

Benefits of Affordable Residential Green Building Incentives

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Benefits of Affordable Residential Green Building Incentives

Final Report

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Abstract

This report has been developed by New York State Energy Research and Development Authority (NYSERDA) as required by Chapter 311 of the Laws of New York of 2018. The purpose is to determine the benefits of providing new financial incentives for the construction of affordable green residential buildings.

Keywords

Affordable, residential, green building, low-income, LMI.

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Acronyms and Abbreviations

ACS	American Communities Survey
AMI	area median income
ANSI	American National Standards Institute
CEF	Clean Energy Fund
DOE	U.S. Department of Energy

DEC	Department of Environmental Conservation
DGIP	Deep Green Incentive Program
ECCC-NY	Energy Conservation Construction Code of New York State
EGC	Enterprise Green Communities
ENERGY STAR®	ENERGY STAR Certified Homes
EPA	U.S. Environmental Protection Agency
ERP	environmentally responsible products
FHA	Federal Housing Authority
GHG	greenhouse gas
HERS	Home Energy Rating System
HOME	Home Investment Partnerships Program
HVAC	heating, ventilation, and air conditioning
IAP	Indoor airPLUS
IAQ	indoor air quality
IEQ	indoor environmental quality
kWh	kilowatt hours
LEED	Leadership in Energy and Environmental Design
LMI	low- to moderate-income housing
LI	Long Island
LIPA	Long Island Power Authority
LR NCP	Low-Rise Residential New Construction Program
MMBtu	million British thermal units
MR	market rate
MWh	megawatt hour
NGBS	National Green Building Standard
NYSBA	New York State Builders Association
QAP	qualified allocation plan
SIP	State Implementation Plan
SONYMA	State of New York Mortgage Agency
SMI	State Median Income
TA	technical assistance
PHIUS	Passive House Institute U.S.
RESNET	Residential Energy Services Network
SnoPUD	Snohomish County Public Utility District
ZERH	Zero Energy Ready Homes program

Definitions as Used in this Report

Affordable

For the purposes of this report, “affordable” is defined as “where the homebuyer has a household income which does not exceed the income limits defined by the State of New York Mortgage Agency (SONYMA) low-interest rate mortgage program in the non-target, one- and two-person household category for the county where such property is located.”¹ This specification is equivalent to 100% of state median family income (SMI) or area median family income (AMI) whichever is greater.

Baseline Assessment

When appropriate, the baseline measurement to analyze the potential benefits of a home under an Affordable Green Building Program will be a home built in compliance with the current Energy Conservation Construction Code of New York State—2016 (ECCC-NY). This is based on the 2015 International Energy Conservation Code and ASHRAE 90.1-2013, as modified by the State of New York and, the 2017 Uniform Code Supplement for New York State based on the 2015 International Residential Code.

Best Practice

In this report, best practice represents the most effective method acceptable for construction of any given measure or system. It includes construction industry standards that may go beyond code requirements. Best practice may also apply to program or administrative functions.

Financing

The Public Authorities Law Section 1872-a states that financing can be from NYSERDA or other public or private sources and available to developers, builders, design professionals or potential owners for affordable units.

Green Building Measures

Green Building Measures refers to the green building practices or processes identified in The Public Authorities Law, Section 1872-a. Specifically included are energy cost and consumption savings, healthy indoor living environments, smart growth/smart planning, integrated design, environmentally responsible products, and waste reduction.

Indirect Benefits

Indirect benefits accrue from a green building measure or program, but are not immediately observable, secondary to the main focus of the program, and often difficult to calculate with any degree of confidence. For this report, potential indirect benefits are identified but not quantified.

Owner

For purposes of new construction, owner refers to a person who owns a residential building on the date that a certificate of occupancy.² In the instances where the certificate is owned by the builder, it includes the potential owner.

Residential Building

A single-family home or multifamily building with less than twelve dwelling units, pursuant to standards and criteria established by the authority,³ excerpt of Public Authorities Law, Title 9, Section 1872—Green Residential Building Program.

Summary

This report has been developed by the New York State Energy Research and Development Authority (NYSERDA) as required by Chapter 311 of the Laws of New York of 2018. The purpose is to determine the benefits of providing financial incentives for the construction of affordable green residential buildings. Chapter 311 describes an Affordable Green Building Program that includes the following:

- Technical assistance
- Access to industry standards
- Financing options through NYSERDA or other public or private sector sources

To address the requirements of Chapter 311, this report assesses the market for newly constructed and affordable green residential buildings, in part by summarizing U.S. Census data on the income eligible population moving into the new housing, either as an owner-occupant or renter. The total number of new homes supplied to eligible households is relatively small (under 1%) compared to the total housing stock as well as to the number of potentially eligible households.

Six major energy and green building programs were considered in comparison to the green building measures specified in the legislation. Of the six programs considered from the variety of programs currently available, three programs (which were evaluated in more detail) were identified as representative examples—the United States Department of Energy’s (DOE) Zero Energy Ready Homes (ZERH), Enterprise Green Communities (EGC), and Built Green. Other programs and sources were referenced to identify appropriate green building measures for a best practices guide.

Data on costs and benefits derived from the three representative programs are quantified where available and appropriate. Overall, costs and benefits vary. Some measures involve minimal costs, while others may require substantial investment. Nevertheless, outcomes from implementing green building measures generally have positive effects on reducing energy demand and carbon emissions.

The benefits of green building measures embodied by those programs are often societal and challenging to quantify but their costs are most often borne by the builder or homebuyer. Reduced energy costs provide the main quantifiable benefit for homeowners and renters. Targeted financial incentives may be necessary to realize the significant benefits available for reduced energy consumption and greenhouse gas (GHG) emissions. As New York increases its efforts to reduce the carbon footprint of the housing stock, it will become increasingly important to draw upon best practices and deliver cost effective

green building programs for low- and moderate-income consumers. New York State is investing substantially in the development of green new construction of dwellings available to this population through NYSERDA’s current programs, in conjunction with housing regulatory agencies, offering incentives and support to increase participation and to secure energy savings, cost reductions, and health benefits.

Table ES-1 shows the potential impacts at various levels of market engagement, based on a comparison with the 2015 International Energy Conservation Code (IECC) as the baseline reference. Depending on the level of financial incentives, technical assistance, and outreach, participation rates will vary. The table shows the participation at 5% and 10% of the eligible households, offering estimates of the corresponding impact at each participation rate, broken out for single-family homes and multifamily buildings. The total potential savings for participation by 100% of the eligible households is illustrated by the data in the third column.

Table S-1. Lifetime Savings Above the 2015 IECC for Various Rates of Participation by Eligible Homebuyers and Renters of Newly Constructed Dwellings

	Savings	5% Participation (157 homes)	10% Participation (313 homes)	100% Participation (3,133 homes)^{4,5}
Single-Family Savings	GHG Emissions (Tons) ⁶	5,721	11,443	114,427
	Energy (kWh)	8,298,271	16,596,543	165,965,428
	Energy Cost (\$)	\$269,750 ⁷	\$539,501	\$5,395,009
Multifamily Savings	GHG Emissions (Tons)	1,690	3,379	33,790
	Energy (kWh)	2,047,786	4,095,571	40,955,714
	Energy Cost (\$)	\$138,785	\$277,570	\$2,775,704
Total Savings	GHG Emissions (Tons)	7,411	14,822	148,218
	Energy (kWh)	10,346,057	20,692,114	206,921,142
	Energy Cost (\$)	\$408,536	\$817,071	\$8,170,713

Note: American Community Survey, 2015-2017, New York Residents MOVED IN PAST 12 MONTHS and Built 2013 or Later, Single-Family and 2-9 Units

This report is neutral on how the green building measures might be administered and does not presuppose any specific financial incentives or inducements for participation. It also leaves open the discussion of whether the individual green building measures could be incorporated into existing NYSERDA programs.

1 Market Assessment

Chapter 311 of the Laws of New York of 2018 requires NYSERDA to determine the benefits of providing new financial incentives for the construction of new affordable green residential buildings.

The legislation describes an Affordable Green Building Program that includes the following:

- Technical assistance
- Access to industry standards
- Financing options through NYSERDA or other public or private sector sources

This section outlines the target market for an affordable green building program, as specified by Chapter 311. The market assessment includes a characterization of the New York State housing market with regard to the following:

- Number of households within the eligible income thresholds.
- New construction rates for defined residential building category of single-family or multifamily units of 12 or less.
- Occupancy characteristics, including renters versus owner-occupied.

This market assessment also includes a brief overview of current NYS program offerings related to the delivery of affordable green buildings and related resources.

In 2017, NYS had approximately 8.3 million housing units, of which about 7.3 million were occupied as primary residences. A majority of those were built before 1960. The overall homeownership rate for the State was 53.8%. New construction each year amounts to a small share of the total stock. In 2017, there were 39,350 permits issued for the construction of new homes, including 10,361 for single-family structures. New construction represents a smaller share of the total supply in New York State than in most other states.

1.1 Income Eligible Households in New York State

For the purposes of this report, affordable is defined as where the homebuyer has a household income which does not exceed the income limits defined by State of New York Mortgage Agency (SONYMA) low-interest rate mortgage program in the non-target, one- and two-person household category for the county where such property is located. This is equivalent to 100% of State Median-Family Income (SMI) or Area Median-Family Income (AMI), whichever is greater.

SONYMA income limits for their Low Interest Rate Program⁸ reflect federal requirements⁹ regarding tax-exempt mortgage revenue bond financing. Income limits for eligibility in non-target areas for “a mortgagor having a family of fewer than 3 individuals” are 100% of the applicable median-family income ([26 USC §143(f)(6)(A)]. The federal law also specifies that the relevant median-family income (greater of state or area) should consider “the regulations prescribed under section 8 of the United State Housing Act of 1937.” In other words, they are based on estimates from HUD.¹⁰

Household size is not specified for the affordable residential green building program. Moreover, the definition of affordable is based only on the income of the prospective occupant—affordable is not defined in terms of the housing or energy cost that the occupant would face.

Past and current NYSEDA programs targeting low- to moderate-family incomes refer to the market segment with household incomes below the HUD threshold of 80% of median-household income. In the NYSEDA February 2017 LMI Characterization Report,¹¹ several measures of low- to moderate-family incomes are discussed and estimated using American Communities Survey (ACS) data for 2013–2015 as well as program data.

The following are notable features of the median incomes estimated by HUD and incorporated in SONYMA and other housing and energy programs:

- The median is for families. Non-family households (mainly people living alone) are not included in the calculations. In 2017, according to the American Community Survey one-year data, in New York State there were 7,304,332 households with median income of \$64,894, including 4,620,008 families with a median of \$80,114.
- For 2017, the statewide median used was \$73,400—lower than the actual median of \$80,114 reported later. The extrapolated value for 2017 was based on ACS five-year data from 2010 to 2014, adjusted for inflation. The extrapolated statewide value for 2018, based on ACS data from 2011 to 2015, was \$77,800.
- For HUD programs, where the requirement is stated as 80% of median, a four-person household must have income below 80% of the relevant median-family income. Households of other sizes face limits that are adjusted for household size. For example, a one-person household must be below 0.7 times the four-person limit or 56% of median (0.7 x 80%).
- In HUD’s system, as well as SONYMA’s, counties within metropolitan areas are grouped and have the same limits. Non-metro counties may rely on alternative limits. If the area median is less than the state median, the state median is used.

As shown in the second bullet, more than two-thirds of all New York State households, about 68% of residents, and about 55% of homebuyers purchasing newly-constructed conventional homes in structures of one to 11 units would meet the definition of affordable, reflecting the use of median family, rather than median-household income as well as the use of the State median where the area median was lower. The income-eligible share of renters is higher, with more than 83% qualifying as affordable.

The definition of affordable and corresponding criterion for eligibility used in this report is a homebuyer with household income not exceeding the income limits defined by the SONYMA low-interest rate mortgage program in the non-target, one- and two-person household category for the county where such property is located. In accordance with federal law regarding mortgage revenue bonds,¹² that income limit is 100% of the greater area or state median-family income. To estimate the number of eligible households, household incomes from the 2017 American Community Survey were compared to the income limits by county for 2017, for the low-interest rate mortgage program.¹³ The numbers for 2017 from ACS were as follows:

Table 1. NY 2017 Households/Units (2017 ACS)

	All	Income Eligible	Share Eligible
Owner	3,930,198	2,161,986	55.0%
Renter	3,374,126	2,828,402	83.8%
Total	7,304,324	4,990,388	68.3%

Note: Applicant eligibility would be assessed using current year’s estimated income, based on year-to-date income. http://www.nyshcr.org/Topics/Home/Buyers/IncomeLimits/IncomeLimits_LIRP_CIP.pdf

The legislation references new owner-occupied homes and may also apply to rentals with expected tenant incomes eligible for the SONYMA low-interest rate mortgage program. Only a small share of owners will relocate in the course of a year, and only a small share of homebuyers will purchase a newly-built home. This can be seen from Table 2, which is based on ACS data for households with homes built in 2014 or later, reporting a move in the preceding 12 months. Similar to the total number of income-eligible homebuyers from Table 1, for those who have moved into new construction, the percentage of income eligible renters is significantly higher than homeowners, with over 80% of renters eligible in structures of one to 11 units. As expected, the pool of income eligible homeowners is significantly higher in one-unit (single-family) homes, while the number of income eligible renters is predominately two- to 11-unit structures (multifamily). Table 2 summarizes information for the income eligible population for new construction 2017.

Table 2. Building Permits Issued in New York State for the New Construction of Residential Buildings in 2017, Which Include Up to Nine Dwelling Units

	Owners			Renters		
	All	Income Eligible	Share Eligible	All	Income Eligible	Share Eligible
Single-Family Homes	4,397	1,609	36.6%	483	438	90.6%
2-9 unit multifamily buildings	89	59	65.7%	1,211	1,027	84.8%
Total for 1-9 unit homes and multifamily buildings	4,486	1,668	37.2%	1,694	1,465	86.4%

Note: American Community Survey, 2017, Single-Family and 2-9 Units

Building permits for construction of new single-family homes in the State in 2017 totaled 10,361 compared to an annual average since 2000 of 15,850.¹⁴

The total number of new homes supplied to eligible households will remain small relative to the total housing stock and to the number of potentially eligible households but could play a role in transforming the energy efficiency of the overall residential stock—especially of the housing serving those with modest incomes.

1.2 Related New York State Affordable Green Building Programs

1.2.1 NYSERDA’s Low-Rise Residential New Construction (LR NCP) Program

NYSERDA’s Clean Energy Fund supports the new construction of single-family homes and low-rise multifamily buildings through LR NCP, with significant support targeting the low- to moderate-income (LMI) housing sector. The tiered incentives support integrated design solutions and pre-development cost reductions. The program includes an emphasis on advanced performance standards such as ENERGY STAR®, ASHRAE, LEED, Passive House Institute, Passive House Institute-US, Net Zero Energy, and Net Zero Energy Capable.

The financial incentives provided to suppliers are based on “performance tiers.” Tier 1 promotes the ENERGY STAR v3.0 as a base performance level but does not include any financial incentives. Tier 2 requires ENERGY STAR v3.1 plus some specific equipment performance requirements. Tier 3 generally requires exceptional building performance in addition to use of renewable energy solutions. Additional incentives are available for projects serving LMI households—defined as “no more than 80% of the State or area median income.” A list of “proxies” is specified for establishing LMI status. Tables 3 and 4 present the current program incentive amounts and results.

Table 3. 2018 Incentive Amounts (per Dwelling Unit)

Performance Level**		Market Rate		LMI	
		1 to 2 unit SF and TH units (for the first 10 attached TH units)***	LR MF (up to 50 units)	1 to 2 units SF and TH units (for the first 10 attached TH units)	LR MF (up to 50 units)
Tier 1	No incentives	0	0	0	0
Tier 2	ENERGY STAR v 3.1	\$950	\$450	\$1,700	\$1,000
Tier 3	ENERGY STAR v3.1 plus higher HERS Index scores	\$4,000	\$1,600	\$4,200	\$3,500

* RESNET Providers may be eligible for a \$100/unit incentive.

** The program includes mechanical systems performance specifications. Buildings intending to certify as PHIUS+ or PHI may request a waiver exemption.

Table 4. NYSERDA New Construction Initiative Results

	Market Rate Results from March 2016 through June 30, 2018 (+ pipeline)	LMI from March 2016 through June 30, 2018 (+ pipeline)
Participants	1,606	3,280
Energy Savings (MMBTU lifetime)	1,668,173	1,144,213
Lifetime CO2e Emissions reduction (metric tons)	147,512	111,317
Lifetime Customer Bill Savings (millions)	\$28.87	\$24.25

Notes: Data on permits from U.S. Census Bureau. Not all new single-family homes are occupied as primary residences. CEF Q2 report.

1.2.2 NYSERDA's Codes Initiative

NYSERDA also administers a codes initiative. Through this effort, NYSERDA seeks to significantly improve the efficacy of energy codes by working with the industry to advance a path for “Code to Zero” that works toward compliance and enforcement. The New York Department of State (DOS) established the New York State Energy Conservation Construction Code (ECCCNYS) which references national model codes, the International Energy Conservation Code (IECC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1.

A 2015 NYSERDA-sponsored survey indicated that energy code compliance in New York State was approximately 77% for residential new construction.¹⁵ As such, this gap represents a need for improved code enforcement as well as a greater understanding of compliance for designers, builders, and others in the construction process.

To support adoption of energy codes with higher performance goals and strengthen compliance and enforcement, NYSERDA will work with local jurisdictions, offering training and compliance platforms to overcome barriers impeding compliance and enforcement. Additionally, NYSERDA intends to support the development of a “stretch-to-zero” energy code that moves the market in a way that is actionable, cost effective and enforceable, supporting the design and new construction of very low or zero carbon emitting buildings capable of achieving at or near net-zero energy performance. NYSERDA will also conduct pilots to identify barriers and opportunities surrounding code development and advancement, test alternative code enforcement structures, and assess approaches to stretch and zero codes. Activities to support code adoption are coordinated with the Clean Energy Fund (CEF) New Construction activities.

1.2.3 NYSERDA's Clean Energy Communities Program

Through the Clean Energy Fund, NYSERDA administers the Clean Energy Communities Program, offering grants to local municipalities, including towns, villages, counties, and cities as well as seeks to address financial and information barriers to adoption of clean energy opportunities. Via the Clean Energy Communities Program, NYSERDA provides technical assistance, outreach, engineering support, tools, and guidance on the following:

- Benchmarking and disclosure
- Clean energy upgrades for municipal buildings
- LED street lights
- Clean fleets, including infrastructure development for electric vehicle charging station
- Solarize campaigns to increase the number of solar rooftops with group purchasing

- Unified Solar Permit to reduce costs and delays for solar projects
- Energy code enforcement training
- Climate Smart Communities Certification
- Community Choice Aggregation—programs that allow local governments to procure power on behalf of the residents, businesses, and municipal accounts from an alternative supplier while still receiving transmission and distribution service from their existing utility
- Property Assessed Clean Energy (PACE) Financing is a means of financing energy efficiency upgrades or renewable energy installations for property owners

The Clean Energy Communities Program is an additional avenue for coordination/collaboration on affordable green building efforts.

1.2.3.1 New York State Homes and Community Renewal

New York State Homes and Community Renewal (NYSHCR) is a state agency focused on housing affordability, offering programs and resources to public and private sector partners. NYSHCR includes the Division of Housing and Community Renewal (DHCR), the Housing Finance Agency (HFA), the Housing Trust Fund Corporation (HTFC), the State of New York Mortgage Agency (SONYMA), and the Affordable Housing Corporation (AHC).

NYHCR's Affordable Housing Corporation (AHC) offers grants for low- and moderate-income families in partnership with local governments and nonprofits. AHC grants of \$35,000 or \$40,000 per unit are allocated, depending on if the area is designated as a "high-cost area." Grants must serve households with incomes between 100% and 166% of the HUD low-income limits.

The New York Low-Income Housing Trust Fund (HTF) Program supports construction of low-income¹⁶ housing, particularly in underutilized or rehabilitation areas. Eligible applicants for funding must be nonprofits or local governments. Private investors are allowed if they partner with nonprofits and allow for at least a 50% controlling interest, limit profits, or make equity investments in a project. Financial incentives of \$125,000 per unit are offered. Initiatives specific to residential new construction offered by HTF include the following:

- Housing Development Fund (HDF) Program: A revolving loan fund to provide loans to nonprofit organizations to develop low-income housing projects. HDF loans may be used for pre-development costs, site acquisition, construction/rehabilitation financing and other mortgageable project development costs. HDF loans may also be used to provide short-term financing repaid from equity contributed by investors in low-income housing credit projects.

- New York State HOME Program (HOME) is administered by the HTFC and uses federal funds to offer affordable housing to households with incomes at or below 80% of the AMI. Rental projects must serve households with incomes at or below 60% of AMI.
- Low-Income Housing Credit (LIHC) Program. LIHTC is federally funded and offers tax-exempt bond financing that generates 4% "as-of-right" Low-Income Housing Tax Credits that can be used for the down payment or to offset the borrower's tax payments. Eligible household income cannot exceed 60% of the AMI, adjusted for family size.
- New York State Low-Income Housing Tax Credit Program (SLIHC) serves households with incomes at or below 90% of the AMI. The program provides a dollar-for-dollar State tax reduction for investors in qualified low-income housing.

NYSHCR reported in its draft Consolidated Action Plan and Annual Action Plans (CAPERS) that for State fiscal years of 2011 through 2015, the HTF program “awarded \$18.2 billion in financing and funding for the construction and rehabilitation of 48,001 housing units in 355 developments located in all ten of the State’s regions. Of these 48,001 units, 35,506 (74%) are affordable to households with incomes at or below 60% of AMI, including 2,280 units (5%) which are affordable to extremely low-income households with incomes at 30% of AMI. Of the 35,506 affordable units, 18,345 (52%) units were new construction, and 17,161 units (48%) were preservation units.”¹⁷

State of New York Mortgage Agency (SONMYA) partners with pre-approved mortgage lenders to offer low-interest mortgage assistance to support access to ENERGY STAR certified new homes for income-qualified first-time homebuyers. Through the SONYMA program, home builders, developers, and local community sponsors can apply for a Project Set-Aside Loan, enabling them to offer low-cost, fixed-rate SONYMA mortgages to qualified buyers. The SONYMA ENERGY STAR program is operated in partnership with NYSERDA and with the New York State Builders Association (NYSBA) and the Long Island Power Authority (LIPA). This program has been barely used, if at all, according to SONYMA staff.

Housing Finance Agency (HFA), in collaboration with the HTF, provides Green Guidelines,¹⁸ which outline the qualifications for the Climate Bond Initiative (CBI). Under CBI, all new construction projects must meet the requirements of ENERGY STAR Certified Homes Program v3.1. Additionally, new construction projects must also select either or both the Enterprise Green Communities Criteria or the NYSERDA Low-Rise New Construction program requirements. Projects may apply for special

HFA approval to meet requirements published by Passive Housing Institute U.S. (PHIUS) or Passive House Institute (PHI), National Green Building Standard (NGBS), or Leadership in Energy and Environmental Design (LEED) in lieu of the above. Applicants are also required to document CBI criteria for low-carbon emissions.

1.2.4 New York City Department of Housing Preservation and Development

The New York City Department of Housing Preservation and Development (HPD) leads the City's effort in providing affordable housing and congruence with the City's aggressive sustainability goals.¹⁹ These include the following:

- Enterprise Green Communities (EGC) Criteria, a self-certification program that embraces a comprehensive green buildings framework for efficiency, healthy indoor air quality, responsible resource use, and a clean environment.
- A Benchmarking Protocol for buildings that receive HPD financing.
- Green Housing Preservation Program which provides low- or no-interest loans to small- and mid-size building owners of affordable housing.
- Integrated Physical Needs Assessment ensures the holistic needs approach.
- Passive House: A high-performance and sustainable building standard.
- Healthy Homes Training: Training on integrated pest management, active design, and smoke-free buildings.

2 Profiling Industry Best Practices in Residential Green Buildings

Various prominent green programs offered across the country were reviewed and considered for further evaluation. Eight programs were selected for evaluation relative to the green building measures. A matrix of these programs and features is included as appendix A. ENERGY STAR[®] and Indoor airPLUS (IAP) are not included in the matrix since they are a prerequisite for several of the programs. Only three were ultimately considered for detailed review.

The following eight programs were initially evaluated:

- Zero Energy Ready Homes (ZERH): a U.S. Department of Energy (DOE)-administered program.
- Enterprise Green Communities (EGC): administered by Enterprise Community Partners.
- Built Green: a statewide program in Washington.
- ENERGY STAR: an Environmental Protection Agency (EPA)-administered program.
- Indoor airPLUS: an EPA-administered program.
- Leadership in Energy and Environmental Design (LEED): sponsored by the U.S. Green Building Council.
- National Green Building Standard (NGBS): a program of the National Association of Home Builders.
- Passive House US (PHIUS): a program of the Passive House Institute, an independent research group.

Of the initial eight programs considered, three programs were evaluated in greater detail. The rationale for selecting these programs for further evaluation is included in the following:

- Zero Energy Ready Homes (ZERH) incorporates ENERGY STAR Certified Homes requirements and, rather than being a “green building program,” incorporates several green-building measures referenced in the legislation (i.e., Indoor airPLUS is required and Integrated Design supported). It also has a relatively simple administrative structure and uses Home Energy Rating System Raters (HERS) to verify compliance. Cost information is clearly documented, as is participation rate. Although multifamily is part of the program, participation is heaviest in single-family homes. Some of the features, including the substantial technical support/assistance and outreach, are useful in incorporating affordable green building features into NYSERDA programs.
- Enterprise Green Communities: EGC has an affordable housing focus. It includes ENERGY STAR as its baseline. It also features all of the green building measures identified with relatively easy submission options. Costs and benefits are more clearly defined than in the other programs. Much of the information is based on multifamily participation.

- **Built Green:** Built Green encompasses all green building measures listed in the definitions section. Built Green is a regional program. Additional information on participation rates and features, such as financial incentives, technical support, and marketing incentives, should yield examples for a robust New York State program. The program also has a unique post-occupancy study of energy reductions achieved at different levels.

Programs not selected for further evaluation include the following:

- ENERGY STAR Certified Homes is part of all three recommended programs, so it's not needed as a separate profile.
- LEED, NGBS, and PHIUS are proprietary certification programs administered by the sponsoring organization. Data on these programs that look at real participation rates would be difficult to measure. Understanding how this data overlaps the green building measures would be close to impossible to track.
- LEED and NGBS rely on a points-based system with mandatory provisions and options to accumulate required points. Hard and soft cost information would be difficult to obtain, partly due to a points-based structure wherein every project uses unique specifications. Although both Built Green and EGC also rely on point-based systems, they have supplied some documented costs.
- PHIUS requires special analysis tools not commonly used within the industry.

2.1 Profiles of the Three Selected Programs

2.1.1 Zero Energy Ready Homes

The U.S. Department of Energy (DOE) launched the Zero Energy Ready Home (ZERH) program in 2013. It followed a predecessor program called the DOE Builders Challenge, which ran from 2008 through 2012.

2.1.1.1 Target Market

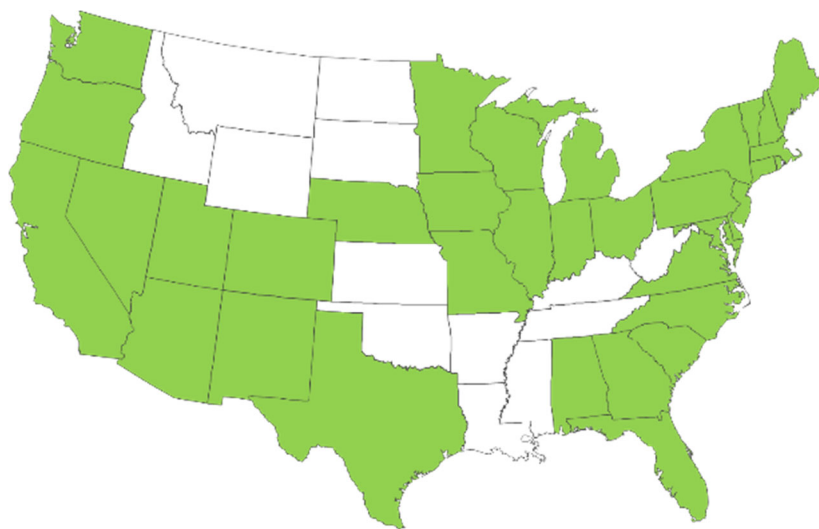
DOE describes the program as targeted to the top builders—those who deliver an efficient home with a healthy indoor environment, advanced technologies, quality construction, and solar-ready features. The program is targeted at market leaders in residential construction and requirements are set at stringent levels in order to maintain that position of leadership. Construction types include single-family detached homes, townhomes, and multifamily buildings up to three stories (plus four-fifths story in multifamily buildings with conditions). Economic markets include everything from high-end custom homes to affordable homes from organizations such as Habitat for Humanity.

DOE takes the approach of requiring all features needed to deliver an efficient, comfortable, durable, and safe home (minimum efficiency features, moisture and bulk water control, comprehensive ventilation, healthy indoor air quality, and efficient hot water delivery).

2.1.1.2 Participation Rate/Geographic Area

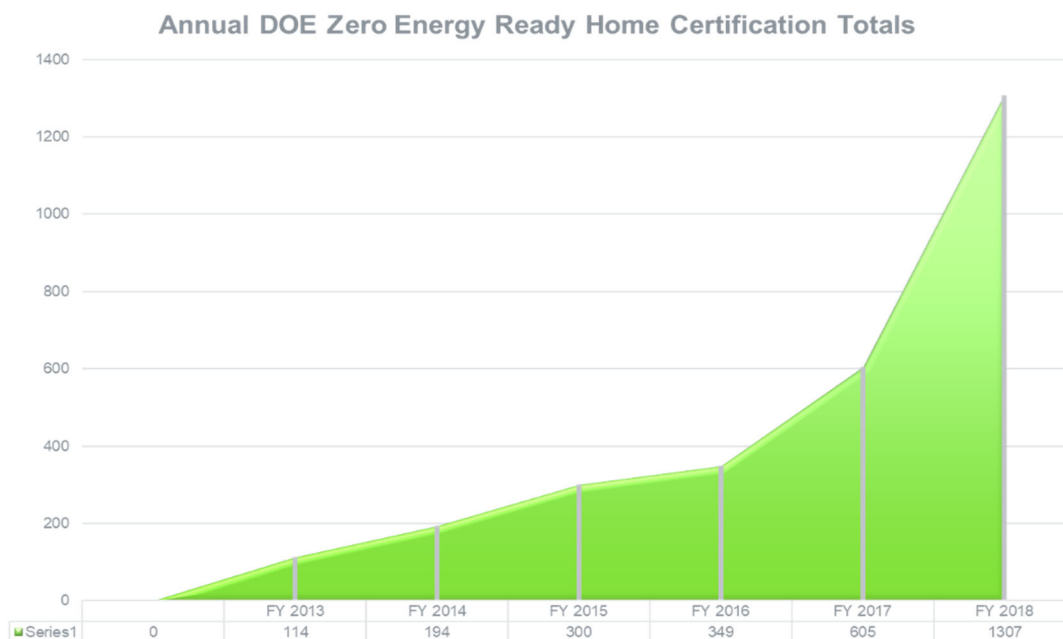
The ZERH program is deployed nationally with home certification in 35 states. As a program positioned for market leadership, overall numbers remain small compared to larger programs, such as ENERGY STAR, but there has been dramatic growth in the last few years.

Figure 1. State Participation in ZERH



As of October 1, 2018, there were 2869 certified homes across the country. The program, in its fifth year, is likely to reach 3000 homes by the end of 2018. Program certifications from fiscal year 2016 to FY 2017 almost doubled, and certifications more than doubled from FY 2017 to FY 2018. The program is expected to move beyond 5000 homes by the end of 2019. With 96 certified homes, New York has the sixth most ZERH certifications of any state. The ZERH program’s annual competition, the Housing Innovation Awards, has recognized 15 New York State homes as Housing Innovation Award Winners and four New York State homes as Housing Innovation Award Grand Winners (in New Paltz and Long Island).²⁰ These homes have included custom homes, affordable homes, and multifamily homes.

Figure 2. Annual ZERH Certification Totals



2.1.1.3 Costs and Benefits

The ZERH program performed a cost analysis comparing minimally compliant ZERH to the 2012 IECC.²¹ This analysis is still appropriate when compared to the 2015 IECC because prescriptive compliance between the 2012/2015 IECC is essentially the same from a cost perspective. The only major residential substantive changes between the two codes are (1) adding a requirement for sealed mechanical rooms in limited applications, (2) the change of duct tightness from a mandatory target to a prescriptive one, and (3) the addition of the Energy Rating Index Path, which does not impact prescriptive path minimum requirements at all. None of these changes add meaningful cost to any significant number of homes.

The DOE analysis showed an incremental cost of approximately \$3,800–\$4,700.²² The analysis was only performed for climate zones three to five but is relevant to most construction in New York State. In addition, ZERH requires ENERGY STAR version 3.1 as part of its certification in the State. ENERGY STAR Builders, according to EPA’s analysis, would already be adding approximately \$1,000–\$1,500²³ in cost above code, so those builders would have a smaller jump to ZERH. According to the aforementioned study on ZERH costs, occupants of a ZERH are likely to see a net positive cash flow between \$12 to \$16 per month. These savings are net of amortized first cost and accrue for the life of the building (see Table 5).

Table 5. DOE Zero Energy Ready Home Energy and Cost Comparison

As compared to 2012 IECC Baseline

Climate Zone	Space & Water Heating Energy Source	12 IECC - HERS Index	ZERH – HERS Index	Monthly Energy Cost Savings for ZERH House vs. 12 IECC House (\$)	Estimated Marginal First Cost for ZERH House (\$)	Amortized Marginal First Cost for ZERH House (\$)	Net Monthly Cashflow (\$)
3	Electric	74	57	\$37	\$4,663	\$25	\$12
3	Gas	72	54	\$37	\$4,216	\$23	\$14
5	Electric	61	53	\$40	\$4,403	\$24	\$16
5	Gas	59	49	\$33	\$3,896	\$21	\$12

Note: https://www.energystar.gov/ia/partners/downloads/ES_Version_3.1_Cost_Savings_Summary.pdf

DOE does not charge any registration or certification fees as a program. The only cost is the fee charged by the HERS Rater for their services (0–\$1,000). In some cases, a HERS Rater may charge the same fee regardless of whether they are only doing a rating or adding program certifications. In others, raters charge by the program.

Several states have financial incentives tied to ZERH certification; New Jersey and Connecticut have added incentives directly tied to ZERH certification. Several states have now included ZERH in their low-income housing Qualified Allocation Plan (QAP) programs. (Pennsylvania is the latest addition.)

In addition to the economic cost/benefit data, there are multiple advantages for builders participating in the ZERH (see Table 6).

Table 6. Features of Zero Energy Ready Home Certification

Zero Energy Ready Home Benefits (Outside of Energy and Cost Savings)	
Marketing Materials	<ul style="list-style-type: none"> • Point of Sale Fact Sheet (Customized with builder info and logo). • Consumer Brochure (Customized with builder info and logo). • Homeowner Manual (Customized with builder info and logo). • Program Logos. • Drop-in Messaging (pre-approved statements from DOE for use in publications, etc.).
Builder Promotion	<ul style="list-style-type: none"> • Annual Housing Innovation Awards Recognizing the best among Zero Energy Ready Home Projects. • Tour of Zero online consumer-facing home tour featuring Housing Innovation Award winners. • Public profile on ZERH Partner Locator showing number of homes certified.
Non-energy Program Requirements	<ul style="list-style-type: none"> • Moisture protection through. (Vital in advanced code environment). • Healthy indoor air quality through ENERGY STAR (ventilation requirements) and Indoor airPLUS (pollutant source control and mitigation). • Mandatory minimums to ensure good building science design.

2.1.1.4 Certification Process

The first step in certifying a home to ZERH requirements is to register as a partner. ZERH has partnerships for builders, raters, and designers who would be eligible to submit home certification. Third-party verification is required and documentation from the energy modeling software showing proof of certification must be submitted to the ZERH program staff. Homes can qualify under either the prescriptive path or the performance path for ZERH certification.

Homes must be modeled to show certification and must also be field verified. The number of site visits by the third-party verifier will vary somewhat but will always include at least a pre-drywall and final inspection on site and will include testing such as a duct-blast test, a blower-door test, and hot water delivery test. Additional testing and inspections will be included in the ENERGY STAR and Indoor airPLUS verification process, such as foundation and moisture management inspections, Heating,

Ventilation, and Air Conditioning (HVAC) system commissioning, and combustion testing. The certification process is meant to build on the typical certification used for HERS ratings, ENERGY STAR, and Indoor airPLUS. In addition, other programs (PHIUS, LEED, EGC) reference ZERH either as a pre-requisite or for points in the certification.

Prescriptive Path

To use the prescriptive path, follow the DOE Zero Energy Ready Home National Program Requirements. A registered verifier should submit the prescriptive compliance report after verification that the home meets the challenge.

Performance Path

Registered verifiers can use Residential Energy Services Network (RESNET) accredited software programs to qualify homes to meet the DOE Zero Energy Ready Home requirements. The software will create a DOE Certificate specific to the certified home.

2.1.1.5 Technical Support and Outreach

Technical Support for the ZERH falls into four major categories:

- Verification support
- Program staff support
- Program resources
- Technical networking

The primary day-to-day technical resource for a builder of a ZERH is their HERS Rater. The energy rater is responsible for verifying all program requirements are met. In some cases, this rater also acts as a consultant to the builder, providing suggestions for ways to optimize cost or technical approach while reaching program requirements. The program relies heavily on HERS Raters to confirm compliance and to explain program requirements to participating builders.

Program technical staff are also available to participating builders and will talk through technical questions and make suggestions, although they cannot design or construct a home for the builder.²⁴ Program staff is responsible for updating the ZERH Program Requirements and will work with a builder to identify gaps between proposed design (or current practice) and these requirements. ZERH also offers a number of program resources, including pre-recorded webinars on a variety of technical topics. The entire suite of webinars can be accessed at the ZERH program website.²⁵

Finally, every year ZERH program staff host a leading builder roundtable—bringing ZERH builders together to discuss technical and market issues and to come up with solutions.

2.1.2 Enterprise Green Communities

Enterprise Green Communities (EGC) program and criteria were established in 2004 by Enterprise Community Partners, a nonprofit organization whose mission is “to create opportunity for low- and moderate-income people through affordable housing in diverse, thriving communities.”²⁶ The EGC program establishes the criteria and provides both financial and technical support—as well as works with state, local, and national governments on policies that promote sustainable housing and economic development.

2.1.2.1 Target Market

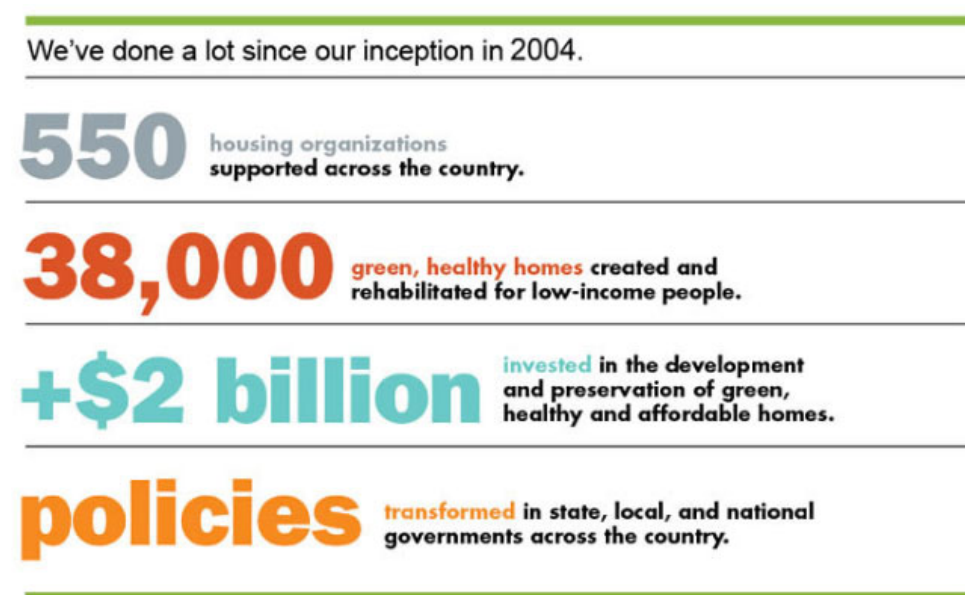
EGC takes a holistic approach to green building and development by targeting the program to developers, investors, builders, and policymakers. This connects the gap between affordable housing investment strategies and environmentally friendly, high performance building practices that provide affordable, but sustainable homes and healthier communities. The EGC program is available nationwide to all buildings that contain affordable housing units, including single-family, multifamily buildings or groups of single-family and multifamily buildings.

As an affordable housing program designed for the low- to moderate-income market, EGC defines affordable housing as, “projects serving residents at or below 60% AMI for rental projects and at or below 80% AMI for for-sale projects,” based on HUD’s annual AMI calculation.

2.1.2.2 Participation Rate/Geographic Area

According to EGC’s 2017 Annual Report, Enterprise as a larger organization, Enterprise Community Partners, helped to build or create more than 61,000 homes in 343 cities. According to program staff, EGC currently has over 1,000 certified new construction homes in 43 states including Washington, D.C.²⁷

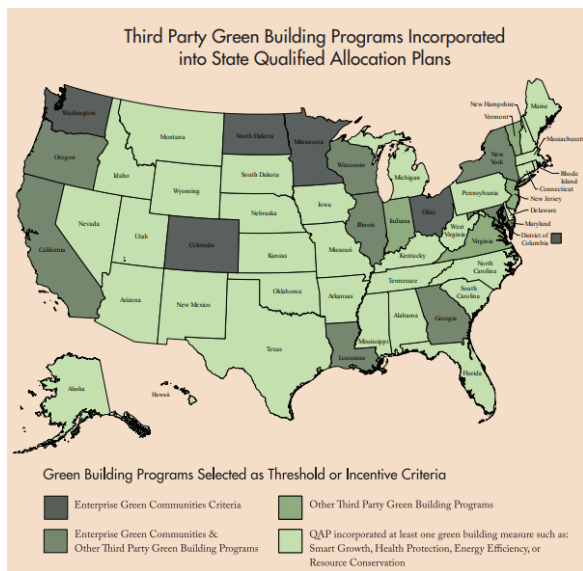
Figure 3. Impacts of Enterprise Green Communities since Inception



2.1.2.3 Cost and Benefits

In 2012 EGC completed an update to a previous cost assessment study, examining the incremental cost of meeting EGC criteria. EGC defines incremental cost as “the additional costs incurred in adopting a particular criterion compared to what the developer otherwise would have installed.”²⁸ Overall, the incremental cost to meet the EGC criteria totaled \$3,546 with a predicted lifetime utility savings of \$3,709. It is important to note that this includes all building and project types eligible for certification under EGC, which can include larger commercial and multifamily buildings and/or far more in depth site and design planning costs, which offset the median-incremental cost in the study.²⁹ For a more relevant metric, the median cost to integrate the water and energy criteria—those measures responsible for utility savings of \$3,709—was only \$1,139. Further, the costs of meeting the energy criteria alone for new construction was estimated to be \$0.85/ft.² or \$1,000 per unit.

Figure 4. Green Building Programs Incorporated in State QAPs



The EGC program does not charge a fee for having projects certified. Similar to the ZERH program, EGC requires new construction to be certified under the ENERGY STAR New Homes program, which requires a HERS Rater.

Beyond energy cost savings, other financial benefits are possible for New York State EGC projects for both market rate and low-income housing. Financial incentives are tied to EGC certification in New York, as well as 12 other states and Washington, DC. Figure 4 highlights those states in which green building programs are included in State Qualified Allocation Plans (QAP).³⁰ Under New York’s QAP, New York State Homes and Community Renewal provides financial benefits to EGC projects through their Multifamily Programs Unified Funding request for proposal (RFP).³¹ Additionally, in some cases there are financial incentives tied to meeting ENERGY STAR Certified Homes criteria through the NYSERDA Residential New Construction Program.³² ENERGY STAR Certification is a requirement for all EGC certified projects and therefore EGC projects have met at least part of the requirement for applying for funds under the program. This program is open to market rate housing in addition to low-income housing.

In addition to the savings and incentives benefits, EGC certification provides outreach and educational support for certified projects, which can be advantageous for builders and developers. The items are listed in Table 7.

Table 7. Technical Support Offered by Enterprise Green Communities Certification

Additional Significant Enterprise Green Communities Tools, Support, and Benefits	
Construction Specifications Tools	To help project teams meet the requirements of the Enterprise Green Communities Criteria, EGC developed a series customizable specifications templates and companion planning spreadsheets. When construction specifications include the correct green building requirements, contractors have the information they need to successfully build green affordable housing. ³³
Design Toolkits (Pre-development and Aging-in-Place)	<p>Pre-development: This toolkit will guide users through the seven steps in the pre-development phase, each of which will help them design better affordable housing developments.</p> <p>Aging-in-Place: The Prioritization Matrix is intended to help organize aging-in-place strategies in a way that will assist the team in recognizing the relative priority level between strategies. Discussion around how vital the strategy is, cost, and phasing will help the team arrange the strategies within the chart.³⁴</p>
Benefits of Program Requirements	Mandatory program requirements such as instituting integrated design plans, waste management plans, site location, integrated pest management, operations, and maintenance manuals, etc. can offer significant cost and time savings by streamlining the construction process, reducing waste removal, and reducing maintenance issues and call backs.

2.1.2.4 Certification Process

EGC is a two-step certification process with pre- and post-build requirements. Additionally, as part of an integrative design process, all certified projects must host a charrette to develop the vision of project goals and team member responsibility. Figure 5 shows an overview of the EGC certification process.

Pre-Build Requirements (due 30 days prior to construction):

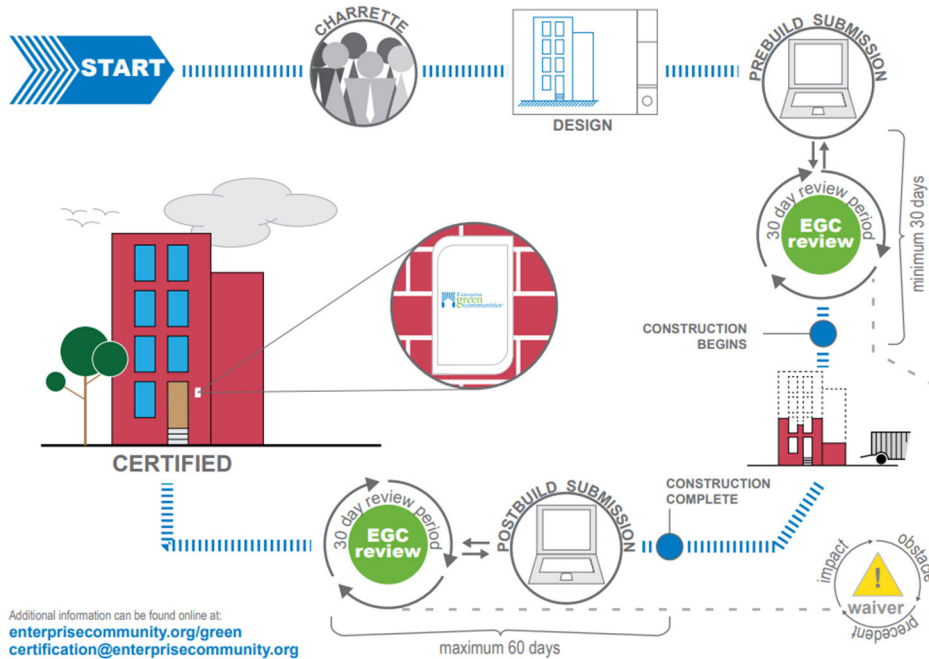
1. Provide project information.
2. Document how the project will meet the appropriate mandatory and optional criteria.
3. Upload the required supplemental documents. Examples include the following (may vary depending on options selected):
 - Site plan showing connections to existing development and infrastructure and the preservation of and access to open space.
 - Projected HERS index score.
 - An outline of project goals and evidence of a team meeting or charrette addressing integrated design.

Post-Build Requirements (due 60 days post construction):

1. Confirm/update project information.
1. Document how the project met the appropriate mandatory and optional criteria.
2. Upload the required supplemental documents. Examples include the following (may vary depending on options selected):
 - Project photos that show the project/site before, during, and after construction completion.
 - ENERGY STAR for new Homes Certification for each dwelling unit or compliance with sampling protocol.
 - Final building maintenance manual.³⁵

Figure 5. Enterprise Green Communities Certification Process

ENTERPRISE GREEN COMMUNITIES CERTIFICATION



2.1.2.5 Technical Support

To support stakeholders, EGC provides a database of Technical Assistance (TA) providers. The TA Providers Database “is a national listing of qualified experts in topics related to the design, development, and construction of energy efficient, environmentally friendly and safe affordable housing.”³⁶

Additionally, EGC has a substantial library of resources that are publicly available and can be filtered by users to obtain specific information on relevant topics from leading industry sources. These resources include research reports, webinars, case studies, toolkits, tutorials, and more. In their criteria guidebook, EGC not only highlights the requirements for the various green building measures, but includes the rationale behind them, provides recommendations, and identifies resources that support the applicant in successfully meeting the required criteria for that measure.

2.1.2.6 Outreach

A major difference between EGC and other green building programs is the holistic approach by targeting the program to developers, builders, investors, and policymakers. Regarding outreach, EGC targets residents, policymakers, and investors to raise awareness of green building practices and the EGC program. Samples of these efforts are outlined in Table 8.

Table 8. Examples of Enterprise Green Communities Outreach Efforts

Residents	The Resident Engagement Tools were designed to help affordable housing developers and building owners engage residents in green and healthy living. These online resources include resident engagement and training cards (and templates for local customization) instructions and sample activities demonstration videos and an illustration library. ³⁷
Policymakers	The A Call to Invest in Our Neighborhoods (ACTION) Campaign is a national, grassroots coalition of roughly 2,100 national, state, and local organizations and businesses calling on Congress to expand the Low-Income Housing Tax Credit (Housing Credit). ³⁸
Investors	The HOME Coalition works to increase awareness about the HOME Investment Partnerships Program (HOME), its importance to the development and provision of affordable housing, and the need to continue funding this vital program. ³⁹

2.1.3 Built Green

Established in 1999 by the Master Builders Association in Washington State, the program was designed to include extensive green building measures and a goal of becoming the norm for new construction in King and Snohomish Counties. Similar programs were developed in Colorado, as well as Atlanta and Kansas City, Missouri. The Washington program remains very active.

2.1.3.1 Target Market

The program is marketed to all residential construction projects that have permits—including single family, multifamily, and existing homes undergoing remodeling or revitalization.

The program certifies projects based on star levels. There were three certification levels offered at program inception, which has since evolved to include a four- and five-star level as well as an Emerald Star certification. The one- and two-star levels have been eliminated. See Appendix B for details on Built Green prerequisites.

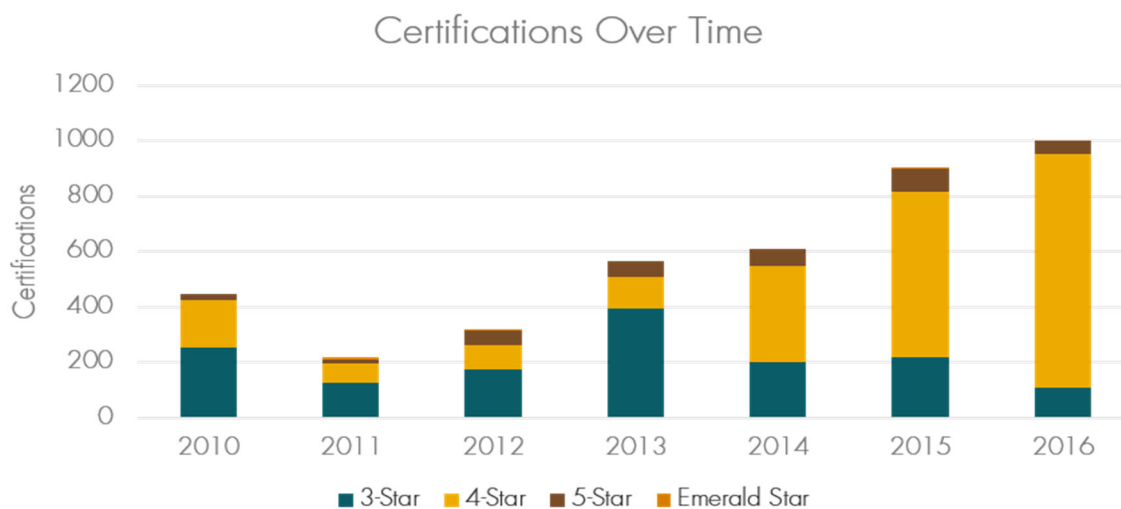
2.1.3.2 Participation Rate/Geographic Area

Built Green has certified more than 31,000 housing units since inception.⁴⁰

Interest in the program continues to grow and the four-star level of certification has become the most popular.

Seattle still dominates the Built Green market, with 77% of 2017 certifications occurring within the city. The geographical spread was stronger than in 2016, however, with 12 other cities playing host to projects.⁴¹

Figure 6. Participation in Built Green



2.1.3.3 Costs and Benefits

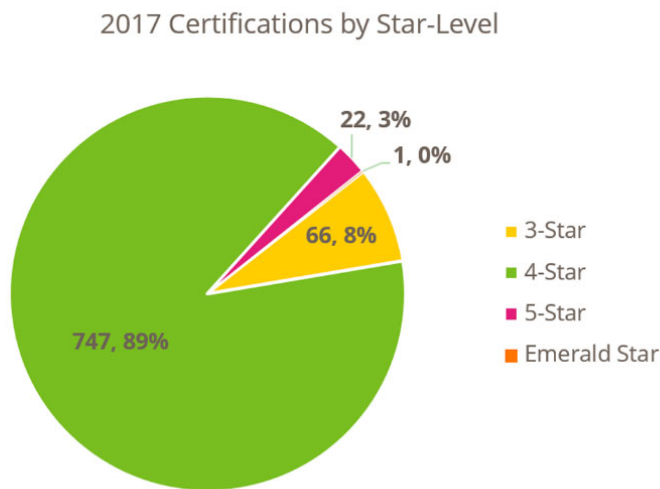
Estimated energy savings from Built Green homes vary with the level of construction. Based on data of 746 homes built in 2014, Built Green determined the following:

- Twenty-five percent improvement in three-star homes, equivalent to 2,900 kilowatt-hours (kWh) per home annually.
- Thirty-three percent improvement for four-star homes, equivalent to 3,806 kWh per home annually.
- Forty percent improvement for five-star homes, equivalent to 4,708 kWh per home annually.
- Cost savings ranged from approximately \$450 to \$558 annually.⁴²

In addition to these energy savings, the program lists the following indirect benefits:

- Healthier, more comfortable living
- Conservation of natural resources
- A healthy habitat through conservation of water and reduced runoff
- A reduced carbon footprint

Figure 7. 2017 Built Green Participation by Star Level



2.1.3.4 Incentives

The program has tiers or levels based on stars. Significant incentives are provided by utilities depending on the location. Additional incentives are covered in Table 9.

Table 9. Built Green Incentives

Incentive	What is Offered	Source ⁴³
Deep Green Incentive Program (DGIP)—two types	Fee waiver/reduction based on tier, and possibly reducing transportation impact fees based on project-specific analysis. <ul style="list-style-type: none"> • Tier 1—Living Building Challenge or Living Community Challenge—100% waiver • Tier 2—Emerald Star—75% waiver of • Tier 3—5 Star—50% waiver Ability to grant certain departures from Development Code Standards so the project may meet requirements for specific programs.	<u>Shoreline Planning and Development</u>
Issaquah Sustainable Building Incentive	Expedited building permit review—5 Stars or higher.	<u>City of Issaquah</u>
Issaquah Stormwater Infiltration Incentive	Provides Service Charge Discounts for developed parcels that infiltrate runoff in private stormwater infiltration facility Design Storm Discount (100 year-50%, 50 year-40%, 10 year—30%).	<u>City of Issaquah</u>
Affordable Housing Incentives	City waives several staff, permit, mitigation, impact, and public work fees.	<u>City of Issaquah Affordable Housing</u>
Kirkland Priority Permit Review	Expedited building permit review—4 Stars or higher.	<u>City of Kirkland</u>
Redmond Green Building Incentives	Expedited building permit review.	<u>City of Redmond</u>
Seattle City Light Financial Incentives	Incentives for high-efficiency systems and equipment—amounts determined by on-site visit.	<u>Seattle City Light</u>
Seattle Priority Green Expedited Program	Expedited building permit review—4 Stars or higher.	<u>City of Seattle Here</u>
Snohomish County Public Utility District 1 (SnoPUD) Rebates	4 Stars or higher <ul style="list-style-type: none"> • \$1,200—for eligible homes with heat pump and 20% energy savings above Washington State Energy Code. • \$300—per Certified multifamily unit 20% above WSEC. • \$800—for a Northwest Energy Efficiency Manufactured Homes Program Certified Manufactured Home. 	<u>SnoPUD</u>

2.1.3.5 Certification Process

Built Green has an interview process for certification of third parties and makes available a list of approved certifiers on the website. Built Green requires that anyone approved join and pay an annual membership fee between \$100 and \$250 depending on whether the approved certifier is a member of the local builders’ association that administers the program.⁴⁴ In addition, to receive some of the utility incentives, the utility does site inspection. Based on utility bills and evaluation, the process seems to work to ensure compliance with program requirements.

2.1.3.6 Technical Support

Technical support to builders is provided through a system of third-party verifiers. A verifier needs to become a member of Built Green, submit an application, and undergo an interview.

Built Green has a very extensive handbook for builders that includes best practices, necessary levels for points, and many additional resources.⁴⁵ The company also has multiple checklists for use by stakeholders.

For consumers, Built Green offers resources on native plants, available incentives, pest control, and water management. All of the above are included on the website, as well as additional resources available from other parties.

2.1.3.7 Outreach

Built Green has an extensive website with resources for all stakeholders. It is easy to find checklists, case studies, and program materials. A sample of the marketing materials include (1) the Built Green label, (2) a homeowner kit, and (3) a variety of marketing materials that a builder can use with prospective homeowners. Built Green also hosts an annual conference and awards program.

3 Analysis of Select Affordable Green Building Measures and Program and Policy Support

NYSERDA examined the potential impact of new financial incentives and technical assistance on specific green building measures. This report will first examine the individual green building measures and benefits, and then discuss the impact of new financial incentives and technical support/assistance within the context of penetration rates for affordable green building practices, along with the impact on greenhouse gas (GHG) emissions. One can assume that benefits of implementing new financial incentives modeled from industry best practice will result in similar benefits.

Section 3.1, Green Building Measures, focuses on resulting benefits or impacts from affordable green building measures, including (1) energy cost and consumption savings, (2) healthy indoor living environments, (3) smart growth/smart planning, (4) integrated design, (5) environmentally responsible products, and (6) waste reduction.

Section 3.2, Program & Policy Support, focuses on implementation methods/approaches that achieve or support program goals and objectives. These include financial incentives and technical support (program support and technical assistance) and reduced emissions and fuel neutrality (policy support).

3.1 Green Building Measures—Impact Analysis

The green building measures, as defined in this report, include the following:

- Reduced energy cost and consumption
- A healthy indoor living environment
- Smart growth/smart planning
- An integrated design process
- The use of environmentally responsible products
- Waste reduction

3.1.1 Energy Cost and Consumption Savings

As is the case with most green building programs, energy conservation is central to the Affordable Green Housing Support initiative. By increasing the energy efficiency of new homes, the occupants can enjoy the same, or greater, comfort and convenience at lower cost, and the community benefits from lower resource demand, reduced emissions of greenhouse gas, and other negative effects on the environment. Similar NYSERDA programs are covered in Section 1, Market Assessment.

3.1.1.1 Best Practices

Cost-effective energy efficiency programs have been delivered by federal, state, and local governments, large and small utilities, and third-party program administrators since the late 1980s. More recently, the movement to net-zero energy buildings has become an increased focus. The widespread recognition of the HERS index rating scale has allowed for a common understanding of energy efficiency. A rating of 0 on the HERS index refers to a home that uses no net energy, and a rating of 100 describes a home built to 2006 International Energy Conservation Code (IECC) minimums. Each point on the scale below 100 is equivalent to an approximate energy reduction of 1% relative to that HERS 100 reference. The HERS Index recently became an American National Standards Institute (ANSI) standard and was adopted as part of the energy code as the Energy Rating Index starting in 2015. Most energy efficiency and green programs use the index to evaluate energy efficiency and set whole house energy performance targets for certification by HERS raters or others.

Energy efficiency programs provide opportunities for customers of all types to adopt energy savings measures and reduce their energy bills. These programs can help customers make sound energy use decisions, increase control over their energy bills, and empower them to manage their energy usage. Customers can experience significant savings depending on their own habits and the program offered.

3.1.1.2 Cost

Several estimates have been made of the incremental cost of meeting beyond-code energy efficiency standards:

- The NYSERDA's April 2018 report for the Clean Energy Fund (CEF) New Construction chapter puts the cost of highly efficient (net zero capable) buildings at 5–10% above standard design and construction which seems to include both hard and soft costs. In that report, NYSERDA states a goal of reducing that cost premium to 3–7% by 2020 and less than 1% by 2030.⁴⁶
- DOE December 2016 estimates of the incremental hard cost of meeting ENERGY STAR 3.1 standards ranged from \$964 to \$1,474.
- A December 2015 report by Bridgewire Consulting for Enterprise Green Communities delves into soft costs, including an estimate of \$500 to \$1,000 for a HERS rater for a single-family home. The cost per unit for a multifamily building averaged \$500 per unit.⁴⁷ It is one of a series of reports on incremental cost from Enterprise Green Communities, based on surveys and mostly focused on multifamily construction.

The NYSERDA estimate is beyond ENERGY STAR 3.1 and depending on where the bar is set for the energy efficiency measure could likely include significant soft costs. Given NYSERDA’s goal of decreasing the cost premium, consider a metric where performance could be verified by a HERS rater.

3.1.1.3 Benefits

Experience drawn from NYSERDA’s Low-Rise Residential New Construction Program (LR NCP) provides a basis for estimating the savings in energy consumption and household energy expense from a potential new initiative. In this program, homes are characterized as meeting “tiers” of performance, and data is collected to measure reductions of energy use and cost relative to estimates for similar units meeting only building codes.

Within the new construction program, special attention and enhanced incentives were provided for homes constructed for low- and moderate-income (LMI) households, defined for four-person households with incomes below 80% of the State or area median. For larger or smaller households, the maximum eligible income was adjusted for household size.

The savings observed for the LMI units were smaller, on average, than for market-rate (MR) units, partly reflecting the fact that 87% of the LMI units were in multifamily structures, and only 3% were in single-family detached homes, while about 60% of MR units were single-family detached. The energy cost savings might, however, represent a larger share of household income for LMI households than for those in market-rate units. Table 10 shows the average energy savings estimated under the LR NCP.

Table 10. Energy Savings Estimated Under the LR NCP

	Market Rate		LMI	
	kWh Electric	MMBtu Gas	kWh Electric	MMBtu Gas
Single Family Tier 1	1,253	27.6	690	7.5
Single Family Tier 2	2,089	46.0	1,150	12.5
Single Family Tier 3	9,416	0.0	4,637	0.0
Low-Rise Multifamily Tier 1	690	7.5	690	7.5
Low-Rise Multifamily Tier 2	1,150	12.5	1,150	12.5
Low-Rise Multifamily Tier 3	4,637	0.0	4,637	0.0

The higher performance tiers were generally found among market-rate units, as Table 11 with its list of units in each category shows (based on data through August 2018).

Table 11. Number of Units Participating Under LR NCP

	Total	Market Rate	LMI
Single Family Tier 1	901	737	164
Single Family Tier 2	2,399	1,980	419
Single Family Tier 3	62	62	0
Low-Rise Multifamily	1,564	156	1,408
Low-Rise Multifamily Tier 2	3,306	814	2,492
Low-Rise Multifamily Tier 3	192	192	0

With the somewhat less restrictive income limits specified for the possible Affordable Green Housing Support initiative, the performance levels for income-eligible participants may exceed those achieved for LMI units under LR NCP, and single-family homes could account for more of the restricted-income participants.

In constructing estimates of energy savings under a new initiative, a similar methodology should be employed to maintain consistency and comparability, but the characteristics of participating units and households will be adjusted to reflect the program design.

Other estimates of the effect of meeting higher efficiency standards also provide helpful information for projecting the benefits of Affordable Green Housing support. DOE's calculation of the household savings for ZERH, relative to IECC 2012 (which approximates the 2016 NY code) is \$33 to \$40 per month.⁴⁸

A post-occupancy study of homes in the Built Green Program found the following when calculating savings compared to above Washington State Energy Code⁴⁹:

- Three-star units (10% above code) saved 2,900 kWh (25% improvement)
- Four-star units (20% above code) saved 3,806 kWh (33% improvement)
- Five-star requirements (30% above code) saved an average of 4,708 kWh (40% improvement)

Consistently funded, well-designed efficiency programs are also cutting electricity and natural gas loads and reducing greenhouse gas emissions.⁵⁰

3.1.2 Healthy Indoor Living Environment

In the course of raising the energy efficiency of new homes, the quality of the indoor air in those homes may be affected. Care should be taken to ensure designs provide adequate indoor air, and appropriate materials and equipment are chosen. Reflecting this concern, the green building programs to be considered as models for this report all include requirements aimed at ensuring healthy indoor air. For ZERH, certification under the Indoor airPLUS program is a requirement. Both EGC and Built Green have more extensive requirements that vary with levels. None of the three specify standards for concentrations of pollutants, which depend on occupant behavior as well as characteristics of construction.

The NY State Energy Plan⁵¹ refers to other aspects of indoor environmental quality (IEQ) such as reduced noise and glare, in addition to indoor air quality (IAQ).

3.1.2.1 Cost

The incremental cost of meeting the Indoor airPLUS requirements has been estimated as \$1,000. Enterprise Green Communities has estimated a median cost of \$0.60 per square foot, or \$680 per unit (in their predominately multifamily sample) for meeting their criteria regarding a healthy living environment (Incremental Costs–2012 update).

3.1.2.2 Benefits

There are no simple metrics for indoor air quality comparable to reductions in energy use in kilowatt-hours (kWh), million British thermal units (MMBtu), or reductions in GHG emissions in carbon dioxide equivalent. EPA's report on the environment⁵² indicates that the only indoor air indicators that are available for the nation over time are for radon and serum continue (second-hand smoke). The benefits of a healthy indoor living environment are well-recognized and substantial.

3.1.3 Smart Growth/Smart Planning

3.1.3.1 Background

The concept behind “smart growth” and “smart planning” is based on strategies that support the connection between development and quality of life. As stated on the NY Department of Environmental Conservation website, “Smart Growth is sensible, planned, efficient growth that integrates economic development and job creation with community quality-of-life by preserving

and enhancing the built and natural environments.”⁵³ The idea and concept behind smart growth has been implemented in various projects and by various jurisdictions and communities across the country for several years; however, with new technologies, growing populations, shifts in housing preferences, etc., smart growth concepts continue to evolve.

Smart planning is a part of the smart growth concept that generally deals directly with transportation. Transportation (both public and private) is often the motivation and the measurement stick for success of smart growth efforts because of the impact transportation has on the environment and quality of life. With smart planning, connecting residents to municipal activities helps to improve their sense of well-being, and in turn, spurs economic growth and environmental health within the community. For example, improving sidewalks in downtown areas, walking paths and access to parks and common areas, improvements to roadways and public transportation, etc. all have a major impact on the functionality and success of a given community.

New York State identifies the following criteria in reference to smart growth:

- Advance projects for the use, maintenance, or improvement of existing infrastructure.
- Advance projects located in municipal centers.
- Advance projects in developed areas or areas designated for concentrated infill development in a municipally approved comprehensive land use plan, local waterfront revitalization plan, and/or brownfield opportunity area plan.
- Protect, preserve, and enhance the State’s resources, including agricultural land, forests, surface and groundwater, air quality, recreation as well as open space, scenic areas, and significant historic and archeological resources.
- Foster mixed land uses and compact development, downtown revitalization, brownfield redevelopment, the enhancement of beauty in public spaces, the diversity and affordability of housing in proximity to places of employment, recreation and commercial development, and the integration of all income and age groups.
- Provide mobility through transportation choices including improved public transportation and reduced automobile dependency.
- Coordinate between State and local government and inter-municipal and regional planning.
- Participate in community-based planning and collaboration.
- Ensure predictability in building and land use codes.
- Promote sustainability by strengthening existing and creating new communities that reduce greenhouse gas emissions and do not compromise the needs of future generations by, among other means, encouraging broad-based public involvement in developing and implementing a community plan and encouraging the adequacy of a governance structure to sustain its implementation.⁵⁴

3.1.3.2 Overview of Current NY State Efforts

Three good examples of regions in New York State pursuing smart growth (with substantial support from NYSERDA and the Department of Environmental Conservation) include Long Island (LI), the North Country, and the Catskill area.

LI partnered with Town of Hempstead, Sustainability Institute of Malloy College, and Community Development Corporation to develop a sustainability plan tailored towards LI. There are several groups involved including the Smart Growth Working Group, and the focus is on water, waste, energy, housing and economic development, and land use and transportation. Phase 1 is complete.

Smart Growth Working Group in Adirondack (North Country) and Catskill Parks is focused on land use planning and strategic use of capital investments to improve housing and economic development.

3.1.3.3 Best Practices

Best practice for the smart growth/smart planning measures could be based on the EPA published guide⁵⁵ in the chapter focused on housing. This is an extensive document published in cooperation with the American Planning Association and the Urban Land Institute.

3.1.3.4 Costs

There were no valid cost estimates found. Most reported the cost as negligible, but it would be inappropriate to assume that there were no costs associated with a smart growth policy. If implemented on a larger scale smart growth/smart planning would have soft costs associated with policy implementation and could have impacts on land costs as a percent of total housing costs.

3.1.3.5 Benefits

Department of Environmental Conservation (DEC) describes the benefits of smart growth/smart planning as the following:

- **Energy Use**—smart growth reduces vehicle miles traveled and decreases greenhouse gas emissions.
- **Green Development**—planned growth incorporates environmental awareness into land use decisions.
- **Water Quality**—smart growth leaves more and larger areas for the natural process of absorption and filtering.

- **Ecosystems and Habitat**—building compactly leaves ecosystems intact to support diverse plant and wildlife populations.
- **Connection to Nature**—smart growth creates links between our neighborhoods and areas set aside for nature-based recreation.⁵⁶

Other benefits from smart growth might include (1) improved health of residents from increased walking, bicycling, and overall more active lifestyles, (2) improved livability of a community, (3) greater mobility choices for all members of the community, (4) increased property values in walkable neighborhoods, (5) more attractive destinations for tourists, (6) enhanced viability of business entities, and (7) enhanced quality of life. None of these benefits are easily measured.

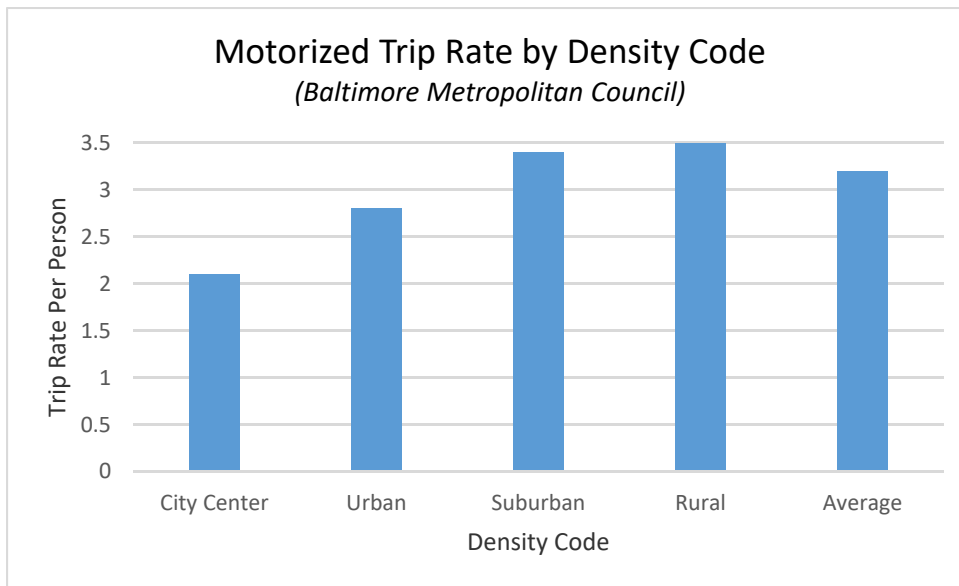
In the context of a green building measure that can be applied to individual units built in various locations across the State and quantified, one recognized approach is to restrict the quantification to something that is both meaningful and measurable. Travel and air-quality benefits may be a quantifiable benefit of promoting smart growth. The EPA officially acknowledged the role of smart growth in improving air quality and has offered three ways to account for air-quality benefits. One of the approaches was followed by the state of Maryland—the first of its kind—to quantify travel and air-quality benefits in the state implementation plan (SIP).⁵⁷

Table 12 indicates the pollution by number of trips, measured in vehicle miles traveled (VMT). In particular, see rows titled, Smart Growth Communities, Imbalanced Growth, and Dispersed Growth.

Table 12. Pollution by Number of Trips

	Regional Vehicle Miles Traveled		NOx		VOC		Non-motorized Person Trips	
	1000 VMT/day	Difference from SG	Tons/day	Difference from SG	Tons/day	Difference from SG	1000/day	Difference from SG
2005								
Smart Growth (SG)	70,115		95.7		45.6		848	
Imbalanced Growth	70,785	670	96.4	0.7	45.8	0.2	835	-13
Dispersed Growth	70,460	345	96.1	0.4	45.7	0.1	837	-11
2025								
Smart Growth	82,808		59.97		39.15		855	
Imbalanced Growth	84,266	1,458	61.57	1.6	39.96	0.81	840	-15
Dispersed Growth	83,737	929	60.47	0.5	39.39	0.24	841	-14

Figure 8. Motorized Trip by Density Code



Although Newport examined this approach for application to the NY smart growth measure, it seemed unlikely to produce meaningful results. However, tracking the geographical participation in an initiative that included smart growth might be useful for further study.

3.1.4 Integrated Design

Much of what is incorporated in integrated design practice is a collaboration between owners, builders, and designers so that HVAC, plumbing, lighting, and wiring, site planning, framing, insulating and other key parts of the project are viewed as interrelated parts of the whole.

3.1.4.1 Best Practice

Integrated design is a key measure in obtaining EGC certification. EGC has found that if not done prior to plan submission, it is difficult to accomplish. To incentivize the measure, EGC offered grants. Best practice includes organizing and conducting a green design charrette to educate and align stakeholders with project goals and to utilize the wisdom of the group. The synergy established in the charrette can be important to ensure that lessons learned through maintenance of other projects are woven into design decisions of current projects. Smaller multidisciplinary teams may also be effective in analyzing and developing solutions to problems that arise along the way.⁵⁸

3.1.4.2 Cost

EGC did a study in 2015 in which it estimated the costs of individual measures included in the EGC certification program. For projects that did not envision an integrated design plan from the beginning the ability to do so later was more expensive and less productive. For others, the cost was zero as it was a regular part of the designer's task. For residential buildings, as defined in this project, costs are estimated as under \$1,000. All costs assigned are soft costs.⁵⁹

3.1.4.3 Benefit

Any modern energy-efficient home or building should include a comprehensive approach to design to address issues of moisture and indoor air quality. ENERGY STAR recognized the need for this approach when creating ENERGY STAR 3.0 and subsequent versions. They included comprehensive moisture protection to ensure that a super-insulated structure with less ability to dry would be protected from bulk moisture. They also added requirements to HVAC design to ensure comfort delivery, adjusted sizing for more efficient homes, and adequate ventilation.

An integrative design and delivery process can increase resiliency, substantially lower affordable housing development costs and encourage health, economic, and environmental benefits for residents, property owners, and communities. EGC has been awarding grant money to community-based nonprofits of \$5,000 to embark on an integrative design process and engage with residents to incorporate sustainable design into their affordable housing projects from the very beginning, using a holistic approach to promote smart location, healthy living environments, resource conservation and green property maintenance throughout the development's life cycle.

3.1.5 Environmentally Responsible Products

Environmentally responsible products for use in construction have different definitions but most often are nontoxic, energy efficient, made from sustainable sources, obtained from local sources, low maintenance, and/or have some recycled content. Xeriscaping, a landscaping plan that utilizes native plants and requires little supplemental water and maintenance is also often identified as "environmentally responsible." Leaving trees in place is another often cited practice of environmental responsibility. There are more complicated (and more accurate) assessments that include life-cycle cost analysis available for building products that can then earn a certification. The following are examples:

- **Green Seal:** Green Seal Certification ensures that a product meets rigorous, science-based leadership standards. It is a life-cycle assessment based, labeling program for building products, green operations, and maintenance procedures. A green seal can be found on anything from a coffee filter to a hotel.
- **Forest Stewardship Council:** A certification program for wood products that come from forests that are managed in an environmentally responsible, socially beneficial, and economical viable way.
- **Science Certification Systems** is a third-party certifier that promotes sustainable development in the forms of environmental protection and social responsibility.
- **Environmental Institute** governs the **Green Guard Certification Program**, another third-party certification organization that provides information related to indoor air quality on insulation, air filters, doors, floor finish, flooring and wall finish. Because of the wide-ranging interpretations of green products or environmentally responsible products, some manufacturers will try to promote their product as green as a sales tactic that stretches the truth or may be debatable. For example, plastic is highly durable, but the environmental impacts question its inclusion as an environmentally responsible product class.

3.1.5.1 Best Practice

Best practice would be to include all of the following elements as part of choosing environmentally responsible products:

- Consult with designers early in the process
- Durable with low-maintenance requirements
- Energy efficient
- Permeable (pervious paving instead of impervious surfaces)
- Free of ozone depleting chemicals and toxic compounds that don't produce toxic by-products
- Often made from recycled materials or content or from renewable and sustainable sources
- Obtained from local manufacturers or resources
- Biodegradable or easily reused either in part or as a whole

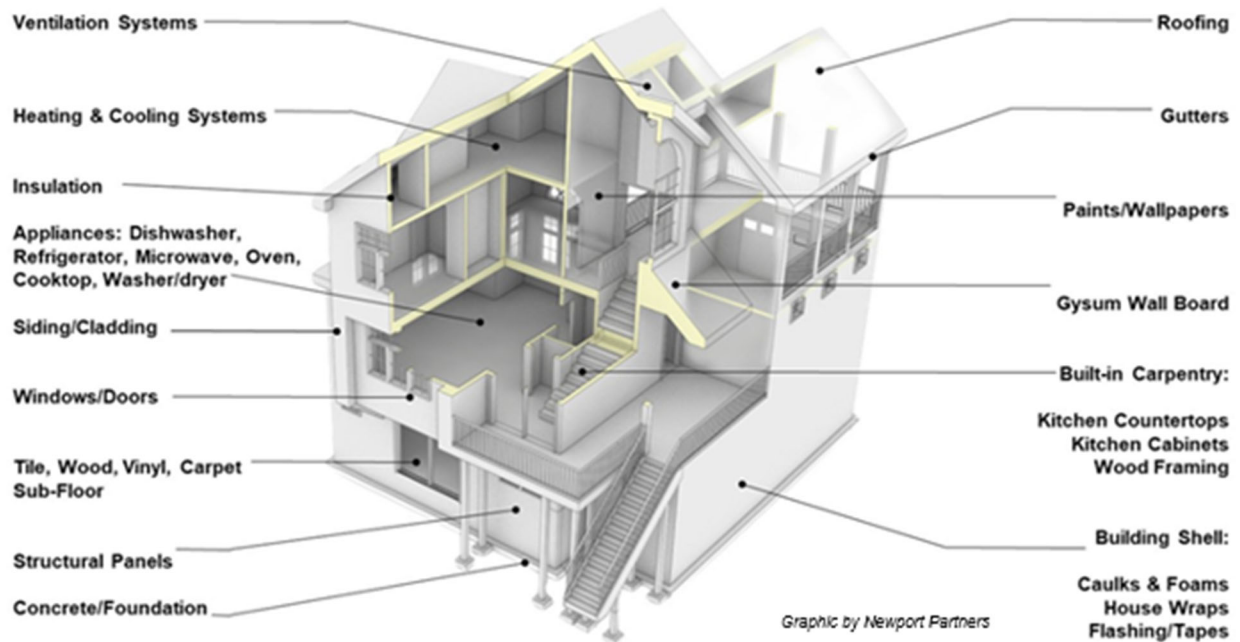
3.1.5.2 Cost

The Enterprise Green Communities 2012 report on incremental cost indicates a median cost of \$0.13 per square foot or \$165 per unit for meeting their standards for environmentally beneficial materials. A large share of projects in their study reported no incremental cost associated with those requirements.

3.1.5.3 Benefit

Occupant health and reduced toxins in the environment are two main benefits of using low-toxin products and leaving trees in place. Obtaining materials from local sources also reduces greenhouse gases. Homes have hundreds of building products. That does not mean that there aren't substantial benefits from supporting this green building measure, but it is easier to accommodate if part of an integrated design.

Figure 9. Sample of Building Products Included in New Construction



3.1.6 Waste Reduction

Reducing waste in residential construction entails the familiar philosophy of “Reduce, Reuse, Recycle.” “Reducing” generally refers to value-engineering design to avoid material waste as well as choosing materials and products that have less packaging. To comply with the second term “reuse” is often more difficult but includes using salvaged materials where appropriate and available. The term “recycle” includes using materials with recycled content as well as disposing of waste that can be recycled rather than dumped in landfills.

3.1.6.1 Best practice

Waste reduction should be considered as part of the integrated design and material selection not as a separate green building measure.

3.1.6.2 Cost

There is not a clear cost to this green building measure although it does take additional time in product specification and planning.

3.1.6.3 Benefits

The environmental benefits of reducing waste are clear and include the following:

- Less waste going to landfills
- Less use of natural resources
- Lower pollution and associated risks

3.2 Program and Policy Support

For purposes of this study, more broadly defined policy and program goals for the new construction of affordable single-family homes and multifamily residential buildings with less than twelve units were analyzed. The potential benefits of providing financial incentives and technical assistance as well as the impact on reducing greenhouse gas emissions are addressed in the subsections that follow.

3.2.1 Financial Incentives

Most NYSERDA programs for new residential construction have provided incentives to suppliers of new housing to produce efficient new homes. Arrangements for providing incentives to suppliers are complicated where eligibility depends on the income of customers, since the identity of the customer is generally unknown during planning and construction. Depending on the program structure, the programs' eligibility requirements may imply that homes can only be sold to income-eligible buyers, creating an obligation that may discourage participation. In current and past programs, that complication has been addressed in various ways.

In some cases, the expected savings from energy efficiency exceed the upfront cost, yet households (and businesses as well) have been unwilling to pay for efficiency, implying that they favor high-discount rates for future savings, or perhaps they distrust estimates of future savings. In any case, this phenomenon, which has been referred to as the “energy paradox” or “energy efficiency gap” is a barrier to the adoption of green building features. For moderate-income households hoping to buy new homes, liquidity constraints may be a factor in the failure to seek high-efficiency homes, but that doesn't seem to be the sole reason. There have been a number of incentive programs in New York State and elsewhere to stimulate the adoption of green building techniques, and these may offer lessons for any new initiative.

3.2.1.1 New York Programs

NYSERDA’s Low-Rise Residential New Construction Program (LR NCP) targets the eligible households referenced in Chapter 311, offering technical assistance and financial incentives to site owners, developers, and builders of dwelling units that would meet specified performance levels and be served by participating utilities. LR NCP relies on a network of Home Energy Rating System (HERS) Raters and Quality Assurance Providers, credentialed and guided by the Residential Energy Services Network (RESNET) standards. Additionally, the ANSI/RESNET 301-2014: Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using the HERS Index is now allowed as the alternative performance path to establish compliance with national and State energy codes, inclusive of the Energy Conservation Construction Code (ECCC) of New York State.

Higher incentive amounts are available for projects with the majority of homes going to low- and moderate-income (LMI) households—defined as “no more than 80% of the state or area median income” by HUD. A list of “proxies” is specified for establishing LMI status. Note that this is a more stringent income standard than the one specified in Chapter 311 but only a majority of occupants in a project must meet the income test.

The financial incentives are based on varying “performance tiers”, with Tier 2 requiring compliance with ENERGY STAR Version 3.1 plus some specific equipment performance requirements. Tier 3 generally requires performance approaching net zero, and solar photovoltaic arrays are typically included in the worksopes. The value of incentives for 2018 are as follows:

Table 13. 2018 Incentive Values for NYSERDA's LR NCP

	Market Rate	LMI
Tier 2	\$950	\$1700
Tier 3	\$4000	\$4200

Preferential loan rates (three-eighths percent points below standard SONYMA rates) are available for homebuyers purchasing new ENERGY STAR certified homes. To be eligible the homebuyer must be classified as a first-time buyer, subject to income and house price limits. The lower mortgage rate is certainly an incentive, but if a lower monthly out-of-pocket cost were alone sufficient to create demand, then the lower utility cost of a highly-efficient home would be enough of an incentive alone (although that lower cost is more uncertain than the difference in mortgage payments).

Along with a lower mortgage rate, the SONYMA ENERGY STAR program (like the standard SONYMA “Low Interest Rate” and “Achieve the Dream” programs) offers interest-free, forgivable Down Payment Assistance Loans. These would more directly address the up-front cost associated with high-energy efficiency.

The SONYMA ENERGY STAR program is operated in partnership with NYSERDA and with the New York State Builders Association (NYSBA) and the Long Island Power Authority (LIPA). This program appears to be infrequently used.

3.2.1.2 Green Residential Building Program

From September 2010 to October 2013, NYSERDA operated a program providing incentives for construction of residential buildings with one to 11 units meeting at least the second level (silver) of either Leadership in Energy and Environmental Design (LEED) for Homes or LEED for New Construction, or the National Green Building Standard (NGBS). Incentives to builders depended on unit size, with single-family units receiving a maximum of \$5,125. A description and evaluation of the program was provided by NYSERDA in an August 2014 report.⁶⁰ Successful elements of this program have been incorporated in the LR NCP.

3.2.1.3 Tax Credit Programs

A variety of federal and state tax provisions have been used to support and incentivize energy efficiency or to pursue other policy objectives. An energy efficiency home credit, worth up to \$2,000 per unit, was available to builders of homes sold or leased from 2005 to 2017 that met specified energy efficiency standards. The credit was “part of the general business credit” deductible from the contractor’s tax liability.⁶¹

During 2008 to 2010, refundable federal tax credits of up to \$8,000 were available for first-time (mostly) homebuyers, subject to income limits, as an economic stimulus measure. During that period there were three different versions of the program with varying terms. There was no direct link to energy efficiency, but the experience with the homebuyer tax credit offers some lessons for a green building incentive.

One constraint on the effectiveness of the tax credit as an incentive was that the targeted potential homebuyers were cash constrained, and the prospect of future receipt of a credit was no help in getting to closing on a home. New York, along with 17 other states, addressed that by offering short-term loans using the tax credits as collateral.

3.2.1.4 Demand Incentives and Supply Response

There may be concerns that offering subsidies to homebuyers for purchasing green homes will not produce the desired change in the characteristics of homes produced. There is evidence from history, however, that a demand-focused policy will produce a supply response.

An early, noteworthy example of a demand-focused policy changing supply may be found in the Federal Housing Authority (FHA) loan program, established in 1934. Mortgage insurance was offered for home purchases, with the stipulation that the homes must meet FHA “minimum property standards.” At a time when building codes were inconsistent and limited, the FHA standards were quickly reflected in new construction.

A more recent example can be found in the first-time buyer tax credit discussed above. In response, builders increased production of homes aimed at first-time buyers, reflected in the size of homes. The median size of homes started in the third quarter of 2008 was 2,082 square feet, down from 2,216 in the previous quarter. After the credit expired, the size of homes increased to pre-incentive values.

A subsidy to income-eligible buyers of efficient homes, combined with technical assistance to builders and other suppliers, could impact supply and avoid the problems of providing supplier incentives tied to the incomes of unknown customers. If the customer for an efficient home did not meet the income requirements, they wouldn't get the extra subsidy, but they would still get greater efficiency.

3.2.2 Technical Assistance and Program Support

All the green building programs reviewed for this report rely on some amount of technical support. In some cases, the support came from the program sponsor and in others it was provided largely through the third-party verifier. Technical support is considered a critical component. As Section 4 of this report suggests, technical assistance and program support elements observed in ongoing successful programs encouraged green building and advanced energy efficiency. These support programs include such things as phone and email support, on-site support, plan review, best practice guides, checklists, marketing support, consumer outreach, and labels.

3.2.3 Reduced GHG Emissions

Emissions of greenhouse gases from the operation of homes results primarily, directly or indirectly, from the combustion of fossil fuels. Nationwide, the majority (~69%) of GHG emissions attributable to residential structures result from fossil fuel consumption in generating electricity.⁶² In New York State, electricity accounts for only 26% of residential GHG emissions, with on-site combustion of natural gas 51% and petroleum 22%.⁶³ New homes are much more energy-efficient than existing homes, even without efficiency improvements that are beyond code requirements, and they are much less likely to use relatively dirty fuels.

3.2.3.1 Cost

The cost of reductions in GHG emissions is built into the cost of higher energy efficiency.

3.2.3.2 Benefits

The reduction in greenhouse gas emissions has been calculated for NYSERDA initiatives based on changes in household combustion of fossil fuels and electricity use. The CEF Budget Accounting and Benefits chapter, as revised September 11, 2018, states on page six that carbon/GHG benefits are “estimated using standard factors to convert electricity, natural gas, and petroleum savings into carbon (1,160 lbs/MWh,⁶⁴ 117 lbs/MMBtu, 162 lbs/MMBtu, respectively).” For petroleum and piped natural gas, those factors are consistent with ones reported by EPA. Propane, used in a substantial share of new homes in the State, is estimated by EPA to produce somewhat more CO₂ (139 lbs/MMBtu) than piped gas.⁶⁵

3.2.4 Efficient Use of All Heating Fuels and Resources

The policy of fuel neutrality is intended to provide support for energy efficiency among all types of homes and fuels, not just those heated with electricity or utility gas. That objective can be challenging. Among LR NCP participating units, less than 5% had propane or oil heat. Table 14, based on ACS data for units in the State, completed during 2015 to 2017, shows that the shares of propane, oil, and other alternative fuels have been significant—especially among homes occupied by households with incomes below the State or area medians.

Table 14. Distribution by Fuel Type

	All occupied units completed 2015 or Later					
	Natural Gas	Propane	Electric	Oil	Other	Total
SF Detached	64.1%	18.0%	5.6%	1.0%	11.2%	12,906
SF Attached	75.2%	0.0%	21.9%	2.9%	0.0%	2,834
2-9 Units	61.7%	3.0%	31.2%	2.1%	2.0%	7,824
10-19 Units	76.3%	0.0%	14.6%	0.0%	9.0%	1,830
20+ Units	45.6%	0.0%	43.7%	5.5%	5.2%	17,226
Mobiles Homes	54.7%	36.9%	1.7%	6.7%	0.0%	1,465
1-9 Units	64.6%	10.9%	16.0%	1.6%	6.8%	23,564
	Income-eligible households					
	Natural Gas	Propane	Electric	Oil	Other	Total
SF Detached	59.3%	12.4%	6.0%	2.6%	19.7%	5,201
SF Attached	81.1%	0.0%	10.5%	8.4%	0.0%	963
2-9 Units	58.9%	3.6%	33.5%	2.6%	1.3%	6,463
10-19 Units	77.1%	0.0%	22.9%	0.0%	0.0%	1,169
20+ Units	46.3%	0.0%	38.8%	8.0%	6.9%	11,889
Mobiles Homes	54.7%	36.9%	1.7%	6.7%	0.0%	1,465
1-9 Units	60.8%	7.0%	20.4%	3.0%	8.8%	12,627

Note: CEF Budget and Accounting Chapter, September 2018, p.6

3.3 Summary of Costs and Benefits

Many of the programs researched for this report did not assign costs and the benefits were largely described in qualitative terms. The cost, where available, varied and are summarized in Table 15.

The following are the qualitative benefits described for the programs relating to societal and homeowner or occupant benefits. The energy benefit was an exception as it was sometimes calculated.

Societal benefits:

- Less landfill waste
- Less use of natural resources
- Lower CO₂ emissions
- Lower risk of pollution incidents
- Increased resilience

Homeowner or occupant benefits:

- Healthier indoor environment
- Improved quality of life
- Reduced vehicle miles traveled
- Improved water quality
- Increased resiliency and durability

Table 15. Summary of Green Building Measure Costs

	NYSERDA	ENERGY STAR V3.0 & 3.1	DOE ZERH	Enterprise Green Communities (Single Family)
Energy Cost and Consumption	5-10% over typical new construction	\$1,000-\$1,500 (Hard Costs) \$500-\$1,000 (Soft Costs)	\$1800-\$2700 (Hard Costs) \$500-\$1,000 (Soft Costs)	\$0.85/ft ² (Hard Costs) \$500-\$1,000 (Soft Costs)
Healthy Indoor Living			\$1,000 per unit	\$0.60/ft ²
Integrated Design				\$1,000
Environmentally Responsible Products				\$165/unit

Calculating the benefit for energy consumption, energy cost, and GHG emissions has a precedent in several programs using REM/Rate, the software used for conducting HERS ratings. Calculation shown in Table 16 are based on modeling results of typical single-family and multifamily units. The table highlights the main quantitative benefits for greenhouse gas emissions, energy consumption, and energy cost savings for consumers or building owners. The eligible population figures in Section 1 Market Assessment, Table 2 are used as multipliers for the calculations in Table 16. The eligible population figures were derived from a three-year average of U.S. Census data from 2015, 2016, and 2017 (shown in the number of homes for each participation rate) and are used as multipliers for the calculations in Table 16.

The estimated impacts based on selected participation levels of 5%, 10% and 100% by eligible households are shown in Table 16. Without a defined program structure, the participation rate is difficult to estimate. The 100% rate of participation illustrates the total potential savings available in the market. Participation rates are heavily influenced by financial and other program support activities including technical assistance, marketing support, and outreach to the target market, as well as market demand for new homes. Potential rates of participation are only shown as examples.

Table 16. Lifetime Savings Above the 2015 IECC for Various Rates of Participation by Eligible Homebuyers and Renters of Newly Constructed Dwellings

	Savings	5% Participation (157 homes)	10% Participation (313 homes)	100% Participation (3,133 homes)^{66,67}
Single-Family Savings	GHG Emissions (Tons) ⁶⁸	5,721	11,443	114,427
	Energy (kWh)	8,298,271	16,596,543	165,965,428
	Energy Cost (\$)	\$269,750 ⁶⁹	\$539,501	\$5,395,009
Multifamily Savings	GHG Emissions (Tons)	1,690	3,379	33,790
	Energy (kWh)	2,047,786	4,095,571	40,955,714
	Energy Cost (\$)	\$138,785	\$277,570	\$2,775,704
Total Savings	GHG Emissions (Tons)	7,411	14,822	148,218
	Energy (kWh)	10,346,057	20,692,114	206,921,142
	Energy Cost (\$)	\$408,536	\$817,071	\$8,170,713

Note: American Community Survey, 2015-2017, New York Residents MOVED IN PAST 12 MONTHS and Built 2013 or Later, Single-Family and 2-9 Units.

4 Technical Assistance and Outreach

The energy and green building programs profiled in this report all have elements of technical assistance and program support to enhance program participation. Technical assistance keeps participants engaged and can begin to build a network of stakeholder support. Program support might include an extensive database of user-friendly resources for builders that include the following:

- Installation guidance
- "Right and wrong" photographs
- Training videos
- Case studies
- Technical reports and relevant standards documents

Support could also include marketing materials to help builders and participating financial institutions promote green building as well as direct consumers to participating builders and financing.

4.1 Best Practices Guide

A best practices guide covering each green building measure can be particularly useful to builders and architects as green building measures, such as Integrated Design Practice, are somewhat hard to understand. Ideally, the guide should include drawings, pictures, and clear examples as there might be several best practices for any given measure depending on building type and design. Checklists should also be included where appropriate. The best practices should include any relevant industry standards applicable to the green building measures.

4.2 Homeowner/Home Builder Hotline

Access to knowledgeable staff through a toll-free number and email would be a very useful component. Communication with staff and homeowner/builder is important to provide the latter with immediate support and to help the former better understand program issues so that they might be addressed.

4.3 Homeowner Kit

A successful homeowner kit available from the NYSERDA website could include information that enhances the consumer's ability to take advantage of green features and add additional green living tips, such as how to utilize rain barrels and the benefits of xeriscaping including suggestions for appropriate native plants. It could also include a checklist for consumers to keep track of how green their home or lifestyle is currently. The kit could be designed for distribution at home shows as well as a downloadable version from the website.

4.4 Educational Videos

Develop short (two- to three-minute) videos, featuring interviews with current or future homeowners, builders, and low-income nonprofits. These videos would put a face on the need for, and benefits of affordable green housing measures. Possibilities for distributing the videos could include the following:

- Placed on the website
- Shared in an email to organizations and builders
- Shared at local community events
- Edited into shorter segments for social media use

Development and implementation of a comprehensive outreach strategy to educate and support the various stakeholder groups—including developers, builders, designers, HERS raters, trade contractors, distributors and suppliers, the finance community, and most importantly, the end user, the homebuyer—is key to the adoption of the Affordable Residential Green measures. The outreach strategy outlined focuses on creating content and resources that can be tailored for multiple channels and diverse audiences based on successful program models described in Section 3 as well as NYSERDA outreach for similar programs. If warranted, special tools and outreach efforts may be directed at eligible households using alternative fuel types.

4.5 Website

A dedicated page could be added to the NYSEERDA website to share overall program information and messaging relevant to each audience. The NYSEERDA website and the Affordable Residential Green page will serve as the central hub for all program resources including the following:

- Program history and overview
- Digital assets including infographics and educational videos
- Facts sheets by audience (builders/developers, homeowners, nonprofits)
- Links to additional resources (New York State Affordable Housing Corporation grantees, Habitat for Humanity, NYSEERDA programs)
- Links to participating financial institutions, builders, and raters
- Highlights or case studies of successful projects
- Homeowner kit
- Best practices guide for green building measures
- Frequently asked questions section from the hotline

The web page needs to be easy to navigate and should include areas for homeowners, designers, as well as builders and construction trades. Baseline content should support the program messaging and reference related NYSEERDA programs and initiatives.

4.6 Partner Tools and Strategies

An outreach strategy should include a database of statewide stakeholders, for example, local government, community, builders, and nonprofit organizations for ongoing program outreach activities including the following:

- Newsletters and updates
- Speaking opportunities at meeting and conferences
- Availability of technical assistance and incentives
- Annual roundtable discussion for stakeholders to focus on the potential for program improvements and to allow for networking among program participants

Consideration should be given to specific outreach and support to HERS raters and other technical professionals that might be part of the verification process. This group can be useful to potential builder clients and are often a source of the program's support network. Webinars with this group can be a useful element.

4.7 PowerPoint Presentations

Develop PowerPoint presentations with images to educate audiences on program benefits and requirements. These would be shared at local meetings, events, and conferences throughout the State.

4.8 Media Outreach

A press release could be issued for the launch of any targeted support and shared with select housing providers, nonprofits, local government reporters, and editors. Interviews with NYSERDA officials at the launch could be considered as a component. Brief case studies should be developed and highlighted both on the website and through traditional and social media.

4.9 Social Media

Participants can stay engaged through the development of a social media schedule and content including images and a dedicated hashtag. Social media can play a key role in sharing news, events, and milestones during the project from launch through implementation, creating a sense of community and enhancing penetration rates. Additional social tools like Facebook Live and Twitter Chats can be used to promote visibility and provide a platform for engagement.

5 Conclusions

This report summarizes the affordable green building measures presented in the legislation and considers several programs and best practices that may provide models for incentivizing the measures.

As shown in [Section 1, Market Assessment](#), the income eligible population moving into new housing is small compared to the overall housing stock. Even though the numbers are relatively small, with less than 1% of the NY housing stock and population impacted, adoption of the green building measures could play a role in transforming the energy efficiency of the overall residential stock—especially of the housing serving those with modest incomes.

The potential savings in both energy consumption and reduced energy costs resulting from the adoption of the energy conservation measures is presented in Table 16. The analysis also shows a significant benefit in the reduction of GHG emissions, which is largely a societal benefit.

Other societal benefits that are more difficult to quantify include:

- Less landfill waste
- Less use of natural resources
- Lower risk of pollution incidents
- Increased resilience

Other qualitative benefits accruing to homeowner or occupants may include:

- Healthier indoor environment
- Improved quality of life
- Reduced vehicle miles traveled
- Improved water quality
- Increased resiliency and durability

This report does not presuppose any specific financial incentives or inducements for participation. It also leaves open the discussion of whether the individual green building measures are incorporated into existing NYSERDA programs or combined as a separate initiative. To realize both the quantitative benefits shown in Table 16. and the qualitative benefits shown above, tax credits and other financial incentives currently available in the market may need to be continued, along with the promotion of best practices, the provision of technical assistance and marketing support, and outreach to the target market.

The benefit of financial incentives for the construction of affordable residential green buildings can be measured by the impact such incentives have on the participation rate in an affordable green building program. While financial incentives often lead to increased participation, administrative requirements such as proof of compliance and excessive paperwork can have a negative impact on program participation rates.

Participation will also be influenced by the stringency and complexity of the green building criteria established for receiving financial incentives. For example, participation in State and local programs based on meeting ENERGY STAR standards declined when ENERGY STAR requirements were increased.⁷⁰ However, inclusion of a program such as ENERGY STAR, an established certification standard, in a broader program can be viewed as positive compared to a less well-known energy metric.

In addition to leveraging an established program such as ENERGY STAR to increase participation, it is often helpful to have tiered incentives as was done in the NYSERDA Low-Rise New Construction Program. Tiers provide choices and flexibility and therefore increase participation. The three programs analyzed for this report all use ENERGY STAR as a pre-requisite, which can simplify a tiered approach, not only because it's familiar, but also because it provides a natural staircase approach for a tiered system. Factors that influence participation rates may also impact the extent of influence on the current and future behavior of consumers, beyond those directly receiving incentives.

Alternative strategies to encourage participation are available. Administrative costs can be reduced with self-certification, using HERS raters or other construction professionals to verify energy, indoor air quality, reduced waste, and product selection measures. Enterprise Green Communities uses an interesting process of random selection of buildings for audit and verification paid for out-of-program funds. Successful programs run by NYSERDA, DOE, and others reduce soft costs through various technical, marketing, and outreach strategies discussed in this report. These strategies are important to program success, but access to financial incentives are likely to continue to be necessary in overcoming financial barriers. The financial incentives may be reduced with a strong technical assistance component and outreach. Ultimately, the participation rate will largely be a result of program design, resources invested in the initiative, and the overall strength of the housing market.

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Appendix A. Chapter 311 of the Laws of New York of 2018

LAWS OF NEW YORK, 2018

CHAPTER 311

AN ACT to amend the public authorities law and a chapter of the laws of 2017, amending the public authorities law relating to establishing the affordable residential green building program, as proposed in legislative bills numbers S. 3746-A and A. 4969-A, in relation to additional aspects of such program and requiring the state authority to furnish a report determining the benefits of providing new financial incentives for the construction of affordable residential green buildings Became a law October 2, 2018, with the approval of the Governor. Passed by a majority vote, three-fifths being present. The People of the State of New York, represented in Senate and Assembly, do enact as follows: Section 1.

Section 1872-a of the public authorities law, as added by a chapter of the laws of 2017, amending the public authorities law relating to establishing the affordable residential green building program, as proposed in legislative bills numbers S. 3746-A and A. 4969-A, is amended to read as follows:

§ 1872-a. Affordable residential green building program. Notwithstanding any law, rule or regulation to the contrary, the authority shall establish and administer a program pursuant to standards and criteria established by the authority which would provide information and resources including technical assistance, access to industry standards, and financing available through the authority or other public or private sector sources, to developers, builders, design professionals, and potential owners for the construction of new residential buildings which are affordable. Such resources shall be available based upon the use of design and building techniques established by the authority which promote integrated design practices for new construction smart growth and smart planning, the reduction of greenhouse gas emissions, achieve energy efficiency and reduce energy consumption, encourage the incorporation of environmentally responsible products, promote the efficient use of all heating fuels and natural resources, reduce waste and promote a healthy indoor living environment while maintaining affordability for household incomes as provided in this section. The authority shall create and maintain guidelines to establish affordable green residential building standards and criteria, and to connect potential owners,

builders, developers, and design professionals associated with the construction of residential buildings with resources for financing, best practices for construction, and other information to achieve these standards and criteria for implementation of such program. The authority shall prepare an annual report on such program which shall be posted on the authority's website.

§ 2. A chapter of the laws of 2017, amending the public authorities law relating to establishing the affordable residential green building program, as proposed in legislative bills numbers S. 3746-A and A. 4969-A, is amended by adding a new section 1-a to read as follows:

§ 1-a. No later than December 31, 2018, the authority shall issue a report to the governor, the temporary president of the senate, and the speaker of the assembly, determining the benefits of providing new financial incentives for the construction of affordable residential green buildings. The report shall include an analysis of the beneficial impacts of such incentives in promoting and achieving smart growth, smart planning, reduced greenhouse gas emissions, energy efficiency, reduced energy consumption, incorporation of environmentally responsible products, efficient use of all heating fuels and natural resources, reduced waste, and healthy indoor living environments while maintaining affordability for potential owners.

§ 3. This act shall take effect on the same date and in the same manner as a chapter of the laws of 2017, amending the public authorities law relating to establishing the affordable residential green building program, as proposed in legislative bills numbers S. 3746-A and A. 4969-A, takes effect.

The Legislature of the STATE OF NEW YORK ss:

Pursuant to the authority vested in us by section 70-b of the Public Officers Law, we hereby jointly certify that this slip copy of this session law was printed under our direction and, in accordance with such section, is entitled to be read into evidence.

JOHN J. FLANAGAN

Temporary President of the Senate

CARL E. HEASTIE

Speaker of the Assembly

Appendix B. Detailed Matrix of Select Residential Green Building Programs

Table B-1. Detailed Matrix

Program	Smart Growth/Smart Planning	Integrated Design	Reduced Emissions	Energy Efficiency (Cost & Consumption)	Environmentally Responsible Products	Fuel Neutral	Waste Reduction	Healthy Indoor Environment
ZERH	N/A	This program leverages the “house as a system” building approach. It leverages ENERGY STAR 3.1 for efficiency and performance as well as additional required measures for risk mitigation. It ensures the components and systems used in construction work together.	All high-performance building certification programs have an underlying goal of reducing greenhouse gas emissions through more efficient, durable, and resilient buildings.	ENERGY STAR 3.1 is a pre-requisite for PHIUS via ZERH. ENERGY STAR 3.1 requirements are designed to improve energy efficiency in homes and buildings. Average ENERGY STAR 3.1 cost savings is \$480 over 2012 IECC. ⁷¹ Average ENERGY STAR 3.1 total upgrade cost is \$1,283 over 2012 IECC.	N/A	All fuel types eligible for certification	N/A	Requires EPA Indoor airPLUS certification to ensure healthy IAQ

Table B-1 continued

Program	Smart Growth/Smart Planning	Integrated Design	Reduced Emissions	Energy Efficiency (Cost & Consumption)	Environmentally Responsible Products	Fuel Neutral	Waste Reduction	Healthy Indoor Environment
<p>Enterprise Green Communities</p>	<p>Awards points for locating projects in LEED for Neighborhood Development locations.⁷²</p> <p>Access to reliable transportation networks ensures that affordable housing residents are connected to amenities. All new construction projects must earn optional points under Criterion 2.8 Access to Public Transportation or 8 optional points through: 2.7 Preservation of and Access to Open Space 2.9 Improving Connectivity to the Community 2.12 Access to Fresh, Local Foods 2.13 LEED for Neighborhood Development Certification 2.14 Local Economic Development and Community Wealth Creation</p>	<p>Awards \$5000 in grant money to community-based nonprofits for using an integrative design process and engaging with residents to incorporate sustainable design into affordable housing.</p> <p>EGC recognizes high-performance building certification programs such as ZERH and PHIUS which promote integrated design through their program requirements.</p>	<p>ENERGY STAR and other certification programs for high performance homes and buildings are recognized by EGC to reduce greenhouse gas emissions.</p> <p>Smart growth measures—specifically in relation to transportation--aimed at emission reduction.</p>	<p>Energy Efficiency is 1 of 8 criteria in the EGC checklist. For new construction EGC requires ENERGY STAR for Homes for single-family and low-rise MF.</p> <p>EGC offers additional points for high performance home programs beyond ENERGY STAR, including ZERH, PHIUS and Living Building Challenge as well as additional points for renewable energy and buildings that are projected to be at least 5% more efficient than the baseline ENERGY STAR requirement.</p>	<p>EGC has requirements for Environmentally Preferable Flooring. This includes hard surface flooring products that are ceramic tile, solid unfinished hardwood floors, or floors that meet the Scientific Certification System’s FloorScore program criteria (including pre-finished hardwood flooring). Additional points are available for including environmentally preferred flooring throughout the building.</p> <p>In several places, EGC references GreenSpec Directory as a resource. The online GreenSpec Directory lists product descriptions for more than 2,000 environmentally preferable products.</p>	<p>All fuel types eligible for certification</p>	<p>Mandatory, with option for more points for going above and beyond. “Commit to following a waste management plan that reduces non-hazardous construction and demolition waste through recycling, salvaging or diversion strategies through one of the three options. Achieve optional points by going above and beyond the requirement.”</p>	<p>Mandatory criteria such as heating and cooling sizing, ventilation, product selection, pest management, mold prevention, etc. that promotes healthy IAQ</p>

Table B-1 continued

Program	Smart Growth/Smart Planning	Integrated Design	Reduced Emissions	Energy Efficiency (Cost & Consumption)	Environmentally Responsible Products	Fuel Neutral	Waste Reduction	Healthy Indoor Environment
Built Green	<p>Section II of the Built Green Single-Family New Construction Handbook is dedicated to Site Selection and Water.</p> <p>Built Green also has a dedicated Built Green Communities handbook which focuses primarily on SG/SP measures. Single Family New Construction can earn additional points by building in a Built Green Community</p>	<p>Built Green promotes integrated design throughout construction. Section I focuses primarily on Integrated Design and offers points for:</p> <p>Incorporate Built Green early in design by conducting an eco-charrette with the homeowner & team to determine Built Green features to be included in the home.</p> <p>Identify team member roles and how they relate to various phases of green lot design, prep and development</p> <p>Create a mission statement that includes the projects goals and objectives</p>	<p>Various measures related to site selection, energy efficiency, environmentally responsible products, etc. all aim to contribute to the reduction of emissions inside and outside the home during construction and when occupied.</p>	<p>Section III is dedicated to energy efficiency measures. Points are awarded based on the stringency of measures taken. Like all other green building programs, a primary goal of the Built Green requirements is to improve energy efficiency costs and consumption. The minimum level is 10% above Washington State Energy Code 2015 which is comparable to ENERGY STAR 3.1, plus it must include a selection of other features.</p>	<p>Built Green offers points for environmentally friendly products. These are highlighted in Section 5 of the handbook. Products include paint, trim, wood, decking materials, insulation, brick, etc.</p>	<p>All fuel types eligible for certification</p>	<p>Section 5 Included as a resource in the appendix, Built Green has a Contractors Waste Reduction Resource Sheet to aid in the reduction of construction waste. They also have a Job Site Recycling Plan worksheet.</p>	<p>An entire section is dedicated to Health and Indoor Air Quality. (Section 4). This includes:</p> <p>Layout And Material Selection</p> <p>Moisture Control</p> <p>Air Distribution And Filtration</p> <p>HVAC Equipment</p> <p>Indoor Pollutant Control</p> <p>Building Entrance Pollutants Control</p> <p>Extra Credit For Health And Indoor Air Quality</p>

Table B-1. continued

Program	Smart Growth/Smart Planning	Integrated Design	Reduced Emissions	Energy Efficiency (Cost & Consumption)	Environmentally Responsible Products	Fuel Neutral	Waste Reduction	Healthy Indoor Environment
<p>LEED for Homes</p>	<p>LEED for Neighborhood Certification rating system includes:⁷³ Smart Location and Linkage encourages communities to consider location, transportation alternatives, and preservation of sensitive lands; discourages sprawl.</p> <p>Neighborhood Pattern and Design emphasizes vibrant, equitable communities that are healthy, walkable, and mixed-use.</p> <p>Green Infrastructure and Buildings promotes the design and construction of buildings and infrastructure that reduce energy and water use, while promoting more sustainable use of materials, reuse of existing and historic structures, and other sustainable best practices.</p>	<p>N/A</p>	<p>All high-performance building certification programs have an underlying goal of reducing greenhouse gas emissions through more efficient, durable, and resilient buildings.</p>	<p>LEEDV4 has an Energy and Atmosphere section which: With 20% of all points allocated to building energy efficiency, LEED has an increased emphasis on energy and the associated impacts. Emphasis on enhanced building commissioning for greater energy and operational performance. Benefits of smart-grid thinking through an option that rewards projects for participating in demand-response programs.</p>	<p>Within the Materials and Resources (MR) section, instead of saying a product is good or bad based on one attribute, e.g. recycled content, LEED enables project teams to have a more robust dialogue with manufacturers about optimizing around environmental, social and health impacts, and better understand trade-offs. This category is designed to consider the entire life cycle of the building, from extraction and manufacturing, to transport, operations, and maintenance and eventually the end of life.</p>	<p>All fuel types eligible for certification</p>	<p>In its solid waste management hierarchy, the EPA ranks source reduction, reuse, recycling and waste to energy as the four preferred strategies for reducing waste.</p> <p>The Materials and Resources (MR) section within LEED v4 directly addresses each of these recommended strategies.</p>	<p>Buildings and spaces with good indoor environmental quality protect the health and comfort of building occupants. Going a step beyond, high-quality indoor environments also work to improve the building's value, enhance productivity, decrease absenteeism and reduce liability for building designers and owners.</p>

Table B-1. continued

Program	Smart Growth/Smart Planning	Integrated Design	Reduced Emissions	Energy Efficiency (Cost & Consumption)	Environmentally Responsible Products	Fuel Neutral	Waste Reduction	Healthy Indoor Environment
<p>LEED for Homes (continued)</p>	<p>Innovation and Design Process recognizes exemplary and innovative performance reaching beyond the existing credits in the rating system, as well as the value of including an accredited professional on the design team.</p> <p>Regional Priority Credit encourages projects to focus on credits of significance to the project's local environment.</p>							<p>LEED uses ASHRAE 62.2 or local code, whichever is more stringent, as a minimum for ventilation requirements. It also offers additional points for taking measures above and beyond what is required such as:</p> <p>EQ Credit: Enhanced Indoor Air Quality Strategies</p> <p>EQ Credit: Low-Emitting Materials</p> <p>EQ Credit: Construction Indoor Air Quality Management Plan</p> <p>EQ Credit: Indoor Air Quality Assessment</p>

Table B-1 continued

Program	Smart Growth/Smart Planning	Integrated Design	Reduced Emissions	Energy Efficiency (Cost & Consumption)	Environmentally Responsible Products	Fuel Neutral	Waste Reduction	Healthy Indoor Environment
NGBS	The NGBS has several areas within it that relate to SG/SP. Chapter 4 is dedicated to Site Design and Development.	N/A	All high-performance building certification programs have an underlying goal of reducing greenhouse gas emissions through more efficient, durable, and resilient buildings.	Chapter 7 details Energy Efficiency requirements designed to reduce cost and consumption. NGBS accepts ENERGY STAR 3.0 and 3.1 for Bronze and Silver level certification respectively.	Section 601 relates to Quality of Construction Materials and Waste and explains the intent as "Design and construction practices that minimize the environmental impact of the building materials are incorporated; environmentally efficient building systems and materials are incorporated; waste generated during construction is reduced. See chapter 6	All fuel types eligible for certification	Chapter 6, specifically Section 601, relates to Quality of Construction Materials and Waste and explains the intent as "Design and construction practices that minimize the environmental impact of the building materials; use of environmental ly efficient building systems and materials; waste generated during construction is reduced.	Chapter 9 details Indoor Environmental Requirements with both mandatory and optional items for additional points.

Table B-1. Continued

Program	Smart Growth/Smart Planning	Integrated Design	Reduced Emissions	Energy Efficiency (Cost & Consumption)	Environmentally Responsible Products	Fuel Neutral	Waste Reduction	Healthy Indoor Environment
PHIUS	N/A	Program requirements ensure integrated design practices are leveraged in construction to provide both energy efficiency and risk mitigation	All high-performance building certification programs have an underlying goal of reducing greenhouse gas emissions through more efficient, durable, and resilient buildings.	<p>ENERGY STAR 3.1 is a pre-requisite for PHIUS via ZERH. ENERGY STAR 3.1 requirements are designed to improve energy efficiency in homes and buildings.</p> <p>Average ENERGY STAR 3.1 cost savings is \$480 over 2012 IECC.</p> <p>Average ENERGY STAR 3.1 total upgrade cost is \$1,283 over 2012 IECC.</p>	N/A	All fuel types eligible for certification	N/A	Requires EPA Indoor airPLUS certification to ensure healthy IAQ

Appendix C. Built Green Prerequisites

Table C-1. Three-Star Requirements

PREREQUISITES

Meet selected star-level requirements

Category	Possible Points	Credit
THREE-STAR REQUIREMENTS (100 points minimum)		
	<i>required</i>	3rd party verification required (See reference)
	<i>required</i>	All star items
	<i>required</i>	Conform to the House Size Matrix (Table 0-1)
	<i>required</i>	Meet all applicable codes and regulations
	<i>required</i>	Program Orientation (one time only)
Site & Water	<i>required</i>	Prohibit burying of construction waste
Site & Water	<i>required</i>	Stabilize all construction entrances with quarry spall or crushed rock
IAQ	<i>required</i>	Ensure proper drainage of crawl space
IAQ	<i>required</i>	All spot fans under 110 CFM are 1.5 sones or less
Materials	<i>required</i>	Post and implement a jobsite recycling plan
	<i>required</i>	Provide a building owners manual in accordance with credit 6-1
Energy	<i>required</i>	10% energy use improvement over Washington State Energy Code (2015)
	<i>required</i>	Achieve a minimum of 40 points in each of sections 2-5
	<i>required</i>	Achieve a minimum of 25 points in each of sections 2-5

Note: <https://www.usgbc.org/Docs/Archive/General/Docs6423.pdf>

Table C-2. Four-Star Requirements

<u>FOUR-STAR REQUIREMENTS (400 points minimum)</u>		
	<i>required</i>	Meet 3-Star requirements
	<i>required</i>	Achieve a minimum of 60 points in each of sections 2-5
Site & Water	<i>required</i>	No zinc galvanized ridge caps, copper flashing or copper wires for moss prevention
Site & Water	<i>required</i>	Landscape with plants appropriate for site topography and soil types, emphasizing use of plants with low watering requirements [drought tolerant]
Site & Water	<i>required</i>	Use the most efficient aerator available for kitchen faucets, lavatory faucets and showerheads
Energy	<i>required</i>	Achieve 20% improvement over Washington State Energy code (2015)
IAQ	<i>required</i>	Use low toxic/low VOC paint on all major surfaces
IAQ	<i>required</i>	Ventilate with box fans in windows blowing out during drywall sanding and new wet finish applications
IAQ	<i>required</i>	Use no products that contain added urea formaldehyde for any interior applications. (CARB II acceptable for meeting the requirement, though not for checklist points)
Materials	<i>required</i>	Practice waste prevention and recycling and buy recycled products (Section 5)
Materials	<i>required</i>	Achieve a minimum recycling rate of 50% of waste by weight

Table C-3. Five-Star Requirements

<u>FIVE-STAR REQUIREMENTS (600 points minimum)</u>		
	<i>required</i>	Meet 4-Star requirements plus point minimum
	<i>required</i>	Achieve a minimum of 100 points in each of sections 2-5
Site & Water	<i>required</i>	Amend disturbed soil with compost to a depth of 10 to 12 inches to restore soil environmental functions (2-34)
Site & Water	<i>required</i>	Use previous materials for at least one-third of total area for driveways, walkways, and patios (See Action item 2-44)
Site & Water	<i>required</i>	Limit use of turf grass to 25% of landscaped area (2-61)
Site & Water	<i>required</i>	Avoid soil compaction by limiting heavy equipment use to building footprint and construction entrance (2-19)
Site & Water	<i>required</i>	Preserve existing native vegetation as landscaping (2-21)
Site & Water	<i>required</i>	Retain 30% of the trees located on site at the start of construction or, alternatively, achieve a Green Factor score of .6 or higher (2-23)
Energy	<i>required</i>	Pre-wire for future PV installation (3-93)
Energy	<i>required</i>	Achieve 30% improvement over Washington State Energy code (2015)
IAQ	<i>required</i>	Detached or no garage OR garage air sealed from house with automatic exhaust fan (4-27)
Materials	<i>required</i>	Achieve a minimum recycling rate of 70% of waste by weight
Materials	<i>required</i>	Use a minimum of 10 materials with recycled content

Endnotes

- 1 Public Authorities Law Section 1872-a.
- 2 Ibid.
- 3 Public Authorities Law Section 1872 (<https://www.nysenate.gov/legislation/laws/PBA/1872>).
- 4 Number of homes derived from average number of eligible homes from 2017, 2016, and 2015 American Community Survey, <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>
- 5 Income eligible homes were parsed out by percent in each NY Climate Zone (CZ) for both single family and multifamily. Total number of Percent estimates used data from U.S. DOE New York Energy and Cost Savings, Table A.3, Page A.3., <https://www.energycodes.gov/sites/default/files/documents/NewYorkResidentialCostEffectiveness.pdf>
- 6 Estimated GHG emissions and Energy Consumption for electric and natural gas/propane from energy modeling completed by Newport Ventures on homes in CZ 4, 5, and 6 in NYS. Homes were modeled to meet minimum NYS energy code requirements compared to 3.1 ENERGY STAR compliance.
- 7 <https://www.nyscrda.ny.gov/Researchers-and-Policymakers/Energy-Prices/Electricity/Monthly-Avg-Electricity-Residential>, <https://www.nyscrda.ny.gov/Researchers-and-Policymakers/Energy-Prices/Natural-Gas/Monthly-Average-Price-of-Natural-Gas-Residential>
- 8 SONYMA income limits for Low Interest Rate Program
- 9 <https://www.law.cornell.edu/uscode/text/26/143>
- 10 <https://www.huduser.gov/portal/datasets/il.html>
- 11 <https://www.huduser.gov/portal/datasets/il.html>
- 12 Federal Law Regarding Mortgage Revenue Bonds, <https://www.law.cornell.edu/uscode/text/26/143>
- 13 Applicant eligibility would be assessed using current year's estimated income, based on year-to-date income. http://www.nyshcr.org/Topics/Home/Buyers/IncomeLimits/IncomeLimits_LIRP_CIP.pdf
- 14 Data on permits from U.S. Census Bureau. Not all new single-family homes are occupied as primary residences.
- 15 Clean Energy Fund Investment Plan: Codes Chapter, p3.
- 16 Defined as less than 80% of median income for the metropolitan statistical area in which a project is located
- 17 Page 5, [Draft 2018 Annual Action Plan](#), published for public comment.
- 18 <http://www.nyshcr.org/Topics/Developers/MultifamilyDevelopment/HFA-Green-Guidelines.pdf>
- 19 <https://data.cityofnewyork.us/report/mmr/HPD/how-we-performed>
- 20 Source: DOE Zero Energy Ready Home Program Staff
- 21 NY did not adopt the 2012 IECC for Residential
- 22 <https://www.energy.gov/sites/prod/files/2016/02/f29/DOE%20Zero%20Energy%20Ready%20Home%20-%20Cost%20%26%20Savings%20Summary%20OCT%202015.pdf>
- 23 https://www.energystar.gov/ia/partners/downloads/ES_Version_3.1_Cost_Savings_Summary.pdf
- 24 National Program Requirements
- 25 <https://www.energy.gov/eere/buildings/zero-energy-ready-home>
- 26 <https://www.enterprisecommunity.org/where-we-work/southeast/see-the-work>
- 27 Per conversation with program staff
- 28 Enterprise Green Communities Criteria: Incremental Cost, Measurable Savings Update, pg. 18
- 29 Reported design phase costs ranged from \$750 to \$41,495; it should be noted that the \$41,495 included ongoing monitoring throughout the construction period. Two projects reported construction phase costs of \$10,000 and \$39,000.
- 30 <https://community-wealth.org/sites/clone.community-wealth.org/files/downloads/tool-enterprise-green-hsg.pdf>

31 <http://www.nyshcr.org/Funding/UnifiedFundingMaterials/2018/MultifamilyProgramsUnifiedFundingRequestforProposals.pdf>

32 <https://portal.nyserda.ny.gov/servlet/servlet.FileDownload?file=00Pt0000004sS3QEAU>

33 <https://www.enterprisecommunity.org/solutions-and-innovation/green-communities/tools-and-services/construction-specifications>

34 <https://www.enterprisecommunity.org/solutions-and-innovation/green-communities/tools-and-services/charrette-toolkit>

35 <https://www.enterprisecommunity.org/solutions-and-innovation/green-communities/certification>

36 <https://www.enterprisecommunity.org/solutions-and-innovation/green-communities/tools-and-services/technical-assistance-providers-database>

37 <https://www.enterprisecommunity.org/resources/resident-engagement-cards-customizable-resident-engagement-cards-13988>

38 <https://www.enterprisecommunity.org/policy-and-advocacy/campaigns-and-coalitions>

39 Ibid

40 Leah Missik, Talia Haller, and AARON Adelstein, Built Green Homes are even more efficient than you—and we—thought. p.5.

41 Ibid.

42 Leah Missik, Talia Haller, and AARON Adelstein, Built Green Homes are even more efficient than you—and we—thought. pp. 3-5.

43 All of the incentives were verified by phone with the organization listed.

44 <https://www.builtgreen.net/membership>

45 <https://www.builtgreen.net/docs/librariesprovider2/handbooks/single-family-new-construction-handbook.pdf?sfvrsn=4>

46 CEF New Construction Chapter pp 11-13.

47 *Bridgewire*, pp.19-22.

48 <https://www.energy.gov/sites/prod/files/2016/02/f29/DOE%20Zero%20Energy%20Ready%20Home%20-%20Cost%20%26%20Savings%20Summary%20OCT%202015.pdf>

49 The 2015 Washington State Code is equivalent to the 2015 IECC.

50 Uncertainty, loss aversion and markets for energy efficiency, *Energy Economics*, David L. Green, Oak Ridge National Laboratory, pp.

51 New York State Energy Plan, Volume 2, Page 87. <https://energyplan.ny.gov/-/media/nysenergyplan/2014stateenergyplan-documents/2015-nysep-vol2-impacts.pdf>

52 <https://www.epa.gov/report-environment/indoor-air-quality>

53 <https://www.dec.ny.gov/lands/45970.html>

54 NY Department of Transportation, Official Order 1752, Dated March 31, 2016

55 Best Development Practices: A Primer for Smart Growth, Reid Ewing and Robert Hodder,

56 <http://www.dec.ny.gov/lands/45970.html>

57 Quantifying Travel and Air-Quality Benefits of Smart Growth in Maryland's State Implementation Plan.

58 2015 Enterprise Green Communities Criteria, pp16-19.

59 2015 Green Communities Criteria: Incremental Cost Survey, Bridgewire Consulting, December 2015, pp.

60 www.nyserda.ny.gov/-/media/Files/Publications/PPSER/NYSERDA/2014-NY-Green-Residential-Building-Program.pdf

61 <https://www.irs.gov/pub/irs-pdf/i8908.pdf>

62 EPA Inventory of US GHG 1990-2016, ES-12

63 NYSERDA 18 New York State GHG Inventory 1990-2015, p4

64 The source for those coefficients is described in the April 2018 report New Efficiency: New York (p 23).

65 CEF Budget and Accounting Chapter, September 2018, p.6

66 Number of homes derived from average number of eligible homes from 2017, 2016, and 2015 American Community Survey, <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>

- ⁶⁷ Income eligible homes were parsed out by percent in each NY Climate Zone (CZ) for both single family and multifamily. Total number of Percent estimates used data from U.S. DOE New York Energy and Cost Savings, Table A.3, Page A.3.,
<https://www.energycodes.gov/sites/default/files/documents/NewYorkResidentialCostEffectiveness.pdf>
- ⁶⁸ Estimated GHG emissions and Energy Consumption for electric and natural gas/propane from energy modeling completed by Newport Ventures on homes in CZ 4, 5, and 6 in NYS. Homes were modeled to meet minimum NYS energy code requirements compared to 3.1 ENERGY STAR compliance.
- ⁶⁹ <https://www.nysersda.ny.gov/Researchers-and-Policymakers/Energy-Prices/Electricity/Monthly-Avg-Electricity-Residential>, <https://www.nysersda.ny.gov/Researchers-and-Policymakers/Energy-Prices/Natural-Gas/Monthly-Average-Price-of-Natural-Gas-Residential>
- ⁷⁰ Expanding the Energy Efficiency Pie: Serving More Customers, Saving More Energy through High Program Participation, York, et.al. ACEEE, January 2015, pp. 35-45.
- ⁷¹ https://www.energystar.gov/ia/partners/downloads/ES_Version_3.1_Cost_Savings_Summary.pdf
- ⁷² <https://www.enterprisecommunity.org/sites/default/files/media-library/solutions-and-innovation/green/ecp-2015-criteria-manual-11-15.pdf>
- ⁷³ <https://www.usgbc.org/Docs/Archive/General/Docs6423.pdf>

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