# PROGRAMS TO PROMOTE ZERO-ENERGY NEW HOMES AND BUILDINGS

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## Key Findings

- We identified 20 programs promoting zero-energy and zero-energy-ready homes and buildings (terms are defined in the introduction); 13 are residential programs, and 7 serve commercial buildings.
- Most of the programs focus on zero-energy-ready construction, but several have substantial zero-energy components. A few programs are starting to look at zero net carbon emissions.
- Together, the programs have an annual budget of about $65 million and have collectively completed nearly 200 single-family homes, about 900 multifamily apartments, and 74 commercial buildings (with the commercial space totaling more than two million square feet of floor area). Affordable housing accounts for a significant portion of the multifamily projects. Many more projects are in process.
- Three program implementers have five or more years of experience with these programs and dominate the project completion counts. Particularly notable are the Energy Trust of Oregon commercial program, NYSERDA multifamily and commercial programs, and Efficiency Vermont programs addressing single-family housing, multifamily housing, modular housing, and commercial buildings.
- Programs report many lessons learned:
    - Residential programs find that training for builders is important, as are special efforts to target the largest builders.
    - Commercial programs find that building a community of practitioners is very important, as are intervening early in the design process and using this early intervention to set and follow through on energy design goals.
    - Programs report that it is useful to have simple incentive structures that are easy for builders, designers, and developers to understand.
    - Programs find that the multiple benefits of zero-energy homes and buildings need to be highlighted. These benefits include impacts on comfort, health, and worker satisfaction, in addition to operating cost savings.

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## Introduction

As baseline building energy codes become more stringent, a growing number of efficiency program administrators are focusing all or a portion of their new-construction programs on zero-energy buildings. This brief is intended to aid these efforts by providing information on current programs.

### *What Is a Zero-Energy Building?*

A zero-energy building (ZEB), according to an official definition by the U.S. Department of Energy (DOE), is "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy" (Peterson, Torcellini, and Grant 2015, p. 4). In other words, over the course of a year, the amount of energy produced by a building or on the building site (typically from photovoltaic panels) equals or exceeds the amount of energy the building purchases from utilities plus the energy losses associated with generating this electricity and bringing electricity and natural gas to the building.

Other definitions of ZEBs address—among other issues—whether offsite renewable energy can be used, either from community-based projects or through the purchase of renewable-energy credits. Some buildings and programs are seeking to move to "zero carbon" and not just zero energy, meaning that carbon dioxide emissions are net zero over the course of a year. The difference between zero energy and zero carbon is that the latter accounts for the carbon emissions associated with electric power generation, including when that power is needed and which generating plants are on the margin at these times. A few programs currently use a zero-energy framing to create market awareness and a foundation for the path to zero carbon.

### *Why ZEBs?*

If the United States is to dramatically reduce greenhouse gas emissions, we need to build new homes and buildings to minimize energy use and emissions, which means zero-energy, or near-zero-energy, construction. A 2019 American Council for an Energy-Efficient Economy (ACEEE) study found that zero-energy new buildings are a key ingredient in efforts to use energy efficiency to cut U.S. energy use and greenhouse gas emissions in half by 2050, with remaining needed emissions reductions coming from no- and low-emissions energy sources (Nadel and Ungar 2019). States such as California (CPUC 2020) and organizations such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) (Krippendorf 2010) and Architecture 2030 (undated) have established goals to make zero energy the standard for new buildings by 2030. Zero-energy buildings generally have a variety of nonenergy benefits relative to standard buildings, such as improved comfort, improved occupant health and productivity, more living/working space (because less space is needed for heating and cooling systems), and higher occupancy rates and resale values due to the attractiveness of the zero-energy concept to building purchasers and renters (Pande et al. 2019)

### *Zero Energy and Zero-Energy Ready*

*Zero-energy* buildings use no net energy on an annual basis. *Zero-energy-ready* buildings are typically highly efficient—efficient enough to be operated with onsite energy but lacking the solar energy systems needed to make the building truly zero energy. Zero-energy-ready buildings often include floor and roof configurations, conduit or wiring, and electric panel capacity that make it easy to hook up a solar system in the future. Zero-energy-ready buildings are sometimes called near-zero, and although there is no formal definition of "zero-energy ready," they commonly use around 50% less energy than standard construction. Many of the programs profiled in this brief promote both zero-energy and zero-energy-ready buildings.

### *Above-Code Specifications that Support Zero-Energy and Zero-Energy-Ready Construction*

A number of above-code standards and rating systems are available to demonstrate compliance with zero-energy design and operation. These include the Passive House specification (both international and U.S versions) (IPHA 2020, PHIUS 2020), the DOE Zero Energy Ready Homes specification and program (discussed below), the Living Future Institute, which runs the Living Building Challenge (which has a comprehensive living-buildings specification and certifies zero-energy and zero-carbon performance) (Living Future Institute 2020), and LEED (Leadership in Energy and Environmental Design) Zero (which certifies buildings that are zero carbon, zero energy, and zero water) (USGBC 2020).

### *The Relationship Between ZEBs and Electrification*

ZEBs are highly efficient and often use electric heat pumps to provide heating, cooling, and hot water, thereby avoiding the cost of gas piping and hookups. Some programs profiled in this brief are available only to all-electric homes and buildings or include all-electric options. But some zero-energy homes and buildings do include limited fuel use.[1] Many zero-carbon buildings do not use fuel.[2]

### *The Economics of Zero-Energy Homes and Buildings*

Zero-energy homes and buildings often cost a little more than conventional homes and buildings, but as experience is gained, costs are going down. Furthermore, some of these costs can be offset by cost savings made possible by very low energy use, which avoids the cost of gas lines and allows the use of simple and relatively inexpensive heating and cooling systems (Petersen, Gartman, and Cordivae 2019). A study by the Massachusetts chapter of the U.S. Green Building Council illustrates the economics of zero-energy buildings. It examined six building types and found that zero-energy designs could typically reduce building energy use by 44–56% and reduce total building costs (mortgage, energy, and other costs discounted over 30 years) by 0.3–9.8% (figure 1). In its primary scenario, the simple payback period on incremental costs ranged from 6 to 19 years, depending on building type.[3]

[1] See, for example, SCG undated.

[2] For example, the Living Future zero-carbon program does not permit direct combustion in new construction (Living Future undated).

[3] These figures are all relative to the Massachusetts building code, which was based on the 2015 International Energy Conservation Code.

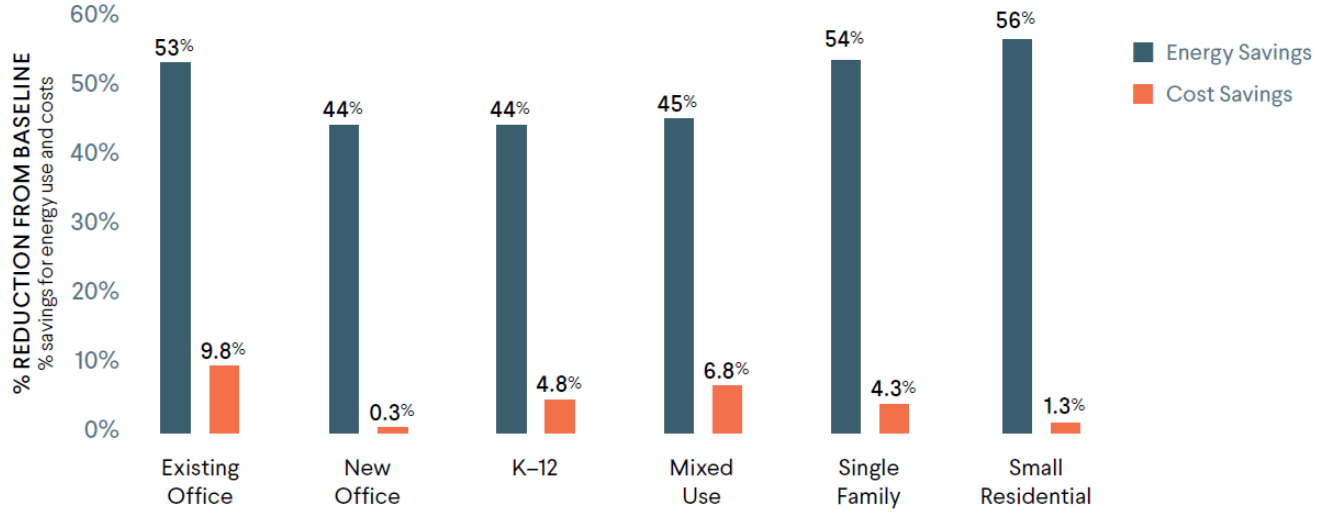


Figure 1. Zero-energy building percent reduction in energy use and cost for six building types. *Source:* USGBC Massachusetts, 2019.

### *Progress on ZEBs to Date*

The number of zero-energy and near-zero homes and buildings has grown steadily in recent years. The New Buildings Institute tracks ZEBs and maintains a database of 580 commercial buildings (at the time of writing) built over the past decade, including buildings with verified actual performance ("Verified"), as well as buildings with modeled performance that has not yet been verified with actual performance data ("Emerging") (NBI 2019). The institute has also identified 101 zero-energy multifamily buildings (NBI 2020). The nearly 700 commercial and multifamily buildings identified in 2019 is a dramatic increase from the 78 buildings identified in the 2012 report (NBI 2012). The Net-Zero Energy Coalition has identified more than 6,000 ZEB or ZEB-ready single-family homes and more than 12,000 units in multifamily buildings in the United States, for a total of more than 18,000 housing units (NZEC 2018).[4]

### *New-Construction Programs*

For many years, utilities and other program administrators have operated programs to improve the efficiency of new homes and buildings. These programs generally also cover major renovations to existing buildings.[5] Typically, these programs use current building energy codes as a base and then encourage construction of homes and buildings that are significantly "above code." For example, many new-homes programs use the ENERGY STAR® New Homes specification, which typically requires about 15% energy savings beyond code.[6] Under these programs, an incentive is paid to the builder for meeting the ENERGY STAR specification, and training and marketing assistance are often provided. For commercial buildings, new-construction programs typically have two tracks—prescriptive and performance. With a prescriptive track, the program provides incentives (typically to the developer) for specific beyond-code measures such as higher-efficiency heating and cooling equipment and lighting

[4] They are now conducting a new survey and plan to publish these results in the fall of 2020.

[5] Just over 20% of U.S. zero-energy commercial buildings occurred during renovations (Higgins 2019).

[6] Several versions of the ENERGY STAR specification are available, with different versions used in different states, depending on the requirements of their base code.

control systems. With a performance track, computer simulations of the proposed design are used to help optimize performance of the overall building. These results are compared with the same building designed to merely meet the requirements of the current code, with incentives paid per unit of energy savings beyond code. Prescriptive approaches are often viewed as easier to use, but energy savings are typically less than with performance approaches.

Zero-energy programs often build on these frameworks. For example, new-home programs may have more-stringent specifications and higher incentives for zero-energy-ready homes and sometimes also provide incentives for solar systems. Achieving net zero in commercial buildings almost always requires using the performance path, with design assistance and computer modeling provided or funded by the program. The program descriptions below provide further details.

### *Overview*

As noted above, as baseline building energy codes become more stringent, a growing number of program administrators are focusing all or a portion of their new-construction programs on zero-energy buildings. This brief is intended to aid these efforts by providing information on current programs and thereby support program implementers considering zero-energy programs. Specifically, we seek to answer the following questions:

- What programs are utilities and states offering to encourage new zero-energy and zero-energy-ready homes and buildings?
- What services and incentives are available? How are they structured?
- What participation levels have these programs achieved?
- How much have these programs cost and saved so far?
- What lessons have been learned?
- What does program experience indicate for future efforts?

To make the scope of this project manageable, we focus on programs funded by utilities and states, which are often large programs, though we briefly mention a federal program. We concentrate on new-construction programs (including major renovations), not retrofit programs.

## Methodology

We first identified programs that fit within our project scope. In addition, we asked other experts on new-construction programs for examples of zero-energy programs they were familiar with. Through this process, we identified many zero-energy and zero-energy-ready programs, although it is possible that we missed some programs now operating. We then reached out to each of the program administrators for an interview to learn more about the program and lessons learned. We also asked program managers to complete a one-page data form. On the basis of this information, we compiled short write-ups on each program and summarized the available data. We sent the draft write-ups and data to each program administrator for verification.

The next section provides descriptions of the programs we researched. Following this, we discuss the available data. We end with a discussion (including lessons learned) and conclusions.

## Programs

In total, we compiled information on 20 programs. The locations of these programs are illustrated in figure 2. We include 13 residential programs and 7 commercial programs.

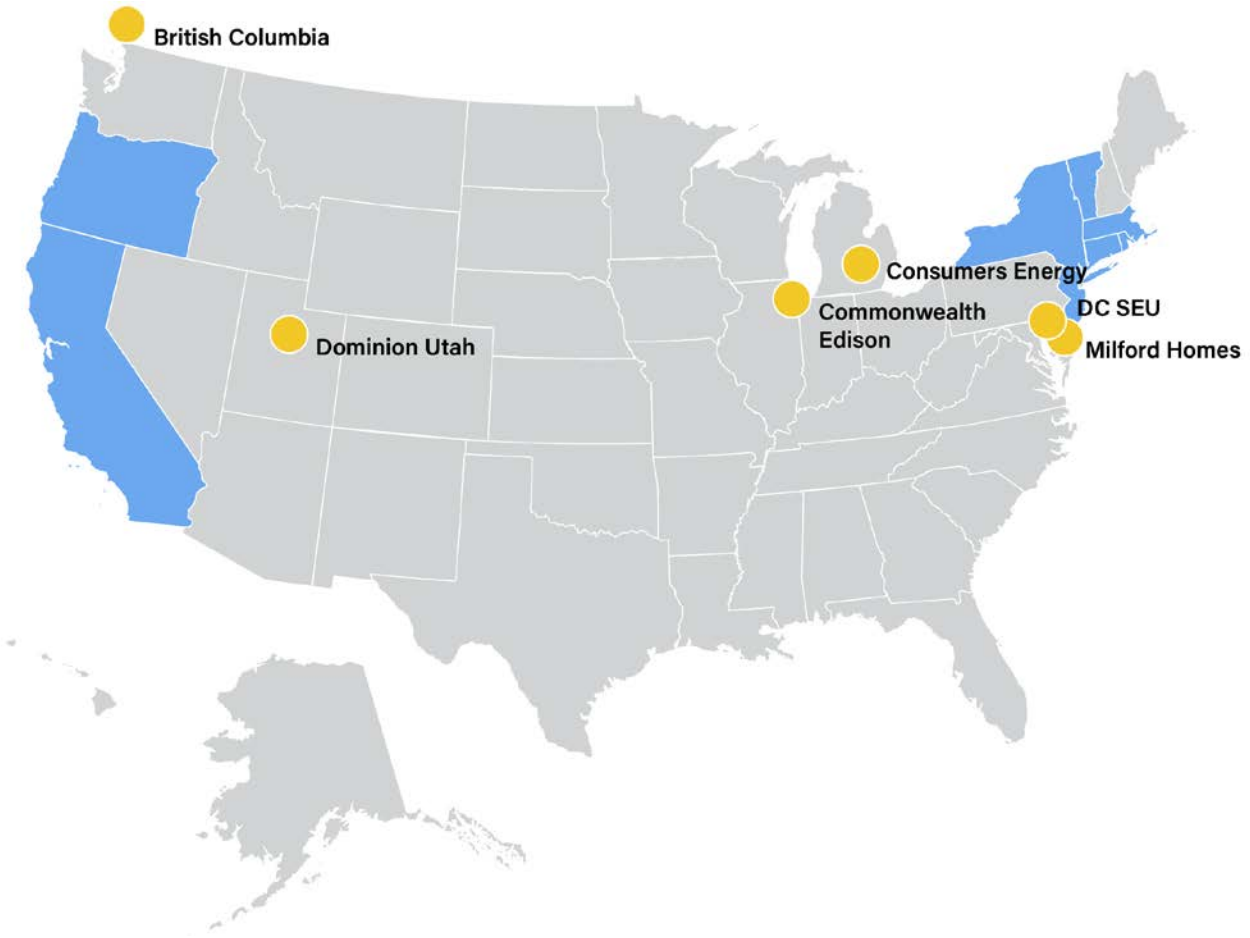


Figure 2. States and programs profiled in this brief. States that are shaded blue have programs that serve the majority of the state. Yellow dots indicate programs operated by individual program administrators that are not discussed in the sections on the shaded states.

### *RESIDENTIAL*

Residential programs address single-family homes, multifamily buildings, and in a few cases, modular homes. In the sections below, we discuss the programs in descending order based on size and scope. Where a program combines several markets, we discuss that program under its largest market.

#### Single-Family

##### EFFICIENCY VERMONT

Efficiency Vermont has operated its Residential New Construction—High Performance Homes program since 2012. The program has two tiers: Efficiency Vermont Certified and High Performance. The latter can be considered zero-energy ready. A High Performance home has high levels of insulation (e.g., R-40 wall insulation and R-60 ceiling insulation), tight construction (e.g., less than one air change per hour as measured with a blower door at 50 pascals of pressure), and a high-efficiency fresh-air system (such as a heat-recovery ventilator). Equipment in the home must generally be ENERGY STAR

and WaterSense certified, and heat pumps must meet the Northeast Energy Efficiency Partnerships (NEEP) cold-climate heat-pump specification. The High Performance program includes design review and consultation, a design rating, a preliminary energy rating, an insulation inspection (before the drywall goes up), a preliminary blower door test, and final verification, including a second blower door test. For homes achieving the High Performance tier, a $3,000 incentive is provided, plus an additional $1,000 if the home is all electric (Efficiency Vermont 2020). Incentives for an Efficiency Vermont Certified home are $2,500 plus $1,000 for all electric, but the many advantages of a High Performance home plus builders' desire to differentiate themselves from the competition allow this modest difference in incentive to work. Efficiency Vermont does not provide incentives for solar systems, but such incentives are available through Vermont Low Income Trust for Electricity (VLITE) for income-qualified customers (VLITE undated). Since the beginning of the program, 86 homes have qualified for the High Performance tier, including 4 in 2019 (2019 participation was below average because new, more-stringent program requirements had just taken effect). Efficiency Vermont is exploring ways to simplify its program requirements without significantly affecting performance. It recommends that programs educate lenders and appraisers on how to properly value the benefits of high-performance homes. Efficiency Vermont also shares cash-flow modeling examples with builders to help them sell these homes (J. Steward, program manager, Efficiency Vermont, pers. comm., June 23, 2020).

#### NYSERDA

The New York State Energy Research and Development Authority (NYSERDA) Low-Rise Residential New Construction Program includes single-family homes, multifamily buildings of three stories or fewer, and some four- and five-story buildings. The program has three efficiency tiers, and all three must meet the ENERGY STAR Certified Homes Version 3.1 specifications. Tier 3 is essentially the zero-energy tier; it requires a final Home Energy Rating System (HERS) rating of 10 or below, including any credits for onsite solar systems. Excluding the solar systems, tier 3 homes must generally have a HERS rating of 40 or below (50 or below for dwelling units smaller than 1,500 sq. ft.). Blower door testing is required, as are several equipment specifications (typically ENERGY STAR), including the NEEP cold-climate specification for heat pumps. For tier 3, incentives are $4,000 per home for 1- and 2-family homes and for the first 10 townhouses built by a builder (plus an additional $200 per unit for low- and moderate-income units). The low-rise program also includes larger multifamily buildings, which we discuss in the multifamily section of this paper. By comparison, tier 1 (ENERGY STAR V 3.0) has no incentives, and tier 2 (enhanced ENERGY STAR) has modest incentives (e.g., $950 for a 1- to 2-family home). Additional bonus incentives are available in specific regions that have a moratorium on adding new natural gas service due to supply constraints (NYSERDA 2019b). For single-family homes, participation at the highest tier has been modest (52 tier-3 homes completed since 2016), although an additional 47 homes have been committed. Participating single-family homes have been primarily in upstate New York areas (Buffalo, Rochester, Albany, and the Hudson Valley), and tier-3 homes have been completed primarily in areas with above-average incomes (M. Brown, program manager, NYSERDA, pers. comm., June 11 and July 8, 2020). Additional incentives are available through other NYSERDA and utility programs for solar and other renewable energy systems and for ground-source heat pumps (NYSERDA 2018).

NYSERDA is evaluating new minimum eligibility criteria and is seeking a balance between percentage better than code and fully electrified buildings, but specific thresholds have not been determined (M. Brown, NYSERDA, pers. comm., June 11 and July 22, 2020). Because New York State has passed legislation to mandate 100% clean energy by 2045, all-electric homes will be zero emissions by that time.

### DOE Zero-Energy-Ready Homes

DOE introduced the Zero Energy Ready Homes program to home builders in 2013. The program is built around a specification that reduces energy use approximately 30-40% compared with a minimum-code home pegged to the 2009 International Energy Conservation Code (IECC). This represents an additional 10-20% energy savings compared with an ENERGY STAR Certified Home, with variations driven by climate and ENERGY STAR version. Many certified homes significantly exceed the minimum specification. In addition to required energy savings, program specifications are designed to manage moisture, comfort, and health risks as enclosures become more efficient. Third-party inspections fully aligned with ENERGY STAR Certified Home specifications are required to assure that these specifications are being followed. The program has a variety of training and marketing aids for builders and program operators (DOE undated). From 2013 to June 2020, more than 6,000 homes were certified, with participation nearly doubling in four of the past five years (e.g., 1,536 homes in 2019 and 1,518 homes in the first six months of 2020) (S. Rashkin, chief architect, Building Technologies Office, DOE, pers. comm., June 16 and July 6, 2020). Figure 3 shows a sample home.

Figure 3. A zero-energy home by New Town Buildings, Denver, Colorado. This is part of the DOE Zero Energy Ready program. *Source:* DOE 2014.

### California

In California in 2008, state agencies set a goal of moving the residential building code to net-zero energy construction by 2020 (CPUC 2008). Since then, steady improvements have been made in each code cycle. In addition, California utilities have funded a series of demonstration programs and case studies showing that zero energy is possible (e.g., Dean 2018; Frontier Energy 2020). In the 2020 California building code, the goal was approximately met. The new code requires that a solar system be installed on new homes—approximately enough to meet the home's electricity needs, not counting space heating. Natural gas space heating is still allowed, so the code essentially requires zero-net electricity, with space heating not included. California utilities have commissioned a "cookbook" of approaches to help builders comply with the new code. This book uses 96 different energy models to identify optimized results. Builders, designers, and energy consultants can use the book to tailor feature packages specific to their climate zone, by single family or multifamily, with or without a battery credit, and tailored to all-electric or dual-fuel (W. Vicent, Energy Codes and Standards, Southern California Edison, pers. comm., May 29 and July 15, 2020).

More recently, the focus has shifted toward all-electric homes, driven by a goal to decarbonize buildings and aided by California's commitment to 100% clean electricity. For example, Southern California Edison (SCE) is now offering two programs—the Clean Energy and Resiliency Rebuild (CLEAR) program and the California Advanced Homes Program. CLEAR offers incentives to build efficient homes in areas devastated by recent wildfires. Under CLEAR, incentives of up to $12,500 are available for efficient all-electric homes and $7,500 for efficient dual-fuel homes. In addition, up to $5,000 is available for installing solar systems and backup batteries (SCE 2019). Pacific Gas and Electric (PG&E) has a similar program called Advanced Energy Rebuild. The California Advanced Homes Program requires energy efficiency improvements beyond code (at least 8.5% better) with no natural gas onsite (W. Vicent, SCE, pers. comm., July 15, 2020). SCE has also proposed to the California Public Utilities Commission (CPUC) that it should be allowed to offer a pilot all-electric new-construction program under its low-income programs. The new-construction program would provide technical assistance and incentives to affordable housing developers for construction of affordable all-electric new homes. It would also include a new-tenant education program (Buendia 2020). A decision on the program is still pending at the CPUC. In addition, the utilities and CPUC are currently reviewing proposals from third parties to operate a statewide residential new-construction program. The request for proposals specified that the program must include paths for zero-energy and all-electric homes.

#### SOUTHERN NEW ENGLAND

In Rhode Island, Connecticut, and Massachusetts, leading utilities are working together to develop zero-energy and zero-energy-ready programs. For example, in Rhode Island, National Grid, which serves most of the state, has a new-construction and zero-energy program. It includes two tracks, Path to Energy Efficiency and Path to Zero Energy Ready. The latter is a pilot and provides additional support and incentives. Under this path, homes can meet the DOE Zero Energy Ready Homes specification, the Passive House Institute U.S. PHIUS+ specification, or the requirements of a voluntary Rhode Island stretch code (State of Rhode Island 2018). Incentives range from $500 to $1,000 per unit for the DOE specification and from $750 to $1,500 for PHIUS+ or the Rhode Island Stretch Code (the high end is for 1- to 4-unit buildings, the low end for 31- to 50-unit buildings; National Grid 2020b). The pilot began in late 2018; it had 4 projects in 2018 and 100 in 2019 (21 under construction, 79 in the final design stage). Of these projects, 83 are affordable housing and 17 are market rate. The program also includes training (13 sessions in 2019), design charrettes, Passive House consulting support, and free DOE Zero Energy Ready Homes certification (National Grid 2020a).

In Connecticut, the two major utilities (Eversource and United Illuminating) offer a joint residential new-construction program with several tiers based on HERS score. Lower HERS scores indicate higher efficiency. The program pays the highest incentives for homes with a score of zero (which essentially means zero-net energy), with incentives gradually decreasing for HERS of 1–40 (essentially zero-energy ready), HERS 41–50, and HERS 51–60. In addition, there are bonuses for all-electric homes and homes earning energy-saving certifications. For zero-energy homes, the incentives are $6,500 for single-family detached, $4,600 for single-family attached, and $3,500 per unit for multifamily. For HERS below 40, the incentives are $4,500, $3,500, and $2,500, respectively, plus an additional $50/$40/$25 per HERS point below 40. Homes must have a HERS of 50 or lower before renewable energy systems can be counted. The all-electric bonus is $2,500/$2,000/$1,000 for single-family detached, single-family attached, and multifamily, and $500–$750 is provided for Passive House certification and $250–$500 for DOE Zero Energy Ready Homes, ENERGY STAR, LEED for Homes, or National Green Building Standard Silver certification (Energize Connecticut 2020a and 2020b). The all-electric component began in March 2019, and the two utilities are just starting to see completions, including a few zero-energy homes, but not many with HERS below 40. Eversource and United Illuminating have found it useful to

work closely with large builders and to give them options so they can choose the best fit for their projects. They are emphasizing all-electric homes, and they are finding that heating, ventilation, and air-conditioning (HVAC) contractors are reluctant to switch from the types of systems they have used in the past. They also note a need for heat pump water heaters (HPHWs) that can be used in multifamily apartment buildings (N. Jones, energy efficiency consultant, Eversource, pers. comm., June 30 and July 2, 2020).

Since 2011, Energize Connecticut has sponsored an annual Zero Energy Challenge, a design and build competition for residential construction. The challenge used the Residential Energy Services Network (RESNET) Rating Standards to determine each completed home's HERS Index while informing on the technology and techniques it takes to build super-energy-efficient, near-zero-energy homes. Common features include photovoltaic systems or solar energy systems, insulated concrete forms, structural insulated panels, and geothermal heat and air-conditioning. Each home received incentives for building with advanced technologies through the Energize Connecticut Residential Construction program. Homes entered into the competition could win prizes up to $5,000 depending on final HERs rating, affordability of construction, and net operating costs (Energize Connecticut 2020c).

Massachusetts has a Passive House program. Please see the multifamily program section below for details.

#### COMMONWEALTH EDISON

In Illinois, Commonwealth Edison (Com Ed), the state's largest utility (serving the greater Chicago area), began an all-electric residential new-construction program on January 1, 2020. Program requirements are air tightness less than 2.5 air changes per hour (at 50 Pascals of pressure), an air-source heat pump with a seasonal energy efficiency ratio of at least 17.8 and a heating seasonal performance factor of at least 11.0, an HPWH with efficiency of at least 3.45 Uniform Energy Factor (UEF), ENERGY STAR certified lighting, appliances, and thermostats (including an electric dryer), low-flow water fixtures, and several comfort and indoor air quality requirements. An incentive of $2,000 is provided per participating home. Induction ranges are encouraged but not required, as are measures to make these new homes photovoltaic-, electric-vehicle-, and battery-storage-ready (e.g., by installing electric service and wiring so that adding these systems later will be easy). Initial participants include townhomes, apartment flats, single-family homes, and accessory dwelling units (Commonwealth Edison 2020). In the first year, Com Ed is targeting completion of 10 homes as part of efforts to develop case studies and expand the program in 2021. As of May 2020, two homes had been completed, and several more are under construction. For the first year, Com Ed is working mostly with builders who have a long-standing interest in energy efficiency; it plans to recruit other builders in future years. While the program is still new, Com Ed has already learned the importance of training home raters on the program's requirements so they can do post-construction inspections (V. Gonzalez, energy efficiency senior program manager, Commonwealth Edison, pers. comm., June 4, 2020).

#### DISTRICT OF COLUMBIA VOLUNTARY NET ZERO ENERGY PROGRAM

The District of Columbia government is planning to adopt a building code requirement in the 2022 code cycle that would require new residential construction to be zero-net energy. This is part of DC's effort to reduce its greenhouse gas emissions and energy use by 50% by 2032, while also increasing renewable energy use to supply 50% of the District's energy by 2032. Details on the new code are now being developed. To help provide a foundation for this new code, the DC Department of Consumer and Regulatory Affairs (DCRA) and the DC Sustainable Energy Utility (DC SEU—the main provider of energy efficiency programs in the District) developed a voluntary program to promote residential net-

zero homes. To qualify for the program, a developer must meet either a DC voluntary net-zero code or an alternative specification such as the Passive House, DOE Zero Energy Ready Homes, or Living Future Institute Zero Energy Certification standards. A developer must also submit a renewable energy plan to meet energy needs with solar electric, solar thermal, or geothermal measures. If limitations prevent onsite renewables, an alternative plan may be proposed. The heart of the program is a "Green Ambassador" who works with the project developer to answer questions and facilitate interactions with DCRA and the DC SEU to move the project swiftly through the permitting and DC SEU incentive processes. The program also includes a $10,000 incentive per home (payable when the building permit is issued) and accelerated permitting. The incentive may be used for such items as performance testing and modeling costs, incremental construction costs such as for envelope improvements, or special equipment such as multi-stage heat pumps, HPWHs, induction cooktops, enthalpy recovery ventilators, and solar systems. The program includes single-family and low-rise multifamily (up to four stories). As of this writing, one home has been completed, three more have received their permits and incentives, and five more are in the pipeline (Boyd and Loncke 2020).

#### DOMINION ENERGY UTAH

Dominion Energy provides natural gas service to about a million customers in Utah, including in Salt Lake City and many of the densely populated areas to the north and south of the city. Dominion's Thermwise program for buildings provides prescriptive rebates for specific measures. In addition, in 2020 it began a Pay for Performance Program that offers incentives of up to $1,400 based on gas savings over baseline and provides a small bonus incentive ($50) for homes meeting the DOE Zero Energy Ready Homes specification. It has a few projects in the pipeline but none completed yet. It is also doing several demonstration Net Zero Home projects with local nonprofit organizations. Those projects highlight the use of natural gas in net-zero construction. The goal is to explore more-efficient and cost-effective options of achieving net zero while using both natural gas and electricity, combining zero-ready construction with hybrid heating systems (i.e., combine electric heat pumps with a natural gas space- and water-heating system), with the renewable energy coming from onsite and offsite sources as well as renewable natural gas (biogas). One project has been completed, and a few more are underway. The program also includes training in high-efficiency construction techniques for builders (B. Taylor, energy efficiency supervisor, Dominion Energy, pers. comm., June 23, 2020).

### Multifamily

Several zero-energy-ready programs have a specific focus on multifamily homes. We include here a few programs that are open to multiple building types but have primarily worked with multifamily projects.

#### NYSERDA

NYSERDA presently has two programs that address new multifamily buildings: a low-rise program (discussed above), which includes predominantly buildings up to three stories, and a mid-/high-rise multifamily program. As with the NYSERDA low-rise program, the mid-/high-rise program has three performance tiers. All three tiers require participation in either the ENERGY STAR performance path or the Passive House Institute or PHIUS+ program (there is also a modified prescriptive path for gut rehabbed projects). Tier 3 is essentially the zero-energy-ready path. It requires achieving 35% energy savings relative to ASHRAE standard 90.1-2013 without including any renewable energy use and 42% energy savings relative to 90.1 when renewable energy systems are included. For tier 3, incentives per unit are $3,100–3,500 for low- and moderate-income apartments and $1,400–1,600 for higher-income apartments (upper end of range for buildings with 50 units or fewer). Like the low-rise program, the mid-/high-rise program has a bonus incentive for regions with a moratorium on new gas hookups. For

tier 3, these incentives are capped at $300,000 per building (up to $600,000 for low-/moderate-income buildings in regions subject to the gas hookup moratorium). In addition, for tier 3, up to $10,000 per building is available for technical support for the first or second project a team undertakes. Also available are additional incentives of $100 per unit for smart-building solutions that enhance the building's energy and operational performance and similar additional incentives to support use of innovative technologies such as solar thermal or grid-responsive controls. The smart-building and innovative technology supplemental incentives are each capped at $100,000 per building. Additional incentives are available through other NYSERDA and utility programs for solar electric generation and other renewable energy systems, as well as for ground-source heat pumps (NYSERDA 2018).

Multifamily housing is now approximately 40% of New York State's new-construction market. As of this writing, a total of 3,567 multifamily units, with 32 tier-3 units, have been completed, and more than 23,000 additional units, with more than 2,000 tier-3 units, have been committed (M. Brown, NYSERDA, pers. comm. June 11 and July 8 and 22, 2020). A sample project is shown in figure 4.

Figure 4. NetZero Village, New York Capital Region (Goodell 2019). This is a low-rise project.

In addition to its low-rise and mid-/high-rise programs, NYSERDA has a "Buildings of Excellence" competition for multifamily buildings. In the first round, 28 winners received up to $1 million in incentives to help cover design and construction costs (NYSERDA 2020a). These projects include 2,785 apartments (M. Brown, NYSERDA, pers. comm., July 8, 2020).

#### EFFICIENCY VERMONT

Efficiency Vermont has a multifamily program similar to its single-family program discussed above. It has two tracks: Efficiency Vermont Certified and High Performance. The High Performance track produces essentially a zero-energy-ready building. It requires R-12 continuous insulation (in addition to filling wall cavities with insulation), an air infiltration rate of less than 0.1 cubic feet per minute measured at 50 Pascals of pressure, and a balanced heat-recovery ventilation system (Efficiency Vermont undated a). Incentives for the higher tier are $2,700 per unit, including $400 provided by the gas utility. In addition, the program will pay 50% of the cost of system commissioning and 50% of

modeling costs to support the integrated design process, each up to $5,000 per project. It has an additional $300 per-dwelling-unit incentive for successful Passive House certification. Since the start of the current program configuration in 2016, it has completed 860 units, typically in buildings of 3–4 stories and 30–60 units per project. Efficiency Vermont has found that builders overwhelmingly look to meet the continuous insulation requirement using "Zip-R" structural insulated panels (Huberwood 2020). Once a builder develops familiarity with the system, repeat use is likely. Integrating heat-recovery ventilation systems is more challenging due to first cost and a need for higher ceiling height. It finds that affordable housing developers readily choose this higher tier as they want energy costs to remain affordable for the life of the building. Market-rate housing developers are more likely to balk at the first cost, but several have participated in the program (S. O'Malley, energy consultant, Efficiency Vermont, pers. comm., June 9 and July 2, 2020).

#### NEW JERSEY CLEAN ENERGY PROGRAM

The New Jersey Clean Energy Programs are operated by contractors hired by the New Jersey Board of Public Utilities. One program is a residential new-construction program. It covers single-family and multifamily, but we list it under multifamily because the majority of participating units have been multifamily. The program has three tiers: ENERGY STAR, DOE Zero Energy Ready, and Zero Energy Ready Plus Renewable Energy. Incentives for zero-energy ready are $1,500 per unit for multifamily, $2,500 for townhouses, and $4,000 for single-family detached. An additional incentive of $30 per million Btu saved relative to the New Jersey building code is available. For renewable energy, an additional $750 (multifamily)/$1,500 (townhouse)/$2,000 (single-family detached) is provided. For single-family detached and attached houses, they also pay the energy rater $1,200 for certifying a zero-energy-ready home and an additional $500 if the home is in an urban enterprise zone or meets affordable housing criteria. In addition, the state has 4% and 9% tax credits for "green homes." Zero-energy-ready homes are eligible for the 9% credit, which has helped promote zero-energy-ready homes (NJ HMFA 2020). The zero-energy-ready part of the program began in 2014. As of this writing, the program has completed 157 zero-energy-ready homes and apartments, of which 124 are in two large multifamily projects. The program manager notes that few consumers are familiar with zero-energy/zero-energy ready and that more marketing and education on these concepts are needed. The rater incentive was added recently to help cover the additional costs of zero-energy-ready certifications. With this, the program has seen a slight increase in participation, primarily for multifamily units. They note that raters are starting to encourage builders to go deeper and meet zero-energy-ready requirements (TRC 2020; J. Lupse, program director, NJ Clean Energy Program, pers. comm., July 1 and 10, 2020).

#### MASS SAVE

In Massachusetts, the state's utilities offer a statewide program under the Mass Save banner to promote new construction meeting Passive House standards. The program was launched in July 2019. As of May 2020, about 50 projects had enrolled in the program, and it hopes to complete more than 4,000 units by 2023. The program began with training for builders in Passive House design and construction techniques. The program will help pay for a project feasibility study (up to $5,000) and for energy modeling (75% up to $20,000). Financial incentives of $3,000 per unit are offered for meeting Passive House standards. Upon completion of a design that meets program standards, an incentive of $500 per unit is paid. The remaining $2,500 per unit is paid upon completion of construction and a final inspection, including a blower door test. In addition, performance incentives of $0.75 per kilowatt-hour (kWh) and $7.50 per therm are paid for actual first-year energy savings (Mass Save 2020). The feasibility studies have been helpful. Builders appreciate knowing up front the per-unit incentives. And

program leaders have found that it is possible to exceed the Passive House standards (B. Giza-Sisson, energy efficiency consultant, Eversource, pers. comm. June 9 and July 1, 2020).

#### BRITISH COLUMBIA ZERO ENERGY CHALLENGE

The Canadian province of British Columbia has developed a "step code" that contains five increasingly stringent "steps." Step five is zero-energy ready—approximately Passive House levels. The plan is to adopt this across the province by 2032, but the province is currently promoting the steps through local building codes and voluntary programs (Pape-Salmon 2020).

The Zero Energy Challenge is an incentive program and juried design competition for buildings built to step five. The program began in 2018, and in January 2019, 16 winning projects were selected to receive design incentives of $0.40–$3.50 (Canadian) per square meter of floor area (varies with building size). On the basis of these designs, 11 projects were selected to receive construction incentives of $10 per square meter for offices, $25 for institutional buildings, $40 for retail, $60 for low-rise multifamily, and $80 for high-rise multifamily (Clean BC 2019). Of these 11 projects, the majority are multifamily. The British Columbia government is considering whether to fund another project round. In addition to the challenge, local jurisdictions are promoting the step code in various ways. One of the more innovative is a community that allows developers to build to a higher density if they build to step five (Z. May, director, Strategic Policy Building and Safety Standards Branch, Ministry of Municipal Affairs and Housing, pers. comm., June 16, 2020).

### Modular Homes

Two programs focus specifically on modular homes. Modular homes are produced in a factory and shipped to the job site in large sections that are then assembled onsite. In many cases, they can be used to replace manufactured homes.[7]

#### EFFICIENCY VERMONT

Like many rural states, Vermont has a sizable percentage of mobile and manufactured homes. Some of these are quite old and inefficient. To help replace these with more-efficient homes, Efficiency Vermont worked with a local modular-home builder to develop several designs for zero-energy modular homes. The homes are highly efficient (e.g., 10-inch thick walls, triple-pane windows). Several designs are available (figure 5), including one-box (14 ft. wide by 40–70 ft. long) and two-box (e.g., 28 ft. wide or 14 ft. wide and two stories) (Vermod 2020). Efficiency Vermont worked with the Vermont Housing and Conservation Board and other local partners to develop financing packages. For example, it currently works with U.S. Department of Agriculture (USDA) Rural Development Section 502 direct loans for the primary mortgage and with the Champlain Housing Trust for a zero-interest second mortgage up to $35,000 that is repaid when the home is sold (VHCB 2020a). These programs target low- and moderate-income purchasers. Efficiency Vermont provides grants of $3,000 or $8,500 per home, the latter for income-eligible purchasers. It has occasionally obtained grants to pay for solar systems. Since the start of the program in 2012, 83 homes have been completed.

[7] Differences among mobile, manufactured, and modular homes are explained by Hannah D. (2019).


Figure 5. Zero-energy modular homes on McKnight Lane in Waltham, VT. *Source:* VHCB 2020b.

#### MILFORD HOMES, DELAWARE

On the basis of the concept developed by Efficiency Vermont, Milford Homes, a Delaware-based affordable-housing developer, started the Ze-Mod program in Delaware in partnership with Energize Delaware, the statewide energy efficiency utility. They worked with a local modular-housing builder to develop the designs. Through Energize Delaware, they offer a $16,500 grant for a qualifying home, plus a $25,000 zero-interest second mortgage that is payable upon sale or refinance. So far, they have completed four homes.

Once Milford Homes identifies interested clients, it introduces the client to the modular-home builder. In addition to the zero-energy-ready homes, the builder also produces less-efficient homes, some of which have more interior floor area than the Ze-Mod homes (which are up to 1,204 sq. ft.). Less-efficient homes from this builder are as large as 1,800 sq. ft., and the client often switches to a larger, less-efficient home. To address this problem, it is developing a larger design (nearly 1,400 sq. ft.) and planning for Milford Homes to be the contractor, so that Milford Housing deals with the manufacturer and the manufacturer no longer has a direct opportunity to sell less-efficient homes (R. Huxtable, vice president, Milford Housing Development Corp., pers. comm. June 15, 2020).

### *COMMERCIAL*

#### ENERGY TRUST OF OREGON

Energy Trust of Oregon's Path to Net Zero is probably the most advanced of the commercial programs, having completed 41 projects with a total of 1.8 million sq. ft. One of these projects is illustrated in figure 6. The program began with an eight-building pilot in 2009 that found that a design-focused program approach leads to net-zero buildings, as documented in the pilot's concurrent process evaluation (Dethman, Kunkle, and Lobkowicz 2012). Many early lessons from pilot implementation were incorporated into an Allies for Efficiency training series on net-zero topics (built around peer-to-peer exchange), ultimately positioning the market to accept a full-scale Path to Net Zero relaunch in late 2014. According to Energy Trust, the program's design strategy has two keys: (1) "early target setting" to position building owners and teams to set and achieve net-zero goals; and (2) "build a community around net zero" to support broad market adoption. It finds that the greatest opportunity to identify and influence deep savings is pre-schematic design, where the program supports shoebox

modeling (simple models, often with only one zone), energy-use intensity (EUI) targeting, and energy-related studies (i.e., daylighting studies and computational fluid-dynamic modeling of natural ventilation) that inform final energy modeling and savings calculations. About halfway through construction document preparation, the program conducts a project review and makes final recommendations to keep projects on track to achieve their original savings target (York et al. 2015).

Currently, the program includes early design assistance (a project kickoff meeting, up to $6,000 for a design charrette, and construction document review), technical assistance (60% of the cost to conduct energy studies such as shoebox modeling, computational fluid-dynamics analysis, daylighting studies, energy modeling, and commissioning design review, not to exceed $40,000), installation incentives ($0.40 per first-year estimated kWh savings and $1.20 per therm), solar-ready incentives (up to $1,800 to determine solar potential, up to $35,000 for a solar system and up to $15,000 to build to solar-ready standards), assistance with energy metering (up to 50% of the cost up to $20,000), and $2,000 for net-zero certification by the International Living Future Institute (ETO 2020).

Energy Trust estimates that about half of eligible commercial new-construction projects are participating in the program. It now has more than 100 projects showing interest in participation, including 50 multifamily projects and 32 education-sector projects. To date, projects emphasize lighting and shell improvements and often use variable refrigerant flow (VRF) systems to provide HVAC. Energy Trust is about to increase the required energy savings from 70% of average existing building EUI to 80%. It expects this change to challenge the design community. It has also developed precalculated packages of measures for smaller projects, with modeling done to develop the packages and incentives to be paid per sq. ft. (J. Olson, senior program manager, Energy Trust of Oregon, pers. comm., June 16 and July 2 and 9, 2020).

Figure 6. Portland Community College Newberg Campus Center. *Source:* ETO 2017.

#### NYSERDA

NYSERDA has a commercial new-construction program that offers three levels of support: (1) review of schematic design phase plans or equipment selections by a NYSERDA-approved technical consultant, providing suggestions for energy savings; (2) cost-shared energy modeling and analysis; and (3) technical and financial support for zero-net-energy, deep retrofit, and smart building projects. To qualify for this third level, projects must exceed the New York Construction Code by at least 25% (20% for all-electric buildings). As part of this third level, NYSERDA will pay 100% of technical consultant costs up to $200,000 per project and $150 per metric ton for first-year $CO_2$ savings up to

$350,000 per project ($450,000 for all-electric projects or projects in areas affected by utility natural gas hookup moratoria). An additional 5% design incentive is available for all-electric projects or projects in gas moratorium areas. Additional incentives are available for smart-building projects (NYSERDA 2019a). As of this writing, 35 projects, including 18 support-level 3 projects, have been completed and another 135 projects are committed, with 102 committed for support-level 3; a substantial majority of these are zero-energy or deep retrofit projects. Zero-energy projects have included colleges and universities, economic development, renovations of old buildings, and agriculture-sector projects (e.g., dairies and vineyards) (M. Brown, NYSERDA, pers. comm., June 11 and July 8, 2020).

In addition to the main commercial new-construction program, NYSERDA runs a competitive Net Zero Energy for Economic Development program for regionally significant economic development projects that are also net-zero energy or net-zero carbon. The program includes net-zero facilities as well as net-zero community projects involving multiple buildings. A budget of $15 million per year has been established (NYSERDA 2020b). Currently, 21 projects are in process; projects receive incentives based on incremental cost (M. Brown, NYSERDA, pers. comm., July 8 and 22, 2020).

#### Efficiency Vermont

Efficiency Vermont has a commercial new-construction program with three tracks: equipment approach, high performance (holistic improvements to reduce energy use 10–20%), and net zero (including efficiency savings of 30–45% below code) (Efficiency Vermont undated b). The program includes design charrettes (which have been popular when they are well facilitated), a modeling requirement (although so far modeling has rarely influenced design because designers have often already decided what type of envelope or system they want), and financial incentives of $70 per first-year million Btu of site energy savings (site energy is used to keep it simple and to encourage electrification). Since the program's start in 2014, 15 projects have been completed, including three in 2019. The 15 projects have averaged about 16,000 sq. ft. in floor area but range up to 35,000 sq. ft. in size. The majority of successful projects have been with institutions, particularly municipalities. Efficiency Vermont finds that some project developers want to be combustion free in addition to net-zero, but VRF systems that often make this possible are expensive. Still, Efficiency Vermont has had some success by focusing on lifecycle costs (N. Carpenter, associate director of engineering, Vermont Energy Investment Corp., pers. comm., June 12 and July 6, 2020).

#### California

As it did with residential new construction, California has established a goal to make commercial new construction net-zero; in the case of commercial, the goal is net-zero by 2030 (CPUC 2008). The California investor-owned utilities developed a set of zero-net-energy (ZNE) case studies (e.g., Dean 2014) and are working with the California Energy Commission to develop a set of building code changes for 2022, 2025, 2028, and 2031 to reach the zero-energy goal. In addition, a few net-zero buildings have been incentivized under its Savings by Design commercial new-construction program. This program has paid incentives based on estimates of project energy savings. In their market research on the commercial ZNE market, California's investor-owned utilities found—among other things—that of new commercial building floor area completed in the prior three years, 0.4% was zero-energy or ultra-efficient (zero-energy ready) (Pande et al. 2019). California's investor-owned utilities are now selecting a contractor to run a new commercial construction program that will likely include a zero-energy/zero-carbon component, probably with an emphasis on zero-carbon.

#### SOUTHERN NEW ENGLAND

As with residential new construction, utilities in Rhode Island, Massachusetts, and Connecticut are just beginning zero-energy commercial building programs. In Rhode Island, National Grid (which serves most of the state) began a Zero Net Energy Building Pilot Program in June 2020 to gain experience with ZEBs and contribute to developing a full-scale program. A ZNE building is defined as exceeding code by at least 30% and producing as much site energy as it uses on an annual basis. Zero-energy-ready projects are also eligible. Under the program, National Grid helps the owner select the design and construction team, provides design and technical assistance, including helping with goal setting and a design charrette, covers 100% of the energy modeling costs, and provides incentives up to $2.70 per sq. ft. (with a cap on total incentive). The majority of the incentive (70%) is paid after project completion, and the rest is paid after one year of monitoring and verification. Additional incentives, up to $15,000, are available to the design team (National Grid 2020c). Presently, the program does not include solar energy. The utilities are also testing a program design for next year under which architecture firms can receive incentives for portfolios of many projects, possibly linked to firm efforts under the American Institute of Architects' 2030 Challenge (M. Chandra, principal analyst, National Grid, pers. comm., June 30, 2020).

Likewise, the Mass Save sponsors just relaunched their C&I New Construction Program, which has several pathways, including a new net-zero-energy/low-EUI pathway that assists with net-zero and zero-energy-ready buildings. This program targets an EUI of 25 or less, and if this is not attainable, at least 25% savings relative to the building code. Buildings of 20,000 sq. ft. or more of conditioned space are eligible. Commissioning is required. Incentives are $1.25 per sq. ft. at the completion of construction, plus a bonus incentive of $1 per sq. ft. for meeting the EUI target based on one year of monitoring. In addition, the program includes early technical assistance, a design team incentive, incentives for verification contractors to help assess building performance 2, 6, and 12 months into building operations, and a bonus incentive of $3,000 for achieving LEED Zero, Living Future, or Passive House certification (Mass Save 2020b).

A Connecticut program very similar to the Rhode Island and Massachusetts programs was launched in August 2020 by Energize Connecticut (Energize Connecticut 2020d).

These programs build on earlier pilot and local programs such as Repower Providence (City of Providence 2020) and work by the Rhode Island Energy Office on a Zero Buildings Pathway, a ZEBs voluntary stretch code, and a ZEBs working group (State of Rhode Island Office of Energy Resources 2020).

#### CONSUMERS ENERGY

Consumers Energy in Michigan is another utility with a Zero Net Energy Pilot Program. The program provides building owners and their designers with five phases of zero-energy guidance, which includes design charrettes, energy modeling, construction incentives, and performance measurement and verification (Consumers Energy undated). The program is really a zero-energy-ready program, as it is funded out of the utility's energy efficiency budget, which does not include solar systems. The program began with about a dozen projects, with eight still in process, including one that is nearly complete. The projects are either all electric or with only limited use of fossil fuels as part of hybrid heating systems. It originally had a complicated incentive structure, but this confused customers and designers and resulted in large variability in cost effectiveness from project to project. It has streamlined to a per-sq.-ft. incentive payable at two key points in the project, after phase 3 (finalized building construction) and after phase 5 (a full year of building operation with measurement and

verification). It also found that a fixed EUI-based threshold did not work for some buildings and is modifying these thresholds as long as energy-saving goals expressed in percentage savings below code are met. Consumers Energy found that to reach zero-net-energy goals, fossil fuel energy needed to be minimized, so it is encouraging all-electric projects. It has also found that the design community needs to be educated that zero energy is achievable; it has developed one design guidebook (Consumers Energy 2019) and is developing a second that is focused on schools. It is tentatively planning to make this a full-scale program in 2021 (J. Wadel, Consumers Energy, Commercial & Industrial Pilot Programs, pers. comm., June 17 and 25, 2020).

## Data

Given that many programs are just getting started, most of the participation and savings so far are from just a few mature programs. Below, we summarize the data collected across the programs. More detailed data on each program can be found in the appendix.

### *START YEAR*

The Energy Trust of Oregon Pathway to Net Zero program is the oldest program in our survey, having begun in 2012. The Efficiency Vermont programs began in 2012, and the NYSERDA new-construction programs began in 2016. The other programs are newer, including several that began in 2020.

### *COMPLETIONS*

Many of the programs include zero-energy and zero-energy-ready homes and buildings as well as less-stringent efficiency tiers. We asked programs to provide the number of completions at zero-energy ready and above. Using this yardstick, across the programs, nearly 200 single-family homes, about 900 apartments, and 74 commercial buildings have been completed through programs, with a large number of additional projects in process. A majority of the completed homes and apartments are in Vermont, while a majority of commercial buildings are in Oregon. New York State has about 5,000 apartments and 110 commercial buildings in process. From discussions with program managers, it appears that a substantial majority of projects are zero-energy ready, and only some projects are truly zero-energy.

### *BUDGETS*

Total program budgets were about $57 million in the most recent completed year, including about $31 million for residential programs and $26 million for commercial programs. For 2020, budgets total about $69 million. In 2020, programs in southern New England are starting up. The 2020 NYSERDA residential budget is down so far, but it is still awaiting approval of its budget for low- and moderate-income housing.

### *INCENTIVES*

All of the programs we report on in this paper provide financial incentives for homes and buildings meeting zero-energy and zero-energy-ready goals. Table 1 summarizes the current incentives being paid by the programs. Residential programs all pay incentives, typically to the builder, on a per-home basis, ranging from a low of $50 paid by Dominion Utah for a DOE Zero Energy Ready Home (its primary incentive is based on energy savings) to $16,500 paid by Energize Delaware for a high-performance modular home. Ignoring these two extremes, incentives range from $200 per apartment to $6,500 per home, with a median incentive for the values shown in table 1 of $3,000 per home or apartment. Most of these incentives are for zero-energy-ready, with qualifying criteria including homes meeting Passive House or DOE Zero Energy Ready Home specifications and homes with HERS scores

less than 10, 40, or 50.[8] Instead of these national-level specifications, some programs have program-specific specifications. NYSERDA, Connecticut, and New Jersey are the only programs with explicit tiers for zero (Connecticut), near-zero (NYSERDA's tier 3), or zero-ready plus renewables (New Jersey). Some of the programs provide higher incentives for low- and moderate-income housing. Three of the programs (Vermont, New Jersey, and Dominion Utah) pay additional incentives for energy savings. In addition to incentives for completed homes/apartments and energy savings, a few programs offer other incentives for all-electric buildings or for such added steps as obtaining state or third-party certifications; the modular-home programs both also include referrals and assistance with low-cost second mortgages; and a few programs have extra incentives for mentoring, feasibility studies, and modeling.

**Table 1. Incentives paid by the different programs**

Residential

| | Incentive | | | |
|---|---|---|---|---|
| Program | Single family | Townhouse | Multifamily | Additional incentives and notes |
| Efficiency Vermont high performance | $3,000 | $3,000 | $2,700 | $1,000 for all electric |
| NYSERDA tier 3 (HERS ≤ 10) LMI | $4,200 | $4,200 | $3,100–3,500 | Additional incentives in downstate zone with |
| NYSERDA tier 3 (HERS ≤ 10) not LMI | $4,000 | $4,000 | $1,400–1,600 | constrained natural gas supplies. For MF up to $10,000 for mentoring, $100/unit for smart controls |
| Rhode Island Passive House | $1,500 | $1,500 | $750 | |
| Energize Connecticut zero energy | $6,500 | $4,600 | $3,500 | $250–750 for obtaining certification |
| Energize Connecticut HERS ≤ 40 | $4,500 | $3,500 | $2,500 | Additional incentives per HERS point <40 |
| Energize Connecticut all-electric bonus | $2,500 | $2,000 | $1,000 | |
| Commonwealth Edison all electric | $2,000 | $2,000 | $2,000 | Only buildings with 4 units or less are eligible |
| Dominion Utah | | | | Pay for performance up to $1,400; $50 DOE ZER |
| NJ Clean Energy zero-energy ready | $4,000 | $2,500 | $1,500 | Plus $30/MMBtu; $1,200/home for rater |
| NJ Clean Energy zero-energy ready + RE | $6,000 | $4,000 | $2,250 | $500 for LMI or located in an urban enterprise zone |
| Mass Save Passive House | | $3,000 | $3,000 | Plus $0.75/kWh and $7.50/therm; also incentives for feasibility studies and modeling |
| Efficiency VT modular homes | $3,000 | | | $5,500 more for low income; low-cost financing |
| Milford Homes, Delaware | $16,500 | | | Low-cost financing |

Commercial

| | Incentives | | | |
|---|---|---|---|---|
| Program | Per sq. ft. | Per unit energy | Per MMT $CO_2$ | Additional incentives and notes |
| Energy Trust of OR Path to Net Zero | | $0.40/kWh<br>$1.20/therm | | Additional incentives for solar; various TA services |
| NYSERDA | | | $150 | Additional incentives for solar; various TA services |
| Efficiency Vermont | | $70/MMBtu | | Various TA services |
| Rhode Island | $2.70 | | | Various TA services |
| Mass Save | $2.25 | | | Various TA services |
| Consumers Energy | $1.50 | | | Various TA services |

**All energy and $CO_2$ incentives are for the first-year savings. MMBtu = million Btu used onsite. MMT = million metric tons.**

The commercial programs all include various technical assistance services such as an initial design charrette and computer modeling. In addition, three provide incentives per sq. ft. for meeting program energy-saving criteria. Oregon and Vermont provide incentives for energy savings beyond the state building code, while NYSERDA pays incentives per million metric tons of emissions reductions as estimated using procedures it specifies (NYSERDA 2019a). The per-sq.-ft. incentives range from $1.50

[8] The Connecticut program has multiple tiers, including HERS of 40 or less and HERS of 50 or less. In table 1, we list only the 40-or-less incentives.

to $2.70 with a median of $2.25. The two energy savings incentives are $70 and about $118 per site million Btu, a simple average of $0.94 per million Btu. In all programs but Oregon's, the efficient design must exceed the building code by 25–45% (varying by state and sometimes by building); in Oregon, energy use per sq. ft. must be at least 70–80% less than the average existing building. Most of the programs target net-zero performance although zero-ready also qualifies.

### *THIRD-PARTY SPECIFICATIONS*

Many of the programs use specifications developed by third-party organizations. Passive House was mentioned most frequently, but DOE Zero Energy Ready Homes and Living Buildings were also common. By incorporating these specifications, programs can leverage the resources, training, and community of experienced practitioners to support the design and construction community in their local area. These common specifications also offer additional ways to market the program to builders and consumers concerned about health, comfort, and sustainability.

### *ENERGY SAVINGS*

Only some programs were able to provide information on energy savings achieved from completions in the most recent year. Commercial programs saved more than 10 GWh (million kWh), with the majority of savings in Oregon but also substantial savings in New York. Oregon saved about 65 billion Btu of natural gas; other programs did not provide data on gas savings. Residential completions in the most recent year saved about 1.8 GWh and 5 billion Btu of natural gas and other fuels. Most of these savings were in Vermont. Thus, in the most recent year, savings from the commercial sector were much greater than in the residential sector. We also note that on a per-building basis, programs typically target 30–40% energy savings in residential buildings relative to current building codes. For the commercial sector, savings relative to code generally range from 30% to 70%.[9]

## Findings and Lessons Learned

As noted above, most of the programs we identified promote zero-energy-ready construction; only a few (NYSERDA, Energy Trust of Oregon, New Jersey, and Energize Connecticut) include a zero-energy tier. This is the case for a variety of reasons, including a long history of programs promoting energy savings (programs are more familiar and comfortable promoting energy efficiency), a desire by programs to maximize cost effectiveness, limitations on the use of energy efficiency budgets to fund renewable energy, and limits on the amount of renewable energy that can fit on many building sites.

We found many more residential programs (13) than commercial programs (7). Several of the programs have been operating for at least five years and are achieving substantial participation and savings. For example, the Energy Trust of Oregon Pathway to Net Zero program estimates that about 50% of commercial new construction is participating in its program. Most of the programs started recently; these programs have quite a few projects in process but only a few completions so far.

For the residential programs, many are using the Passive House specifications (often participants can use either the U.S. or the international version). Quite a few programs use HERS ratings, with the highest tiers looking for scores of 40 or below. Some programs use the DOE Zero Energy Ready Homes specification, often with lower energy savings and incentives than for the Passive House or HERS

[9] Similar savings for commercial buildings were noted by Higgins (2019), who found that buildings with zero-energy-verified performance on average used 60% less energy than comparable existing U.S. commercial buildings and 46% less than new buildings under one of the most stringent building codes (California's Title 24).

below 40. In many of the residential programs, multifamily units predominate, including developments by affordable housing developers. As one program noted, affordable housing developers look to keep operating costs low so these homes will still be affordable in 40 years.

Programs have found that training for builders is important, as are special efforts to target the largest builders. Efficiency Vermont recommends working with lenders and appraisers to ensure they properly value the benefits of high-performance homes. They also provide materials on cash-flow modeling to help the builders sell these homes. Programs report that providing builders with options is useful so that each builder can find an approach that works for them. Several programs work to train and/or incentivize home raters so they can do final quality control inspections. The modular-home programs show the importance of working with a local manufacturer to develop the designs and of not giving the manufacturer an opportunity to shift purchasers to less-efficient homes.

For the commercial programs, the Energy Trust of Oregon has found that building a community of practitioners is very important, as is intervening early in the design process and using this early intervention to set and follow through on energy design goals. It offers a variety of technical assistance services to facilitate early intervention, such as shoebox modeling and natural ventilation studies. Most of the commercial programs have found design charrettes to be useful, and all provide assistance with computer modeling. In the commercial sector, education and municipal buildings have been good initial targets, as well as multifamily to the extent that these are part of commercial and not residential programs. Several programs pay incentives at two stages, such as an initial payment upon completion of designs and a final payment upon completion of construction. A few programs in Southern New England defer a portion of payment until a year after occupancy so they can verify that savings targets are reached in practice. Without such a scheme, obtaining post-occupancy data can be difficult, and limited available data indicate that actual performance may not meet goals. Paying builders and developers for actually meeting goals may be a useful way to address this issue.

Several of the programs provide additional incentives for all-electric homes and buildings, noting that their electric grids are becoming increasingly clean and therefore going all electric can reduce emissions. The Consumers Energy program has found that minimizing use of fossil energy makes it easier to reach net-zero-energy performance. Zero and zero-ready homes and buildings often use ductless or VRF heat pumps; several programs report that training contractors on their installation and maintenance can be useful. Programs also note that further work on HPWHs for multifamily buildings is needed. On the other hand, a few gas utilities are promoting renewable natural gas as a way to achieve net-zero energy, although this raises the question of whether new construction is the best use of limited renewable natural gas supplies.

Many of the programs noted that to promote zero and zero-ready homes and buildings, the multiple benefits of these homes and buildings need to be featured, such as their impacts on comfort, health, and worker satisfaction, in addition to operating cost savings. Programs also report that it is useful to have simple incentive structures that are easy for builders, designers, and developers to understand.

Quite a few programs are trying creative new approaches that will be useful to evaluate. For example, NYSERDA has extra incentives for smart buildings and for using innovative technologies such as grid-responsive controls. It also provides mentoring support to multifamily developers for each developer's first two projects. In addition, it is the only program implementer we identified that pays commercial incentives per ton of avoided $CO_2$, although the California commercial program may also move in this direction. Efficiency Vermont is now requiring continuous insulation and heat-recovery ventilators in

high-performance homes. Rhode Island is working with architecture firms on portfolios of projects, tying into firms' 2030 challenge commitments. And programs in Rhode Island and Massachusetts will be paying a portion of their incentives on the basis of actual performance in the first year after occupancy. Massachusetts is also offering incentives to help pay for contractors to verify systems are operating properly 2, 6, and 12 months into building operations.

A few programs see their efforts as part of a market transformation approach to ultimately move toward zero-energy building codes. This is a major focus of California utilities and state government. Likewise, the Northwest Energy Efficiency Alliance (NEEA) is now developing a strategy to make zero-energy common practice by 2030 (B. Liu, senior manager, Codes, Standards, and New Construction, NEEA, pers. comm., June 30, 2020). In some states, utilities can get energy savings credit for their contributions toward code development and adoption (Misuriello et al. 2012).

Because many of the programs are new, it would be useful to repeat this research in a few years when many more programs will have results.

## Conclusion

Programs to promote zero-energy and zero-energy-ready homes and buildings are growing in number, driven by a desire to achieve energy savings and greenhouse emissions reductions relative to even the most stringent current building codes. Many programs have begun only recently. Three program implementers have five or more years' experience with these programs; these implementers dominate the project completion counts. Particularly notable are the Energy Trust of Oregon commercial program, NYSERDA multifamily and commercial programs, and Efficiency Vermont programs addressing single-family, multifamily, modular housing, and commercial buildings. Collectively, these programs report many lessons learned, as summarized above. These programs are an important contributor to efforts to transform new-construction markets and ultimately make zero-energy and zero-carbon buildings common practice.

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## Appendix: Data by Program

The following tables summarize the data provided to us by each program. The first set of tables covers the residential programs; the second set covers the commercial programs. While we have sought to collect the data in as standardized a form as possible, programs differed somewhat in how they responded. Therefore, care should be used in comparing programs. These data are best seen as providing a broad picture. Furthermore, all of these programs are regularly changing. The data capture a snapshot in time.

## *RESIDENTIAL PROGRAMS*

| Program administrator | Efficiency Vermont | Efficiency Vermont | Efficiency Vermont | NYSERDA |
|---|---|---|---|---|
| Program | Residential New Construction- High Performance Homes | Zero Energy Modular Homes | MF New Construction Program: High Peformance Track | New Construction Housing |
| Start year | 2012 | 2012 | 2016 (in its current configuration) | 2016 |
| | | | | |
| Completions since program beginning | | | | |
| Number of homes | 86 | 83 | N/A | 52 |
| Number of apartments | N/A | N/A | 860 | 32 |
| Number of commercial buildings | N/A | N/A | N/A | N/A |
| Commercial building total floor area | N/A | N/A | N/A | N/A |
| | | | | |
| Completions in most recently completed program year | | | | |
| Number of homes | 20 | 4 | N/A | 11 |
| Number of apartments | N/A | N/A | 320 | 0 |
| Number of commercial buildings | N/A | N/A | N/A | N/A |
| Commercial building total floor area | N/A | N/A | N/A | N/A |
| | | | | |
| Total program budget in most recently completed program year | $590,000 | Included in column to right | $760,000 | $10,577,890 |
| Total estimated participant cost share in most recent year | | | | $41,624,266 |
| | | | | |
| Budget in current program year (without adjusting for effects of COVID-19) | $468,500 | - | $405,000 | $5,717,737 |
| | | | (above does not include NG) | |
| Are incentives available for design team? | No | No | Yes | No |
| Are incentives available for computer modeling? | No | No | Yes | Yes for performance that requires modeling |
| Is other technical assistance available? | Yes | Yes | Yes | Yes |
| | | | | |
| Incentives for efficiency measures in most recent year | | | | |
| (if efficiency and renewable incentives are combined, ok to enter these here) | | | | |
| Per first-year kWh saved | - | - | | |
| Per lifetime kWh saved | - | - | | |
| Per first-year fossil fuel Btu saved | - | - | | |
| Per lifetime fossil fuel Btu saved | - | - | | |
| Per sq. ft. of floor area | - | - | | |
| Per home | $2,500-3,000 | $3,000-8,500 (currently) | | $4,000–5,200 |
| Per apartment | - | - | $2,300-2,700 | $1,400–3,900 |
| Per metric ton of $CO_2$ saved | - | - | | |
| Are renewable incentives included in answer? | No | No | No | No |
| | | | | |
| Are separate incentives available for solar systems on/by the building? | Not through Efficiency Vermont | Not through Efficiency Vermont | Not by Efficiency Vermont | Yes |
| | | | | |
| Does your program use any third-party specifications? | | | | |
| Passive House | Yes | Yes | Yes | Yes |
| DOE Zero Energy Ready Homes | Yes | Yes | | Yes |
| Living Buildings | | | | |
| Other (please specify) | NGBS, ENERGY STAR, IAP | NGBS, ENERGY STAR, IAP | | RESNET, ASHRAE |
| | | | | |
| Annual estimated savings from completions in most recent year | | | | |
| (net savings if available) | | | | |
| MWh of electricity (1,000 kWh) | 472 | 18 | 1,170 | 98 |
| Decatherms of natural gas (million Btu) | 1,392 | N/A | 4,300 | 85 |
| Million Btu of other fuels | 3,264 | N/A | 862 | |
| Thousand gallons of water | 351,186 | N/A | 4,800 ccf | |
| Are these net or gross savings? | Net | Net | Gross | |
| | | | | |
| Notes: | | | Gas utility incentive of $400/unit | |

| Program administrator | NYSERDA | National Grid Rhode Island | Mass Save | Commonwealth Edison |
|---|---|---|---|---|
| Program | Buildings of Excellence | | Passive House multifamily incentive and training program | Electric Homes New Construction |
| Start year | 2019 | 2020 | 2019 | 2020 |
| | | | | |
| Completions since program beginning | | Program just starting | | |
| Number of homes | N/A | | 0 | 2 |
| Number of apartments | 0 | | 0 | 0 |
| Number of commercial buildings | N/A | N/A | N/A | N/A |
| Commercial building total floor area | N/A | N/A | N/A | N/A |
| | | | | |
| Completions in most recently completed program year | | Program just starting | | |
| Number of homes | N/A | | 0 | 2 |
| Number of apartments | 0 | | 0 | 0 |
| Number of commercial buildings | N/A | N/A | N/A | N/A |
| Commercial building total floor area | N/A | N/A | N/A | N/A |
| | | | | |
| Total program budget in most recently completed program year | $18,039,810 | Program just starting | Part of larger new-construction program | $168,000 |
| Total estimated participant cost share in most recent year | | | | |
| | | | | |
| Budget in current program year (without adjusting for effects of COVID-19) | $5,000,000 | | Part of larger new-construction program | $168,000 |
| | | | | |
| Are incentives available for design team? | Yes | | Yes | No |
| Are incentives available for computer modeling? | | | Yes | No |
| Is other technical assistance available? | | | Yes | No |
| | | | | |
| Incentives for efficiency measures in most recent year | | | | |
| (if efficiency and renewable incentives are combined, ok to enter these here) | | | | |
| Per first-year kWh saved | | | | |
| Per lifetime kWh saved | | | | |
| Per first-year fossil fuel Btu saved | | | | |
| Per lifetime fossil fuel Btu saved | | | | |
| Per sq. ft. of floor area | $15–20 | | | |
| Per home | | $1,000–1,500 | $3,000 | $2,000 |
| Per apartment | | $500–1,500 | $3,000 | |
| Per metric ton of $CO_2$ saved | | | | |
| Are renewable incentives included in answer? | No | No | No | No |
| | | | | |
| Are separate incentives available for solar systems on/by the building? | Yes | | Yes, but not through the EE program | Not yet |
| | | | | |
| Does your program use any third-party specifications? | | | | |
| Passive House | Yes | Yes | Yes | |
| DOE Zero Energy Ready Homes | Yes | Yes | Yes | |
| Living Buildings | | | | |
| Other (please specify) | RESNET, ASHRAE | RI Stretch Code | | All electric/no gas |
| | | | | |
| Annual estimated savings from completions in most recent year | | | N/A | |
| (net savings if available) | | Program just starting | | |
| MWh of electricity (1,000 kWh) | | | | Not available |
| Decatherms of natural gas (million Btu) | | | | N/A |
| Million Btu of other fuels | | | | Not available |
| Thousand gallons of water | | | | N/A |
| Are these net or gross savings? | | | | N/A |
| | | | | |
| Notes: | | | | |

| Program administrator | New Jersey Board of Public Utilities | DCSEU and DCRA | Dominion Energy Utah | Milford Homes, Delaware |
|---|---|---|---|---|
| Program | New Jersey - Residential New Construction | Voluntary Residential NZE Program | Zero Energy Ready Homes | Ze-Mod |
| Start year | 2002/2014 (program/ZER added) | 2019 | 2020 | 2018 |
| | | | | |
| Completions since program beginning | | | New in 2020 | |
| Number of homes | 33 | 1 | | 4 |
| Number of apartments | 124 | | | N/A |
| Number of commercial buildings | N/A | | N/A | N/A |
| Commercial building total floor area | N/A | | N/A | N/A |
| | | | | |
| Completions in most recently completed program year | | | New in 2020 | |
| Number of homes | 7 | 1 | | |
| Number of apartments | 124 | | | N/A |
| Number of commercial buildings | N/A | | N/A | N/A |
| Commercial building total floor area | N/A | | N/A | N/A |
| | | | | |
| Total program budget in most recently completed program year | $524,344 | | New in 2020 | |
| Total estimated participant cost share in most recent year | Not available | $20,000 | None | |
| | (for ZER incentives; ACEEE added 25% for administration) | | | |
| Budget in current program year (without adjusting for effects of COVID-19) | $524,344 | $20,000 | $2,500 + performance incentives | |
| | (expect similar) | | | |
| Are incentives available for design team? | Yes | Included in overall incentive | No | No |
| Are incentives available for computer modeling? | No | Included in overall incentive | Yes | No |
| Is other technical assistance available? | No | Yes | Yes | No |
| | | | | |
| Incentives for efficiency measures in most recent year | | | | |
| (if efficiency and renewable incentives are combined, ok to enter these here) | | | | |
| Per first-year kWh saved | | | | |
| Per lifetime kWh saved | | | | |
| Per first-year fossil fuel Btu saved | | | Up to $1,400; pay for performance | |
| Per lifetime fossil fuel Btu saved | | | | |
| Per sq. ft. of floor area | | | | |
| Per home | $2,500–4,500 (plus $1,200 to rater) | $10,000 | $50 for DOE ZER | $16,500 |
| Per apartment | $1,500–2,250 | | | |
| Per metric ton of $CO_2$ saved | | | | |
| Are renewable incentives included in answer? | Yes | No | No | No |
| | | | | |
| Are separate incentives available for solar systems on/by the building? | Yes | No | No | No |
| | | | | |
| Does your program use any third-party specifications? | | | | |
| Passive House | | Yes | | No |
| DOE Zero Energy Ready Homes | Yes | Yes | Yes | No |
| Living Buildings | | Yes | | No |
| Other (please specify) | | | | |
| | | | | |
| Annual estimated savings from completions in most recent year | | | | |
| (net savings if available) | | | | |
| MWh of electricity (1,000 kWh) | 232 | | | |
| Decatherms of natural gas (million Btu) | 465 | | | |
| Million Btu of other fuels | | | | |
| Thousand gallons of water | | | | |
| Are these net or gross savings? | | | | |
| | | | | |
| Notes: | | | | In addition, low-cost financing is available |

## *COMMERCIAL PROGRAMS*

| Program administrator | Energy Trust of Oregon | NYSERDA | NYSERDA | Efficiency Vermont |
|---|---|---|---|---|
| Program | Pathway to Net Zero | Commercial New Construction | Net Zero Energy for Economic Development | Commercial New Construction - Net Zero track |
| | | | | |
| Start year | 2010 | 2016 | 2018 | 2014 |
| | | | | |
| Completions since program beginning | | | | |
| Number of homes | N/A | N/A | N/A | N/A |
| Number of apartments | N/A | N/A | N/A | N/A |
| Number of commercial buildings | 41 | 18 | 0 | 15 |
| Commercial building total floor area | 1,814,426 | | | 242,900 |
| Average floor area per building | 44,254 | | | 16,193 |
| | | | | |
| Completions in most recently completed program year | | | | |
| Number of homes | N/A | N/A | N/A | N/A |
| Number of apartments | N/A | N/A | N/A | N/A |
| Number of commercial buildings | 9 | 4 | 0 | 3 |
| Commercial building total floor area | | | | 74,100 |
| | | | | |
| Total program budget in most recently completed program year | $6,417,804 | $3,774,832 | $15,152,161 | $125,000 |
| Total estimated participant cost share in most recent year | Not available | $4,422,387 | $6,515,429 | $346,400 |
| | | | | |
| Budget in current program year (without adjusting for effects of COVID-19) | $5,925,758 | $6,300,000 | $15,000,000 | $100,000 |
| | | | | |
| Are incentives available for design team? | Yes | Yes | Yes | Yes |
| Are incentives available for computer modeling? | Yes | Yes | Yes | Yes |
| Is other technical assistance available? | Yes | Yes | Yes | Yes |
| | | | | |
| Incentives for efficiency measures in most recent year | | | | |
| (if efficiency and renewable incentives are combined, ok to enter these here) | | | Incentives based on incremental cost | |
| Per first year kWh saved | $0.40 | | | $70 per million Btu site energy |
| Per lifetime kWh saved | | | | |
| Per first year fossil fuel Btu saved | $1.20 | | | $70 per million Btu |
| Per lifetime fossil fuel Btu saved | | | | |
| Per sq. ft. of floor area | | | | Above incentives average $1.68/sf |
| Per home | | | | |
| Per apartment | | | | |
| Per metric ton of CO2 saved | | $150 | | Above incentives average $740 (first year) / $40 (lifetime) |
| Are renewable incentives included in answer? | No | No | Yes | No |
| | | | | |
| Are separate incentives available for solar systen | Yes | Yes | No | No |
| | | | | |
| Does your program use any third-party specifications? | | | | No |
| Passive House | No | Yes | Yes | |
| DOE Zero Energy Ready Homes | N/A | No | No | |
| Living Buildings | Yes | Yes | No | |
| Other (please specify) | | LEED, ASHRAE | ASHRAE | |
| | | | | |
| Annual estimated savings from completions in most recent year | | | | |
| (please provide net savings if available) | | | | |
| MWh of electricity (1000 kWh) | 7,610 | 2,895 | | 380 |
| Decatherms of natural gas (million Btu) | 64,527 | Not available | | Not available |
| Million Btu of other fuels | Not available | Not available | | 1,238 |
| Thousand gallons of water | Not available | Not available | | Not available |
| Are these net or gross savings? | Gross | Net | | Net |

| Program administrator | Consumers Energy | National Grid Rhode Island | Mass Save |
|---|---|---|---|
| Program | ZNE Pilot Program | Zero Net Energy Building Pilot Program | |
| | | | |
| Start year | 2017 | 2020 | 2020 |
| | | | |
| Completions since program beginning | | | |
| Number of homes | N/A | N/A | N/A |
| Number of apartments | 0 completions (1 in progress) | N/A | N/A |
| Number of commercial buildings | 0 completions (9 in progress) | Program just began | Program just began |
| Commercial building total floor area | (908,567 sq. ft. in progress) | | |
| Average floor area per building | | | |
| | | | |
| Completions in most recently completed program year | | | |
| Number of homes | | | |
| Number of apartments | | | |
| Number of commercial buildings | | Program just began | Program just began |
| Commercial building total floor area | | | |
| | | | |
| Total program budget in most recently completed program year | $1,000,000 | Program just began | Program just began |
| Total estimated participant cost share in most recent year | | | |
| | | | |
| Budget in current program year (without adjusting for effects of COVID-19) | $725,000 | $106,000 | |
| | | | |
| Are incentives available for design team? | No | Yes | Yes |
| Are incentives available for computer modeling? | No | Yes | Yes |
| Is other technical assistance available? | Yes | Yes | |
| | | | |
| Incentives for efficiency measures in most recent year | | | |
| (if efficiency and renewable incentives are combined, ok to enter these here) | | | |
| Per first year kWh saved | | | |
| Per lifetime kWh saved | | | |
| Per first year fossil fuel Btu saved | | | |
| Per lifetime fossil fuel Btu saved | | | |
| Per sq. ft. of floor area | $1.50/sq. ft. | $2.70 | $2.25 |
| Per home | | | |
| Per apartment | | | |
| Per metric ton of CO2 saved | | | |
| Are renewable incentives included in answer? | No | No | No |
| | | | |
| Are separate incentives available for solar system | Yes | No | |
| | | | |
| Does your program use any third-party specifications? | | | |
| Passive House | Yes | No | |
| DOE Zero Energy Ready Homes | | N/A | N/A |
| Living Buildings | Yes | No | |
| Other (please specify) | LEED | | |
| | | | |
| Annual estimated savings from completions in most recent year | | | |
| (please provide net savings if available) | | | |
| MWh of electricity (1000 kWh) | 0 completed (4,012 MWh savings for projects in progress) | Program just began | Program just began |
| Decatherms of natural gas (million Btu) | | | |
| Million Btu of other fuels | | | |
| Thousand gallons of water | | | |
| Are these net or gross savings? | | | |