar potential on a particular site. Once the team knows how much energy can be generated on-site, the annual production can set a solar budget, or set the amount of energy the building can consume each year.

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. 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.)

Resources

- NZE Charrette Toolkit
- PV Watts© solar calculator
- Mapdwell Solar System DC
- Solar Sage
- DCRA Solar Permitting

DPR Office | Reston, VA
Credit: Hoachlander Davis Photography.

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Integrated Design and Construction

Achieving a NZE goal for any new construction or deep renovation project requires that a design team commit to designing integrated building systems where the interrelationships between the building and its systems, surroundings, and occupants interact to achieve maximum efficiency make efficient and effective use of resources. Teams should carefully consider climate as a resource, taking advantage of free daylighting, cooling, and other passive strategies as appropriate. New construction projects can take advantage of building orientation—elongating buildings along an East-West axis if possible—as a way to manage energy loads like lighting and heat gain.

The effective operation of a net-zero energy building involves the integration and interactive effects of three core complimentary elements that, when taken together, lower energy use and costs, reduce carbon emissions, and minimize load impacts to the grid. These elements include energy efficiency optimization, renewable energy generation, and energy storage and grid harmonization.

New construction projects can take advantage of building orientation as a way to manage energy loads like lighting and heat gain.

Energy efficiency can be optimized through passive design strategies, efficient systems for lighting and end-use equipment, highly integrated controls, as well as automated demand response systems that allow a building operator, utility or third-party energy manager to curtail building energy loads during peak demand periods. On-site, grid-connected renewable energy systems supply electricity to the building or back to the grid with the net total energy produced at least equivalent to the energy used by the building over a 12-month period. 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. Ultimately, integrating these three components minimizes the

Below: Work on the AGU building's wet well which connects to the building's municipal sewer heat exchange system. The municipal sewer heat exchange is an energy reduction strategy that will provide heating and cooling to the building. AGU's building is the first in the United States to use this technology. Photo Credit: Kevin Koski for AGU.

Teams should carefully consider climate as a resource, taking advantage of free daylighting, cooling, and other passive strategies as appropriate.

use of bulk fossil-fuel power production and maximizes clean renewable energy generation, while limiting adverse impacts to the power grid from growth in distributed energy resources.

Designers of NZE buildings focus on a sealed envelope to manage infiltration loads. In net zero buildings, the level of envelope performance goes well beyond code requirements. Programs and standards such as Passive House Institute can lead to significant mechanical load reductions.

Once loads have been reduced with passive strategies, NZE designers carefully investigate the occupancy and use patterns to ensure that electrical and mechanical equipment is sized appropriately. Plug loads in NZE buildings represent 30-50% of the load and must be carefully considered and managed. Reducing loads leads to smaller mechanical systems which can save first costs and ongoing operational costs. Once all loads have been reduced and served with high-performance equipment, remaining loads can be offset with renewable energy, also managing the first costs of the photovoltaic system.

NZE projects often use iterative energy modeling throughout the design process to estimate the building loads and identify the energy efficiency measures for the project. Iterative modeling can begin early in the Schematic Design phase with climate, site, and solar simulations to provide feedback which can be incorporated into fundamental design decisions. Iterative energy models can then begin to factor in building systems. These “shoebox” energy models are different. They compare relative savings associated with big design options to uncover which is more advantageous in a particular building. They may also help prevent oversizing mechanical systems, reducing upfront costs. Shoebox models can be distinguished from other energy models that are focused more on documenting design decisions or code compliance. Iterative models can help prompt integrated design conversations early on in the process.

The design of controls and systems for easy metering are important considerations during design. Some NZE 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. Note that energy submetering in the District is only allowed for energy management purposes in multifamily buildings and cannot be used for other purposes.

Building systems commissioning is a process to ensure that 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. Bringing a commissioning agent on board to review the drawings for agreement between the OPR, BOD, and design documents before construction begins, is worth the investment. The Building Commissioning Association can help identify a qualified professional and understand best practices.

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

Commissioning can also extend throughout construction and into post-occupancy. During construction, the controls integrator and/or commissioning agent will review submittals prior to installation and will test the installed systems to ensure they are working together correctly according to the OPR. Commissioning can help to identify any operational issues, before occupancy. The commissioning agent can also assist in resolving any issues uncovered in this process. Lastly, this individual can help train owners and occupants to use the systems properly for maximum efficiency. Post-occupancy commissioning can identify and resolve any unexpected operational issues after move-in.

It is important for the design team to keep the project goals and OPR in mind throughout the entire design and construction process. When project finances get tight, whether or not everyone is familiar with the NZE goal, efficiency strategies can be “value engineered” out of the final design, because they may have a long-term payback period and comparatively high first cost. However, this method often has unexpected consequences in building performance. When systems are properly integrated, each component is critical to achieving the NZE goal so both first costs and ongoing lifecycle costs should be considered during value engineering.

Lifecycle cost analysis (LCCA) tools provide insights into upfront and long-term operation and maintenance costs to evaluate the total project cost and the value of up front

investments. Using the tool early, in combination with energy modeling, can facilitate selection of the best equipment for the project by evaluating the initial costs comparing 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 operator 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.

Resources

- ZE Design Fundamentals Fact Sheet
- NBI Technical Resource Guides: Daylighting Pattern Guide Daylighting Guide for Office Interiors Plug Load Guide
- Luminaire Level Lighting Control
- Radiant Heating and Cooling + Dedicated Outdoor Air Systems
- ZE Building Controls: Characteristics, Energy Impacts, and Lessons
- Passive House Institute (United States)
- Whole Building Design Guide Building Commissioning Building Commissioning Association
- Build Green DC
- Clean Energy DC Plan
- Engaging Tenants in Reducing Plug Load Energy Use
- Athena Impact Assessment

Post-occupancy commissioning can identify and resolve any unexpected operational issues after move-in.

Credit: U.S. Department of Energy

Project Hand-off

While design characteristics have a significant impact on long-term building energy use; building maintenance, operation, and occupancy strategies are absolutely critical to the long-term NZE result. 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.

Turning the project over to the owner is a critical point in a NZE 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 – in order to achieve a NZE result. For example, if the building is naturally ventilated, the occupants should know when to open or close windows. The same holds true for daylighting strategies that can easily be disabled by occupants. Cleaning crews should also be trained to turn off systems, such as lighting, when their work is done.

Interactive energy data displays can help familiarize occupants with the impacts of their behaviors on energy use. Touchscreen dashboards displayed in the building can educate occupants and help inform visitors of sustainability interests. Similarly, online platforms allow occupants to see, in real-time, the effects their behaviors have on building energy consumption. Such tools can help engage occupants and remind them to use building systems as designed.

Facility operations and maintenance staff should meet with the design team and commissioning agent to learn about the building systems, controls, and automation systems before taking over maintenance responsibilities. It may be helpful for the design team to develop an operations manual that includes equipment data forms and warranty information.

> Turning the project over to the owner is a critical point in a NZE project.

The contractor, architect and/or engineer can also assist the building operator in troubleshooting performance issues early in occupancy. They should provide as-built drawings that show changes that may have been made during the construction process. These will be helpful during future remodels to know where ducts, pipes, wires, etc. are located.

United Therapeutics' Unisphere | Silver Springs, MD
Credit: Ewing Cole

Facility operations and maintenance staff should meet with the design team and commissioning agent to learn about the building systems, controls, and automation systems before taking over maintenance responsibilities.

Finally, recapping successes and challenges at a close-out meeting can be valuable for everyone to reflect on the development process through the lens of NZE. Close-out meetings provide an opportunity to note what was different from a conventional design and construction approach and identify how to make changes for future projects. Creating lessons learned and developing case studies can influence future projects, for this team and others. The ideas can also be presented in papers or at conferences with a larger audience.

Resources

- Sensitivity Analysis: Comparing the Impact of Design Operations, and Tenant Behavior on Building Energy Performance
- Using Key Performance Indicators for Energy Performance

American Geophysical Union | Washington, D.C.
Courtesy: AGU

Success in NZE should be shared broadly. Tours of NZE buildings are motivating to other prospective building owners.

Operation and Verification

> NZE buildings are not just designed to NZE standards; they are operated at NZE.

Ongoing tracking and review of energy performance with a building management system, energy dashboard, or EnergyStar® Portfolio Manager are helpful 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 NZE performance. In researching these buildings, NBI has learned that NZE buildings may not operate at NZE during the first twelve months of operation. Instead, it takes longer to meet the target due to commissioning. After one year of NZE performance, energy data can be submitted to NBI or the International Living Future Institute (ILFI) for third-party review.

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 NZE goals.

Success in NZE should be shared broadly. Tours of NZE buildings are motivating to other prospective building owners. Some ways to share your story might be by speaking at conferences, publishing case studies, and/or explaining lessons learned.

Resources

- Getting to Zero Registry, Buildings List and Database FAQ NBI Getting to Zero Database and Registry
- ILFI Net Zero Certification
- 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
- Working Together for Sustainability: The RMI-BOMA Guide for Landlords and Tenants

NZE Project Checklist

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

Stakeholder Awareness:

- ☐ Identify a NZE champion
- ☐ Identify stakeholders, drivers, and messaging
- ☐ Distribute case studies
- ☐ Schedule tours

Energy Goals and Targets:

- ☐ Benchmark existing building performance
- ☐ Evaluate building pipeline for NZE opportunities
- ☐ Use remote analytics to prioritize assessments
- ☐ Conduct on-site assessments
- ☐ Draft Owners Project Requirements (OPR)
- ☐ Set energy target EUI

Team Selection:

- ☐ Address NZE in Request for Proposal (RFP)
- ☐ During team interviews, ask about NZE
- ☐ Understand NZE implications of various contractual structures (design-build, lease-leaseback, integrated project delivery, etc.)
- ☐ Incorporate NZE and energy targets into the RFP, OPR, and contract documents

Finance and Incentives:

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

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
- ☐ Conduct envelope and systems commissioning

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!

Cover Photo: American Geophysical Union | Washington, D.C.

Rendering aerial & Modernization image: A rendering of AGU's renovating building showcasing the solar photovoltaic array which will generate the building's energy. Courtesy of AGU.

New Buildings Institute (NBI) is a nonprofit organization driving better energy performance in commercial buildings. 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. We also develop and offer guidance and tools to support the design and construction of energy efficient buildings.

Throughout its 20-year history, NBI has become a trusted and independent resource helping to drive buildings that are better for people and the environment. Our theory of change includes setting a vision and defining a path forward. We then set out to create the research that serves as the basis for tool and policy development necessary to create market change.

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nbi new buildings institute

The Department of Energy and Environment (DOEE) is the leading authority on energy and environmental issues affecting the District of Columbia. Using a combination of regulations, outreach, education, and incentives, DOEE administers programs and services to fulfill our mission to improve the quality of life for the residents and natural inhabitants of the nation's capital by protecting and restoring the environment, conserving our natural resources, mitigating pollution, increasing access to clean and renewable energy, and educating the public on ways to secure a sustainable future. We work collaboratively with other government agencies, residents, businesses, and institutions to promote environmentally responsible behavior that will lead to a more sustainable urban environment.

WE ARE WASHINGTON DC GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

DEPARTMENT OF ENERGY & ENVIRONMENT
GOVERNMENT OF THE DISTRICT OF COLUMBIA

SUSTAINABLE DC

NET-ZERO ENERGY DC

CLEAN ENERGY DC