

**New York State Net Zero Energy  
Residential New Construction Baseline Study**

*Final Report*

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## Notice

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# 1 Introduction

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The New York Public Service Commission established the Energy Efficiency Portfolio Standard (EEPS) to fund energy efficiency assistance in New York. Customers of Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric and Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid, Orange and Rockland Utilities, Rochester Gas and Electric Corporation, Corning Natural Gas Corporation, KeySpan Gas East Corporation d/b/a National Grid, Brooklyn Union Gas Company d/b/a National Grid NY, and National Fuel Gas Distribution Corporation fund EEPS through payment of the System Benefits Charge (SBC) on utility bills.

The Purpose of this document is to present a market model of the Net Zero Energy (NZE) low-rise, new construction residential industry in New York State, describe definitions of NZE baseline market metrics and indicators, and provide baseline estimates of market indicators for the NZE low-rise, new homes market in New York State for 2015.

## 1.1 Program Description

In 2015, the New York State Energy Research and Development Authority's (NYSERDA) Low Rise New Construction (LRNC) program provided technical support and financial incentives to qualified builders, Home Energy Rating System (HERS) Raters, HERS Providers, and heating, air-conditioning, and ventilation (HVAC) contractors working on eligible new, low-rise, high-performance residential buildings in the service territory of electric or natural gas utilities in New York State that collect the SBC or the EEPS surcharge. The goal of the program is to “encourage the construction of single-family homes [detached homes and up to four attached homes] and low-rise [generally three or fewer stories] residential dwelling units which operate more energy efficiently, are more durable, more comfortable, and provide a healthier environment for their occupants than would otherwise be achieved.”<sup>1</sup> The program also provided support and incentives to gut rehabs of these building types on a case-by-case basis.

In 2015, the program offered three tiers of incentives to participating builders working on eligible projects. Tier 1 included a \$2,000 incentive per dwelling unit for ENERGY STAR Certified Homes Version 3.0 and New York Energy Smart Homes. Tier 2 included a \$2,500 for units smaller than 1,500 sq. ft. and \$3,000 for units greater than or equal to 1,500 sq. ft. for ENERGY STAR Certified Homes Version 3.1. Tier 3 included \$4,000 for units smaller than 1,500 sq. ft. and \$8,000 for units greater than or equal to 1,500 sq. ft. for NZE homes.<sup>2</sup> The program provided HERS Providers with an incentive of \$100 for each qualified

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<sup>1</sup> NYSERDA. 2014. “Low-Rise Residential New Construction Program Opportunity Notice (PON) 2309.” Accessed October 2016 at <https://www.nyseda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities/PON-2309-Low-Rise-Residential-New-Construction-Program>

<sup>2</sup> Tier 3 incentives were not available for participants in PSEG Long Island territory.

dwelling unit that their affiliate Raters rate and verify, and also provided additional incentives to increase builder participation in the program, marketing of participating homes, and participating affordable homes.

## 1.2 Summary of Objectives and Methods

The team achieved three objectives with this research (Table 1-1).

**Table 1-1. Research Objectives, Purposes, and Methods**

Objective	Purpose	Data Source	Method
Develop and confirm 2015 low-rise, new construction NZE residential market model	Provide illustration of NZE residential market, including relationships among key market actors, supporting organizations, and market processes	Secondary research and interviews/surveys with key market actors	Graphical analysis of relationships
Define quantitative and qualitative baseline market indicators from the metrics for low-rise, new construction NZE residential market to measure and track	Specify measurable and replicable market indicators for which to obtain baseline estimates	Secondary research	Specification of 74 measurable and replicable quantitative and qualitative market indicators
Measure low-rise, new construction NZE residential baseline market indicators for 2015	Establish first year, baseline estimates of NZE market indicators	Secondary research and interviews/surveys with 12 key market actor groups	Estimation of averages and ranges for quantitative data Identification of themes in qualitative data

The 12 NZE market actor groups with which we conducted interviews and surveys are:

- Architects (3), design-build firms (4), builders (6), and property developers (1) who designed and/or constructed a NZE home in 2015. Architects primarily design the homes, builders primarily build the homes, design-build firms primarily design and build the homes, and property developers primarily develop multiple residential properties in a neighborhood, community, or complex. All the design-build firms and most of the builders (4 of 6) reported providing property development services, but not as their primary business service; the property developer also reported assisting with design and construction but not as its primary business service. The team calculated metrics for each group separately for this report since their core business services differ but they could be considered as one group since they do offer similar secondary services.
- HVAC contractors (5) who designed and/or installed a system in a NZE home in 2015.
- Solar photovoltaic (PV) contractors (7) who designed and/or installed a solar PV system on a NZE home in 2015.
- HERS raters (5) who rated a NZE home in 2015.



- Distributors (4) of NZE-needed heating, air-conditioning, and ventilation (HVAC) equipment, insulation products, windows, and solar PV systems and components.
- Building inspectors (4) who permitted and/or inspected a NZE home in 2015.
- Training, trade, and professional organizations (6) with a focus on NZE residential buildings, technologies, and/or practices and who have members in New York State.
- Homebuyers who purchased a NZE home that was built in 2015 (8) and earlier (10) (NZE homebuyers).
- Homebuyers who purchased a Non-NZE energy efficient single-family home (58), single-family home (11), or low-rise multifamily home (3) between July 2014 and March 2016 (72) (Non-NZE homebuyers).

## 2 NZE Home Definition and Market Model

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### 2.1 NZE Home Definition

For this research, the team used NYSERDA’s working definition of an NZE home. The definition states a new NZE home is “a grid-connected home that is built to be highly energy efficient and is connected to renewable electric generation, so that the renewable generation offsets all of the home’s average annual energy consumption.” In addition, for a home to qualify as a NZE low-rise, new construction home through the LRNC, it must earn a HERS score of 10 or less, generally have three or fewer stories, and be newly built or gut-rehabilitated.

In contrast, Non-NZE homes fall short of these energy performance criteria. The team divided Non-NZE homes into two types: homes built to current energy codes (code-built homes) and homes that include some energy efficient features or renewable generation but not to the extent that the home is NZE (Non-NZE energy efficient [EE] homes). Examples of the latter include ENERGY STAR Certified homes, New York Energy \$mart homes, U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) Certified homes, and Passive Houses.

### 2.2 NZE Market Model

Before beginning the market indicator baseline research, the team developed a hypothesized model of the NZE low-rise, new construction residential market in New York State. After conducting the market indicator baseline research, the team used data collected from secondary sources and interviews or surveys with market actors to revise the model as needed to represent the actual structure of and relationships that comprise the market (Figure 2-1; Section 2.3 below describes the revisions the team made to the hypothesized market model).

#### 2.2.1 Revised Market Model

Research shows that the NZE low-rise, new construction residential market has a vertical alignment, with three phases: 1) pre-construction, 2) design and construction, and 3) post-construction. Each market phase involves different market actors and processes, although some actors also have a role in more than one phase.

##### 2.2.1.1 Pre-Construction Phase

The pre-construction phase of NZE home development involves processes including the creation, update, and enforcement of mandatory and voluntary building and product requirements (codes and laws), the manufacture and distribution of NZE-needed technologies, materials and equipment, and professional training and support for market actors. Key actors include the state and local jurisdictions, planning officials, building and product code and certification organizations, building code officials, manufacturers,

distributors, and distributor networks, and training, certification, professional, and trade organizations. Actors and processes in the NZE pre-construction phase help provide a starting point for the design and construction phase.

Actors in the design and construction phase reported that they rely upon codes, labels, and building inspectors, and they use materials, equipment, and advice available from manufacturers and distributors, and training and support from organizations to help guide the design and construction of NZE homes.

### 2.2.1.2 Design and Construction Phase

The design and construction phase of the NZE market consists of designing the building, HVAC system, solar photovoltaic (PV) system and other components, the selection of materials and equipment, and the construction of the building, including installation of equipment and the home energy rating. Primary market actors involved in the design and construction phase include architects and designers, builders, property developers, HVAC contractors, solar PV contractors, HERS raters, and homebuyers who purchased their home before or during construction. Other actors working in this phase include building code officials who inspect NZE buildings, and manufacturers and distributors that visit or consult on projects involving their equipment.

### 2.2.1.3 Post-Construction Phase

In the post-construction phase is when the completed NZE home is marketed, appraised, sold to and purchased by a homebuyer, or rented to/by tenants. Key market actors in the post-construction phase of the NZE market consists of appraisers, lenders, relators, and homebuyers; homebuilders and developers who sell their homes directly to homebuyers also participate in this phase.

## 2.2.2 Changes Made to the Hypothesized Market Model

After data collection for this research, the team made three changes to the hypothetical market model (Figure 2-2) to create the revised market model in Figure 2-1. First, in the hypothetical market model, the team defined the first phase as the pre-construction and design phase, and included architects and designers and their supporting organizations. In other housing markets, there is typically a design phase and a construction phase in which the architect produces the design and hands it off to the builder to execute. The team learned through interviews with architects, builders, and developers, however, that most architects and builders currently collaborate throughout the design and construction of a NZE home. For nearly all interviewed architects and builders, NZE design and construction has been an iterative process in which aspects of the design of the home often must be revised during construction. Based on these findings, the team changed the construction phase to the design and construction phase and included the architects in this phase.

Figure 2-1. Revised NZE Residential New Construction Market Model for New York State, 2015

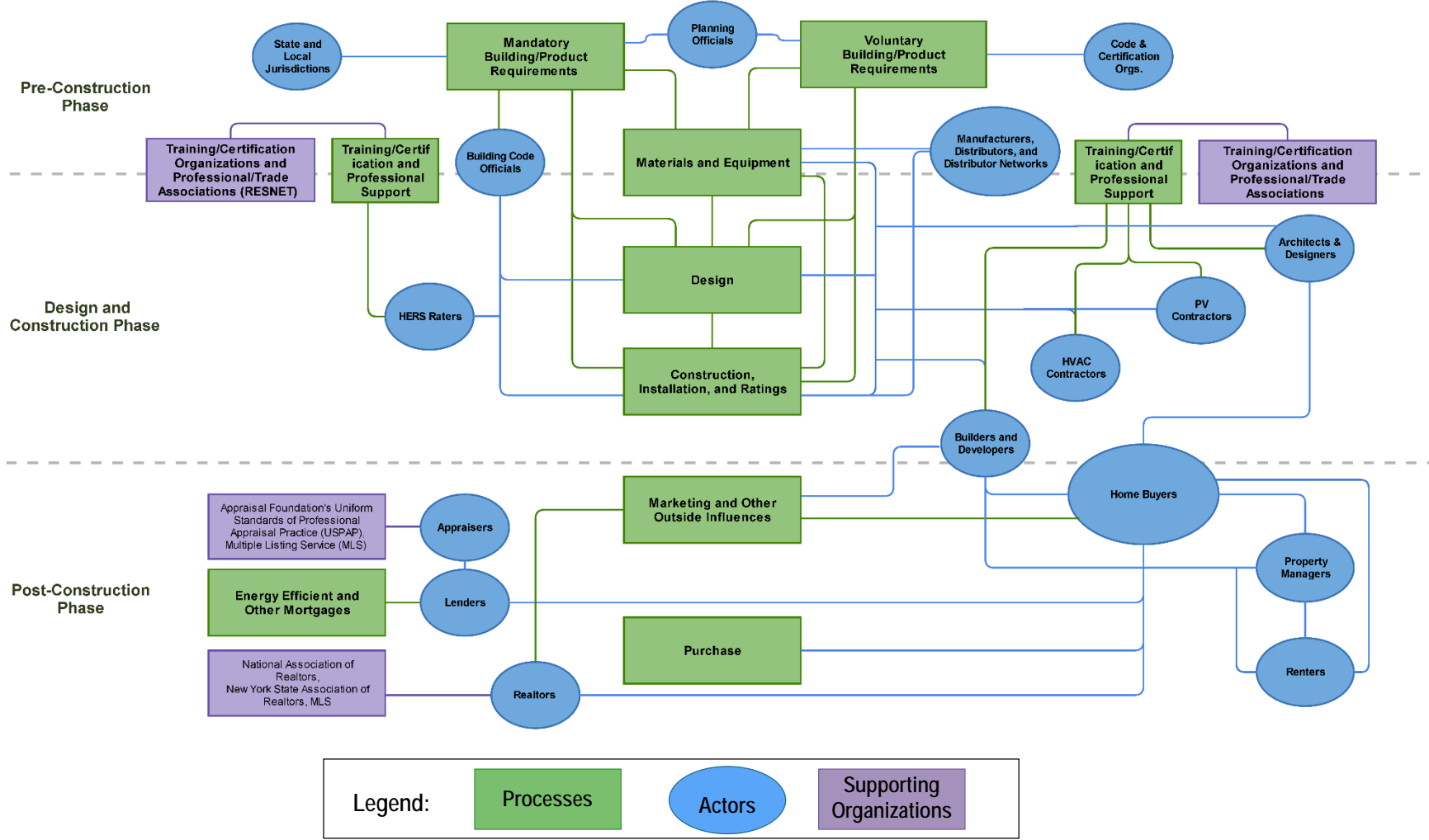
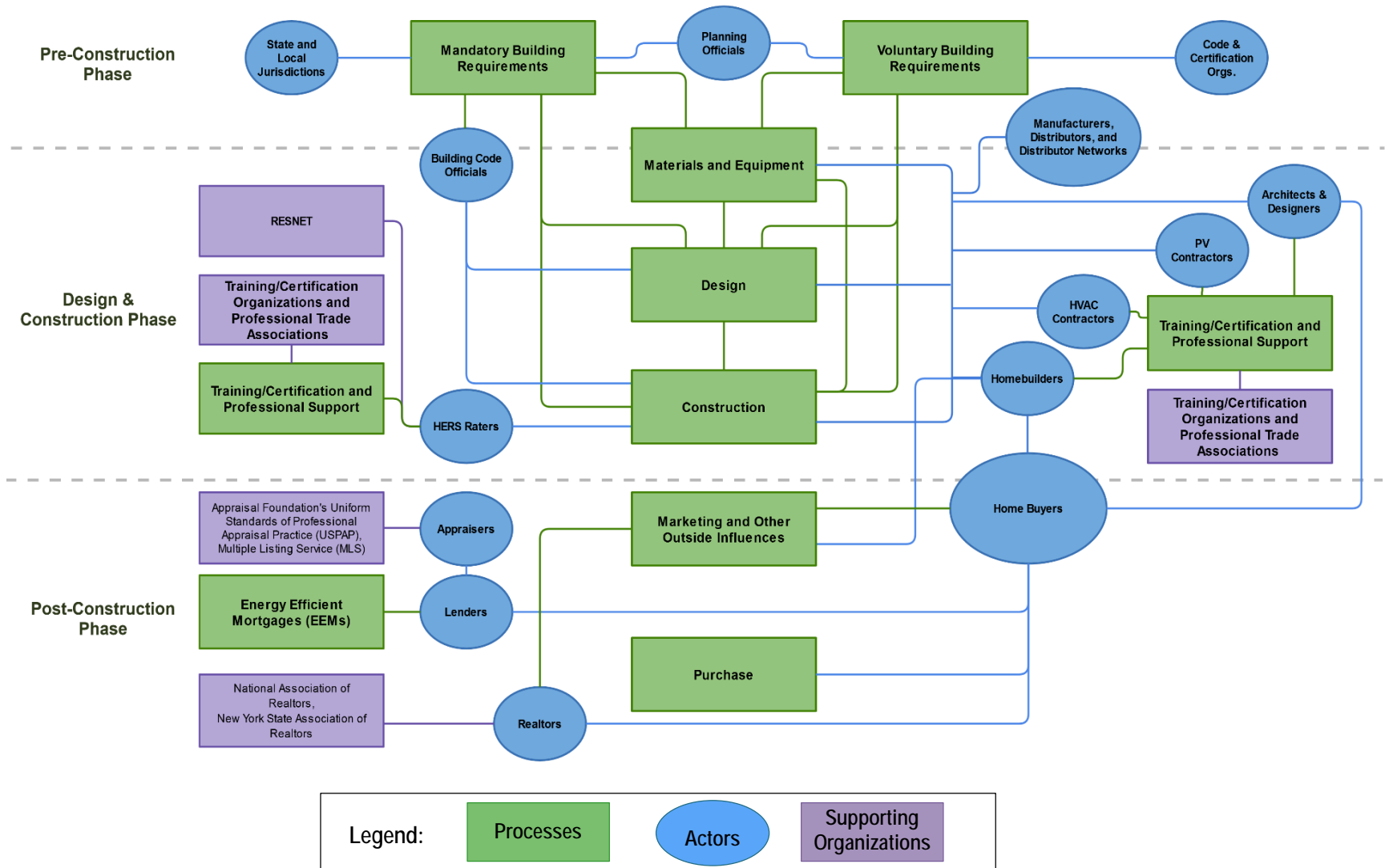


Figure 2-2. Hypothesized NZE Residential New Construction Market Model for New York State, 2015



Second, in the hypothesized market model, the team included in the construction phase the training, certification, professional, and trade organizations that provide training and support to market actors. Through interviews with these market actors, the team learned that most of them received training and became members of these organizations before working on their first NZE home, and continued receiving training and support after their first home. The team revised the market model to include these organizations in both the pre-construction phase and the design and construction phase.

Third, in the hypothetical market model, the team included HERS raters and their supporting organizations in the post-construction phase, under the assumption that HERS raters' primary role was to perform the home energy rating after the home is built. The team learned through interviews with HERS raters and other market actors involved in the Design and Construction Phase that HERS raters often get involved during the design and, especially, the construction of the home. All the HERS raters reported consulting with architects, builders, and contractors and conducting energy modeling throughout the construction and, sometimes, the design of the home. Some HERS raters did indicate that they are not brought onto the project early enough in the Design and Construction Phase but all reported getting involved to some extent in addition to performing the home energy rating. Given these findings, the team revised the market model to include HERS raters in the Design and Construction Phase.

## 3 NZE Market Metrics and Indicators

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The team collected and analyzed data from multiple sources for estimates of 19 market metrics, which the team divided into 74 measurable market indicators. In Sections 3.1, 3.2, and 3.3, the team highlights 32 of these pre-construction, design and construction, and post-construction phase market indicators.

(Appendices A to C present a detailed discussion of each indicator, including the full indicator estimates, the methods used for collecting and analyzing the data, and recommendations for future studies.) Chapter 4 lists the secondary sources the team used to collect market indicator estimates and identify NZE market actors, as well as the interview and survey methods and a brief disposition for each market actor group. (Appendix D provides a more detailed discussion of data collection methods and interview/survey guides.)

The team divided market indicators into two types - quantitative indicators and qualitative indicators - based on how the data were collected. The 43 quantitative indicators are estimates of the broader NZE market collected from secondary databases with standardized variables and from market actor interview questions with a limited range of answer options (e.g. close-ended questions and questions that ask for a specific value like a rating or percentage). The team calculated the quantitative metrics using frequencies, percentages, averages, and ranges.

The market indicator estimates provided by distributors, training, trade, and professional organizations, building inspectors are also quantitative but since the team did not attempt a census or a random sample probability survey with these groups, the findings cannot be generalized to the larger population or used in statistical tests or comparisons. The same applies to the quantitative market indicator estimates collected from Non-NZE single-family and multifamily homebuyers; the team did not obtain enough completed surveys from these groups for the statistical confidence/precision needed to generalize to the Non-NZE homebuyer population.

The 31 qualitative indicators are estimates of only the respondents the team interviewed (not the broader market). The team collected these indicator estimates from secondary literature sources and open-ended market actor interview questions that did not have a limited range of answer options. The team calculated the qualitative metrics by coding the open-ended interview responses into categories and computing the percentage of interviewed market actors who mentioned each category. The team did not know in advance which answer options to include in the questions for these indicators and needed to ask open-ended questions to determine which categories of answer options to include in future studies.

### 3.1 Pre-Construction Phase Market Metrics and Indicators

The team collected and analyzed data for estimating four metrics and 16 indicators for the NZE pre-construction phase market (see Appendix A). In this Section, the team highlights six of these indicators, as shown in Table 3-1.

**Table 3-1. Select NZE Pre-Construction Phase Market Metrics & Indicators, Types, and Data Sources**

Market Metrics (MM) & Indicators (MI)	Type	Secondary Sources	Distributors	Training, Trade, & Professional Orgs	Building Inspectors	Architects, Builders & Developers	HVAC & Solar Contractors	HERS Raters
<i>MM1: Price, availability, and annual sales of NZE-needed technologies</i>								
MI1a: Price per unit of NZE-needed technologies	Quantitative	X	X					
<i>MM3: Number and type of NZE-related trainings, certifications, and professional and trade organizations for NZE market actors in New York State</i>								
MI3a: Number and types of organizations with some focus on NZE residential buildings and/or practices	Quantitative	X		X	X	X	X	X
MI3b: Number and types of organizations with some focus on NZE residential buildings and/or practices that provide memberships	Quantitative	X		X	X	X	X	X
MI3c: Number and types of NZE-related trainings provided by organizations in the past two years with some focus on NZE residential buildings and/or practices	Quantitative	X		X	X	X	X	X
MI3d: Number and types of NZE-related certifications or credentials offered by organizations in the past two years with some focus NZE residential buildings and/or practices	Quantitative	X		X	X	X	X	X
<i>MM4: New York State NZE market actors' awareness of and experience with high-performance home labels and certifications</i>								
MI4a: Number and list of high-performance home labels/certifications and certifying organizations	Quantitative	X			X	X	X	X

### 3.1.1 Price Per Unit of NZE-Needed Technologies

This quantitative indicator is the average price and range of prices of NZE-needed HVAC, insulation, water heating, window, and solar PV technologies. The team collected data for this indicator from at least four distributors of each technology type that service New York State. Table 3-2 presents the average price, range of prices, and number of distributors that provided prices for each technology. The prices do not include the costs of installation. (See section A.1.1 in the Appendix for product specifications, data collection methods, and additional details.)



**Table 3-2. Average Price of NZE-Needed Technologies from Distributors that Service New York State\***

NZE Technology	# of Price Points	Average Price	Price Range
<b>HVAC</b>			
HVAC Low-capacity Gas Furnace	4	\$996.55	\$729.99 - \$1,192.20
Single Zone - Air Source Heat Pump	4	\$1,415.21	\$938.95 - \$1,913.00
Tri-Zone - Air Source Heat Pump	4	\$3,526.95	\$3,239.95 - \$4,219.95
Ground source heat pump	5	\$4,319.65	\$2,870.00 - \$7,958.25
High Efficiency Central Air Conditioners (CACs)	4	\$2,701.25	\$1,788.00 - \$3,199.00
Heat recovery ventilator (HRV)	4	\$935.78	\$651.32 - \$1,324.49
Energy recovery ventilator (ERV)	5	\$935.60	\$460.95 - \$1,595.75
<b>Insulation</b>			
6" Thick Insulated Concrete Form (ICFs)	4	\$20.91	\$18.70 - \$22.35
8" Thick Insulated Concrete Form (ICFs)	4	\$21.50	\$19.49 - \$23.10
Zip Wall System	4	\$52.24	\$47.46 - \$63.00
<b>Water Heating</b>			
Heat pump water heater	4	\$1,343.75	\$979.00 - \$1,599.00
<b>Windows</b>			
Double Hung - Triple pane windows	5	\$406.50	\$166.00 - \$560.70
Casement - Triple pane windows	5	\$451.50	\$240.00 - \$599.15
<b>Solar PV Systems &amp; Components</b>			
4kW - Solar PV System	4	\$6,481.25	\$5,637.99 - \$7,755.00
6kW - Solar PV System	4	\$9,592.58	\$8,311.31 - \$10,950.00
8kW - Solar PV System	4	\$13,404.65	\$11,540.00 - \$15,415.00
10kW - Solar PV System	3	\$17,365.00	\$14,225.00 - \$19,020.00
Solar Panel	2	\$537.09	\$280.13 - \$794.04
4kW Power Inverter	2	\$2,560.12	\$1,477.24 - \$3,643.00
6kW Power Inverter	2	\$3,806.67	\$2,999.34 - \$4,614.00

\* Prices are for equipment only and do not include the cost of installation.

The team also provided market indicator estimates for availability issues with five types of NZE-needed technologies and solutions to overcome those issues (Section A.1.2), sales trends of five types of NZE-needed technologies (Section A.1.3), and 10 major upstream market barriers to adopting NZE-needed technologies (Section A.2).

### 3.1.2 Number and Types of Organizations, Trainings, Certifications, and Credentials with Some Focus on NZE Residential Buildings or Practices

These four quantitative indicators are the number and type of training, trade, and professional organizations that have at least *some focus on NZE buildings, technologies, and/or practices*, the number of these organizations that provide memberships, the number and type of *NZE-related trainings* offered by these organizations either online or in the Northeast US, and the number of *NZE-related certifications and credentials* provided by these organizations (Table 3-3). The team collected data for these indicators from organizations’ websites, web search, and interviews with NZE market actors. The team identified 58 total NZE-related organizations, 43 of which provide 165 NZE-related trainings, and 26 of which provide 41 NZE-related certifications and credentials. See Section A.3.1 in the Appendix for the full list of organizations, data collection methods, and additional details.

**Table 3-3. Number and Type of Organizations, Trainings, and Certifications and Credentials Available to New York State NZE Market Actors in the Past Two Years That Have Some Focus on Residential NZE Buildings, Practices, or Technologies**

Organization, Trainings, and Certifications	N
Total	58
Type:	
Training	14
Trade	9
Professional	26
Distributor	5
Government	4
Number offering memberships	33
Number offering news/research	48
Number offering events	34
Number offering trainings	43
Number of trainings offered, by type:	165
Building Science & Design	62
Distributed Energy Resources	22
Energy Analytics & Audits	32
Geothermal	12
HVAC	14
Building Shell	17
Marketing and Sales	6
Number offering certifications/credentials	26
Number of certifications/credentials offered	41

The team also provided market indicator estimates for the percentage of interviewed market actors who are aware and members of NZE-related organizations, who are aware of and received NZE-related training, and who are aware of and received a NZE-related certification or credential in the past two years (Section A.3.2). The most common organizations, trainings, and certifications reported by interviewed market actors are related to Passive House, LEED, and ENERGY STAR.

### 3.1.3 Number and List of High-Performance Home Labels/Certifications and Certifying Organizations

This quantitative market indicator is the list and count of high-performance home labels and certifications, and the certifying organizations in, but not limited to, the Northeast U.S. (Table 3-4). The team collected data for this indicator from secondary sources, web searches, and interviews with NZE market actors. The team identified 10 organizations that provide 15 high-performance home labels or certificates. See Section A.4.1 in the Appendix for the full table that includes organizations outside the Northeast U.S., data collection methods, and additional details.

**Table 3-4. Number and List of High-Performance Home Labels and Certifications, and Certifying Organizations in the Northeast U.S.**

Organization	Home Label/Certificate
N=10	N=15
Building Performance Institute	Home Energy Score (with DOE)
Enterprise	Green Communities Home
Living Future Institute	Living Building Challenge Net Zero Energy Building
National Association of Home Builders (NAHB)	National Green Building Standard Home
New York City Office of Environmental Remediation	New York City Green Property Certification
Passive House Academy or Passive House Institute (PHIUS)	Passive House
RESNET	Home Energy Rating
US Department of Energy (DOE)	Zero Energy Ready Home
	Home Energy Score (with BPI)
EPA	ENERGY STAR Certified Home
	Indoor airPLUS Qualified Home
USGBC	LEED Certified Home
	LEED Silver Home
	LEED Gold Home
	LEED Platinum Home

The team also provided market indicator estimates for the percentage of interviewed market actors aware of and the percentage who worked on or owns a home that received a high-performance home label

certification (Section A.4.2), and the high-performance home labels/certifications selected by interviewed market actors as the best at communicating the value and features of NZE homes (Section A.4.3). The most common home labels reported for both of these indicators are ENERGY STAR Homes, LEED Homes, Passive Houses, and HERS Certificates.

### 3.2 Design and Construction Phase Market Metrics and Indicators

The team collected and analyzed data for estimating four metrics and 22 indicators for the NZE design and construction phase market (Table 3-2). In this Section, the team highlights eight of these indicators, as shown in Table 3-5.

**Table 3-5. Select NZE Design & Construction Phase Market Metrics & Indicators, Types, and Data Sources**

Market Metrics (MM) & Indicators (MI)	Type	Secondary Sources	Building Inspectors	Architects, Builders & Developers	HVAC & Solar Contractors	HERS Raters
<i>MM1: Number of market actors working with NZE homes, and proportion of all residential market actors in New York State</i>						
MI1a: Number of market actors who worked with new NZE homes completed in 2015 in New York State	Quantitative	X	X	X	X	X
MI1b: Number of market actors who worked with new NZE homes completed in 2015 or earlier in New York State	Quantitative	X	X	X	X	X
MI1c: Number of residential market actors in 2015 in New York State	Quantitative	X				
MI1d: Proportion of residential actors in 2015 in New York State who worked on a new NZE home completed in 2015	Quantitative	X	X	X	X	X
MI1e: Proportion of residential actors in 2015 in New York State who worked on a new NZE home completed in 2015 or earlier	Quantitative	X	X	X	X	X
<i>MM2: Characteristics and experience of market actors working with NZE homes</i>						
MI2e: Interviewed New York State NZE market actors' average rating of their overall experience working on new NZE homes	Quantitative		X	X	X	X
MI2g: Interviewed New York State NZE market actors' average rating of their experience working on new NZE code-built homes compared to their experience working on new Non-NZE homes	Quantitative		X	X	X	X
MI3f: How New York State NZE design and construction market actors collaborate	Qualitative		X	X	X	X

### 3.2.1 Numbers of Market Actors Who Worked with New NZE Homes

Three of these five quantitative indicators are the count of market actor firms that completed a NZE home in 2015, that completed a NZE home in 2015 or earlier, and that were in business in New York State in 2015 (Table 3-6). The other two of these five quantitative indicators are the proportion of all market actor’s firms in New York State in 2015 that completed a NZE home in 2015 and the proportion that completed a NZE home in 2015 or earlier (Table 3-6). The team collected data for these indicators from secondary sources and interviews with NZE market actors. The team found that the size of the NZE market actor groups represent a small percentage of the total population of market actors in New York State. See Section B.1.1 in the Appendix for the full table of indicator estimates, data collection methods, and additional details.

**Table 3-6. Number of New York State Market Actors Who Worked on a New NZE Home in 2015, and Proportion of All Market Actors in New York State**

	Offices of Building Inspectors	Architects & Design-Build (Designers) Firms	Builders & Design-Build (Builders) Firms	Property Developer Firms	HVAC Contractor Firms	Solar PV Contractor Firms	Energy Consulting and HERS Rater Firms
Average Total NYS Population Size <sup>1,2</sup>	894	2,776	3,252	518	3,289	129	170
Percent of Population Working in the Residential Market <sup>3</sup>	100%	54%	64%	N/A	72%	N/A	N/A
Average Residential Population Size	894	1,499	2,081	518	2,368	129	170
Worked on confirmed NZE home in 2015	13	12	13	1	11	10	9
Proportion of residential population	1.5%	0.8%	0.6%	0.2%	0.5%	7.8%	5.3%
Worked on confirmed NZE home in 2015 or earlier	20	14	15	2	16	15	11
Proportion of residential population	2.2%	0.9%	0.7%	0.4%	0.7%	11.6%	6.5%

<sup>1</sup> Includes residential and non-residential market actors.

<sup>2</sup> Building inspectors: 2010 U.S. Census; Architects: Hoovers, InfoUSA, NCARB & AIA; Builders: Hoovers, InfoUSA, NYSBA; Property Developers: Hoovers & InfoUSA; HVAC Contractors: Hoovers & InfoUSA; Solar PV Contractors: Hoovers, InfoUSA, & NYSERDA, 2015; HERS Raters: Hoovers, InfoUSA, & RESNET, 2015.

<sup>3</sup> Building inspectors: assumed; Architects: AIA, 2015 (national estimate); Builders: NAHB & AGCA, 2015 (national estimate); Property Developers: not available; HVAC Contractors: U.S. BLS, 2010 (national estimate); Solar PV Contractors: not available; HERS Raters: not available.

### 3.2.2 Experience with NZE Homes

The two quantitative indicators are the average ratings interviewed New York State NZE market actors provided for their overall experience working on new NZE homes and for their experience with NZE homes compared to Non-NZE code-built homes (Table 3-7).<sup>3</sup> Two qualitative indicators are the types of reasons market actors gave for each of their two rating. The team collected data for these indicators from interviews with NZE market actors. Most interviewed market actors rated their experience with NZE as excellent compared to their experience with Non-NZE homes; most also rated their NZE homes as not much more difficult to work on than their Non-NZE homes. See Section B.2.3 in the Appendix for the qualitative indicator estimates, data collection methods, and additional details.

**Table 3-7. Type of Experience Overall with NZE Homes and With NZE Homes Compared to Non-NZE Homes Reported by Interviewed New York State NZE Market Actors**

	Building Inspectors	Architects	Design-Build	Builders	Developer	HVAC Contractors	Solar PV Contractors	HERS Raters
<b>Overall NZE Experience Average Rating (0=very poor, 10=excellent)</b>								
N	4	2	4	5	1	5	7	5
Overall NZE Experience	10	10	10	9	10	9	8	8
Range	(9-10)	(10)	(9-10)	(8-10)	(10)	(6-10)	(7-9)	(6-10)
<b>NZE Experience Compared to Non-NZE Experience Average Rating (0=NZE no more difficult, 10=NZE much more difficult)</b>								
N	3	2	1	3	1	5	7	5
Inspecting (range)	1 (0-2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Design (range)	N/A	2 (2-3)	8 (8)	3 (0-6)	8 (8)	N/A	N/A	N/A
Build (range)	N/A	0	10 (10)	5 (0-8)	6 (6)	N/A	N/A	N/A
Develop property (range)	N/A	0	5 (5)	3 (0-6)	3 (3)	N/A	N/A	N/A
HVAC (range)	N/A	N/A	N/A	N/A	N/A	5 (0-8)	N/A	N/A
Solar PV (range)	N/A	N/A	N/A	N/A	N/A	N/A	1 (0-5)	N/A
HERS Rating (range)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2 (0-7)

The team also provided market indicator estimates for interviewed market actors’ firmographic characteristics (Section B.2.1), number and percentage of NZE and Non-NZE homes in 2015 (Section B.2.2), collaboration with other market actors on NZE homes (Section B.3.1), up to 10 major technical

<sup>3</sup> The majority of market actors reported some experience with code-built homes and thus were able to answer questions comparing NZE homes to code-built homes.

barriers and 20 major institutional barriers to adopting NZE design and construction practices, and solutions to overcome these barriers (Sections B.4.1 and B.4.2).

### 3.3 Post-Construction Phase Market Metrics and Indicators

The team collected and analyzed data for estimating 11 metrics and 36 NZE indicators for the NZE post-construction phase market (Appendix C). In this Section, the team highlights eighteen of these indicators, as shown in Table 3-8.

**Table 3-8. Select NZE Post-Construction Phase Market Metrics, Indicators, Types, and Data Sources**

Market Metrics (MM) & Indicators (MI)	Type	Secondary Sources	Building Inspectors	Architects, Builders & Developers	HVAC & Solar Contractors	HERS Raters	NZE Homebuyers	Non-NZE Homebuyers
<i>MM1: Number, location and geography of NZE homes in New York State</i>								
MI1a: Total number of NZE homes built in New York State in 2015 and earlier	Quantitative	X		X				
MI1b: Total number of NZE homes built in New York State in 2015 and earlier by location in New York State's economic regions	Quantitative	X		X				
MI1c: Total number of NZE homes built in New York State in 2015 and earlier by climate zone in New York State	Quantitative	X		X				
MI1d: Total number of NZE homes built in New York State in 2015 and earlier by participation in NYSERDA's LRNC program	Quantitative	X		X				
<i>MM2: Number of new NZE homes built and proportion of all new homes built/permitted in New York State</i>								
MI2a: Number of new NZE homes built in New York State in 2015	Quantitative	X		X				
MI2b: Number of all homes built/permitted in New York State in 2015	Quantitative	X						
MI2c: Proportion of all new homes built/permitted in New York State in 2015 that are new NZE homes	Quantitative	X						
<i>MM3: Sale price, estimated market value, annual sales, and availability of NZE and Non-NZE homes in New York State</i>								
MI3a: Estimated market value of NZE and Non-NZE homes in New York State in 2015	Quantitative	X						
MI3b: Sales price of NZE and Non-NZE homes in New York State in 2015	Quantitative	X						

Market Metrics (MM) & Indicators (MI)	Type	Secondary Sources	Building Inspectors	Architects, Builders & Developers	HVAC & Solar Contractors	HERS Raters	NZE Homebuyers	Non-NZE Homebuyers
MI3c: Average percent difference in building costs of NZE vs. Non-NZE homes in New York State in 2015 reported by interviewed NZE market actors	Quantitative			X				
MI3d: Average percent difference in sales price of NZE vs. Non-NZE homes in New York State in 2015 reported by interviewed NZE market actors	Quantitative						X	
<i>MM5: New York State homebuyers' awareness, willingness to pay for, and motivations to buy NZE and Non-NZE homes</i>								
MI5a: Percentage of New York State NZE and Non-NZE homebuyers who are aware of NZE homes	Quantitative						X	X
MI5b: Sources of New York State NZE and Non-NZE homebuyers' awareness of NZE homes	Qualitative						X	X
MI5c: Level of priority New York State NZE and Non-NZE homebuyers place on making their next home a NZE home	Quantitative						X	X
MI5d: Average percentage more in price New York State NZE and Non-NZE homebuyers are willing to pay for their next home to be a NZE home compared to a code-built home	Quantitative						X	X
<i>MM6: New York State homebuyers' level of satisfaction with NZE and Non-NZE homes and reasons for their level of satisfaction</i>								
MI6a: New York State NZE and Non-NZE homebuyers' level of overall satisfaction with their home	Quantitative						X	X
<i>MM11: New York State market actors' understanding of NYSERDA's definition of NZE homes</i>								
MI11a: Percentage of market actors who understand NYSERDA's NZE home definition	Quantitative		X	X	X	X	X	X
MI11b: Percentage of market actors who suggest changes to NYSERDA's NZE home definition	Quantitative		X	X	X	X	X	X

### 3.3.1 Number, Location, Geography, and NYSERDA LRNC Participation of NZE Homes in New York State

These four quantitative indicators are the total count of confirmed NZE homes built in New York State by year built and home type, the count of NZE homes by economic region, the count of NZE homes by



climate zone, and the count of homes by participation in NYSERDA’s LRNC program (Table 3-9). The team collected data for these indicators through multiple secondary sources and interviews with market actors. Overall, the team identified and confirmed 47 single-family NZE homes and 159 multifamily NZE units built in New York State in 2015, and 29 single-family NZE homes and 6 multifamily NZE units built before 2015. The team also identified but could not confirm 25 single-family NZE homes and 18 multifamily NZE units built in New York State in or before 2015. See Section C.1.1 in the Appendix for more counts of unconfirmed and total NZE homes, data collection methods, and additional details.

**Table 3-9. Number, Location, Geography, and NYSERA LRNC Participation of Confirmed NZE Homes in New York State**

Confirmed NZE Homes	Single Family			Multifamily					
	2015	Pre-2015	Total	2015		Pre-2015		Total	
				Units	Buildings	Units	Buildings	Units	Buildings
<b>Total</b>	47	29	76	159	14	6	1	165	15
<b>Region</b>									
Long Island	1	1	2	0	0	0	0	0	0
New York City	0	0	0	3	1	6	1	9	2
Mid-Hudson	6	22	28	0	0	0	0	0	0
Capital Region	5	2	7	156	13	0	0	156	13
North Country	0	0	0	0	0	0	0	0	0
Mohawk Valley	0	0	0	0	0	0	0	0	0
Southern Tier	26	0	26	0	0	0	0	0	0
Central New York	0	0	0	0	0	0	0	0	0
Finger Lakes	3	1	4	0	0	0	0	0	0
Western New York	6	3	9	0	0	0	0	0	0
<b>Climate Zone</b>									
4	1	1	2	3	1	6	1	9	2
5	15	6	21	0	0	0	0	0	0
6	31	22	53	156	13	0	0	156	13
<b>NYSERDA LRNC Participation</b>									
Yes	19	20	49	159	14	0	0	159	14
No	28	9	37	0	0	6	1	6	1

### 3.3.2 Numbers and Percentages of New NZE Homes Built and Permitted

The three quantitative indicators are the count of new single- and multi-family NZE units built in New York State in 2015, the number of all new single- and multi-family units permitted in 2015, and the

percentage of all new homes permitted in New York State in 2015 that are NZE homes (Table 3-10). The team was unable to find reliable, up-to-date data on new homes built or sold in New York State in 2015 so the team used as a proxy the number of new homes permitted in New York State in 2015 provided by the U.S. Department of Housing and Urban Development (HUD). The team found that NZE homes built in 2015 represent a very small percentage of building permits issued in New York State in 2015. See Section C.2.1 in the Appendix for the full table of indicator estimates, data collection methods, and additional details.

**Table 3-10. Number of Building Permits, Confirmed and Unconfirmed NZE Homes, and Proportion of New Building Permits that are NZE Homes in New York State in 2015 (U.S. HUD)**

	1-Unit Permits	2-Unit Permits	3-4 Unit Permits	5+ Unit Permits	Total Permits	Total Built*
Number of New Building Permits	7,623	1,032	1,170	61,735	71,560	15,633
Confirmed NZE Homes Built in 2015	47	0	3	156	206	206
Proportion of New Building Permits that are Confirmed NZE Homes	0.6%	0%	0.3%	0.3%	0.3%	1.3%

\* Calculated by subtracting the total housing units in NYS reported in the 2014 American Community Survey (ACS; n=8,191,528) from the total housing units in NYS reported in the 2015 ACS (n=8,207,161)

### 3.3.3 Sale Price and Estimated Market Value of NZE Homes and Non-NZE Homes in New York State in 2015

These two quantitative indicators are the average sales price and estimated market value of confirmed NZE single-family homes and surveyed Non-NZE single-family homes built in New York State in 2015 (Table 3-11). For comparison purposes, the team limited the homes it collected data for to those located in four New York State economic regions – Capital, Finger Lakes, Mid-Hudson, and Western – since these were the only regions to include a new NZE home built in 2015. The team collected data for these indicators from real-estate listing websites and county property tax records. The team found that NZE homes had higher sales prices and estimated market values, on average, compared to Non-NZE homes. See section C.3.1 in the Appendix for the full table of indicator estimates by home size, the data collection methods, and additional details.

**Table 3-11. Average Sales Price and Estimated Market Value of New NZE and Non-NZE Homes Sold in New York State in 2015 in the Capital, Finger Lakes, Western New York, and Mid-Hudson Economic Regions of New York State**

	Sales Price			Estimated Market Value		
	N	Mean	Range	N	Mean	Range
2015 NZE Single Family Homes	11	\$504,294	\$375,000 - \$629,380	18	\$428,944	\$144,844 - \$647,406
2015 Non-NZE Single Family Homes	43	\$359,925	\$160,000 - \$643,507	43	\$371,971	\$153,835 - \$657,549

### 3.3.4 Building Costs and Sales Prices of NZE vs. Non-NZE Code-Built Homes Reported by Interviewed NZE Market Actors

These two quantitative indicators are the average percent difference in building costs and in sales prices of new NZE vs. new Non-NZE code-built homes in New York State in 2015 reported by interviewed market actors. Interviewed NZE architects, design-build firms, builders, and property developers reported the percentage more in cost required to build an NZE home compared to a similar Non-NZE code-built home (Table 3-12), which ranged from 1.5%-40%.<sup>4</sup> Interviewed NZE homebuyers reported the percentage more in the sales price they paid for their NZE home compared to what they would have paid for a similar Non-NZE code-built home, which ranged from 5-50% (Table 3-13). See Section C.3.2 in the Appendix for additional details and data collection methods.

**Table 3-12. Average Percent Difference in Building Costs of NZE vs. Non-NZE Code-Built Homes in New York State in 2015 Reported by Interviewed NZE Market Actors**

	Architects	Design-Build	Builders	Developer
N	3	4	4	1
Average % Increase in Cost for NZE home vs. code-built Non-NZE home	12%	10%	17%	25%
Range	10%-15%	2.5%-30%	1.5%-40%	25%

**Table 3-13. Average Percent Difference in Sales Prices of NZE vs. Non-NZE Code-Built Homes in New York State Reported by Interviewed NZE Homebuyers**

	Built in 2015	Built in 2015 or earlier
N	7	18
Average % More Paid for NZE home	18%	19%
Range	5%-40%	5%-50%

<sup>4</sup> The majority of market actors reported some experience with code-built homes and thus were able to answer questions comparing NZE homes to code-built homes.

The team also provided market indicator estimates for the annual sales and availability of NZE and Non-NZE homes in New York State in 2015 (Section C.3.3). All of the homes for which data were available had been sold or rented by 2016. In addition, the team provided estimates for the percentage of NZE and Non-NZE homebuyers who purchased their home before, during, or after it was built, and their reasons for doing so (Section C.4.1). Over half of NZE homebuyers purchased their home before it was built.

### 3.3.5 Percentage of New York State NZE and Non-NZE Homebuyers Who are Aware of NZE Homes and Sources of Homebuyers' Awareness

The quantitative indicator is the percentage of surveyed NZE and Non-NZE homebuyers who reported awareness of NZE homes (Table 3-14). The qualitative indicator is the sources of awareness reported by these aware homebuyers, and the percentage who reported each source (Table 3-14). The team collected data for these indicators from surveys of homebuyers. The team found that a minority of Non-NZE homebuyers reported awareness of NZE homes, and that NZE and Non-NZE homebuyers reported different sources of awareness. See Section C.5.1 in the Appendix for the full table of indicator estimates, data collection methods, and additional details.

**Table 3-14. Percentage of New York State NZE and Non-NZE Homebuyers Who are Aware of NZE homes and Sources of Homebuyers' Awareness**

	NZE Homebuyers	Non-NZE Homebuyers
N	18	60
Percent Aware	100%	24%
<b>Sources of Awareness (multiple responses allowed): (N)</b>	18	10
Builder or Designer	50%	10%
Real Estate Agent	22%	0%
Work in Industry or Interested in Renewable Energy & Sustainability	22%	10%
Self-Directed Research	0%	30%
Word of Mouth (Family/Friends/Neighbors)	33%	0%
News Media, Magazines	0%	40%
Internet	0%	20%
Television	0%	10%

### 3.3.6 Priority of and Willingness to Pay for NZE Homes Compared to a Code-Built Home

The first quantitative indicator is the percentage of surveyed homebuyers that reported making their next home a NZE home would be of high, medium, low, or no priority (Table 3-15). The second quantitative

indicator is the average and range of percentages more in price surveyed homebuyers reported willing to pay for their next home to be a NZE compared to a code-built home (Table 3-15). The team collected data for these indicators from surveys with NZE and Non-NZE homebuyers. The team found that most surveyed homebuyers reported a high or medium priority on making their next home a NZE home and that they would pay 0%-100% more for it. See Section C.5.2 in the Appendix for the full table of indicator estimates, the data collection methods, and additional details.

**Table 3-15. Level of Priority New York State Homebuyers Place on Making Their Next Home a NZE Home and Average Percentage More in Price Homebuyers Are Willing to Pay for Their Next Home to Be an NZE Home Compared to a Code-Built Home**

	NZE Homebuyers	Non-NZE Homebuyers
N	15	46
High Priority	87%	20%
Medium Priority	13%	48%
Low Priority	0%	23%
No Priority	0%	8%
N	4	72
Average percent more that respondents reported they are willing to pay for NZE home vs. code-built home	15%	13%
Range	10-20%	0%-100%

The team also collected market indicator estimates for the types of motivations surveyed homebuyers reported for buying their NZE or Non-NZE home. The team identified 10 categories of motivations.

### 3.3.7 NZE and Non-NZE Homebuyers' Average Level of Satisfaction with their Homes

The quantitative market indicator is the average level of overall satisfaction surveyed New York State NZE and Non-NZE homebuyers reported with their home, as measured on 0 to 10 scale where 0 means not at all satisfied and 10 means extremely satisfied (Table 3-16). The qualitative indicator is the types of positive and negative reasons surveyed homebuyers reported for their overall level of satisfaction, which were collected from an open-ended survey question, and the percentage of homebuyers who reported each type of reason (See Section C.6.1). The team found that surveyed homebuyers were overall highly satisfied with their home, and that they reported 10 positive reasons and 10 negative reasons for their satisfaction rating. See Section C.6.1 in the Appendix for the full table of indicator estimates, including the types of reasons homebuyers reported, as well as the data collection methods and additional details.

**Table 3-16. New York State NZE and Non-NZE Homebuyers’ Average Level of Overall Satisfaction with Their Home, and Positive and Negative Reasons for Their Level of Satisfaction**

Satisfaction (0 = Not at all satisfied, 10 = Extremely satisfied)	NZE Homebuyers	Non-NZE Homebuyers
N	16	72
Average Satisfaction Rating	9.5	9
Range	8 – 10	3 – 10

The team also collected market indicator estimates for six major barriers for selling and 12 major barriers for purchasing NZE homes (Section C.7), six NZE and Non-NZE homebuyer demographic characteristics (Section C.8) and eight home characteristics (Section C.9), the importance NZE and Non-NZE homebuyers associate with 29 home features included and not included in their home (Sections C.10.1 and C.10.2), and the 15 features of Non-NZE homes that market actors reported are difficult to include in NZE homes (Section C.10.3).

### 3.3.8 Market Actors’ Understanding of, and Suggested Changes to NYSERDA’s Definition of NZE Homes

The two quantitative indicators are the percentages of interviewed New York State market actors who reported they understood and reported suggested changes to NYSERDA’s NZE home definition (Table 3-17). The qualitative indicator, which was collected from an open-ended interview question, is the types of changes to the definition suggested by interviewed market actors and the percentage who mentioned each type of change. See Section C.11.1 in the Appendix for the full table of indicator estimates, including the types of changes suggested, as well as the data collection methods and additional details.

**Table 3-17. Percentage of New York State Market Actors Who Understand and Who Suggest Changes to NYSERDA’s Definition of NZE Homes\***

	Building Inspectors	Architects	Design-Build	Builders	Developers	HVAC Contractors	Solar PV Contractors	HERS Raters	NZE Home-buyers	Non-NZE Home-buyers
N	4	3	4	6	1	5	7	5	18	58
Understood	100%	100%	100%	100%	100%	100%	100%	100%	72%	90%
Suggested changes	0%	33%	50%	17%	0%	40%	14%	80%	28%	21%

\* NYSERDA’s definition states a new NZE home is “a grid-connected home that is built to be highly energy efficient and is connected to renewable electric generation, so that the renewable generation offsets all of the home’s average annual energy consumption.”

## 4 Data Collection and Analysis Methods

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The team used multiple data sources to collect estimates of NZE market indicators and to identify market actors to interview or survey. Table 4-1 lists key sources the team used and in Appendices A-C, the team cites the sources used for each metric.

The team conducted in-depth phone interviews (IDIs) and web surveys with 12 key groups of NZE market actors to collect data used to estimate baseline values for all market indicators for which secondary data alone did not provide current and/or reliable values. Table 4-2 presents the market actors the team interviewed and surveyed, including the number of completes, the original list size, the data collection method, and the sampling approach. Appendix A describes the data collection methods the team used, summarizes the interview/survey dispositions, and presents the interview guide or survey instrument for each market actor group.

The team reached the interview quotas with distributors, training, trade, and professional organizations, and NZE building inspectors. The team attempted a census with the other NZE market actors but did not complete interviews with all the actors in lists due to some refusals and non-contacts. Although the NZE market actor group sizes and number of completes is small, the firms that completed interviews represented a wide range of firmographic characteristics, services territories in New York State, and experience working on NZE homes (see Section B.2.1). The interviewed NZE and Non-NZE homebuyers also came from different parts of the state and reported a wide range of demographic and home characteristics (see Sections C.8 and C.9).

In addition, the team had trouble completing surveys with the Non-NZE homebuyers in the purchased list of New York State homebuyers from Experian, which turned out to be not as representative of the state as Experian marketed. As a result, the team also attempted surveys with Non-NZE EE homebuyers who purchased a Non-NZE EE home that received incentives through NYSERDA's LRNC program in 2015. The team achieved most of the completed surveys of Non-NZE homebuyers from the EE homebuyers (81%), and obtained enough completes for the 85/10 confidence/precision needed to generalize findings to the population of New York State Non-NZE EE homebuyers in 2015. The team obtained too few completed surveys from the other Non-NZE homebuyers to have the confidence/precision to generalize findings to the New York State population of Non-NZE homebuyers.

The team used Excel to compute frequencies, percentages, averages, medians, and ranges for market indicator estimates from all interviewed market actors except the homebuyers. The team used SPSS and Excel to compute market indicator estimates from NZE and Non-NZE homebuyers.

**Table 4-1. Data Sources Used to Estimate Market Indicators and Identify Market Actors to Interview**

Source	Market Indicators	Distributors	Training, Trade, & Professional Organizations	Building Inspectors	Architects, Builders & Developers	HVAC & Solar PV Contractors	HERS Raters	NZE Homebuyers	Non-NZE Homebuyers
NYSERDA LRNC staff members		X	X	X	X	X	X	X	
NYSERDA CRIS database	X				X	X	X	X	X
Market actor interviews	X		X		X	X	X		
Web keyword searches	X	X	X		X	X	X	X	
Organizations' and business' websites	X	X	X	X	X	X	X		
NZE homebuyers' website/blogs					X	X	X	X	
Passive House Institute US and International Passive House Association databases	X				X	X	X	X	
Northeast Sustainable Energy Association case study database	X				X	X	X	X	
Zero Energy Project listings	X				X	X	X	X	
RESNET listings	X						X		
Experian									X
Published NZE studies	X								
Hoovers, InfoUSA, Dodge	X								
US Department of Housing & Urban Development State of Cities Data Systems Building Permits Database	X								
Real estate listing websites (Zillow.com, Realtor.com, Trulia.com, Redfin.com, Homes.com)	X								



**Table 4-2. Methods, Approaches, and Number of Completes for NZE Market Actor Interviews and Surveys<sup>a</sup>**

Market Actor Group	Completes	List Size	Method	Sampling Approach
Distributors of NZE-needed technologies	4	25	Phone interviews	Purposive sample: one per NZE-needed technology type (HVAC, solar PV, insulation, and windows)
Training, Trade, and Professional Organizations for NZE market actors	5	14	Phone interviews	Purposive sample: five organizations most frequently mentioned by market actors and that have focus on NZE buildings
NZE Building Inspectors	4	20	Phone interviews	Purposive sample: officials in four towns with most NZE homes
NZE Architect firms	3	7 <sup>b</sup>	Phone interviews	Attempted census of list
NZE Design-Build firms	4	5 <sup>b</sup>	Phone interviews	Attempted census of list
NZE Builder firms	6	9 <sup>b</sup>	Phone interviews	Attempted census of list
NZE Developer firms	1	3 <sup>b</sup>	Phone interviews	Attempted census of list
NZE HVAC Contractors	5	10 <sup>b</sup>	Phone interviews	Attempted census of list
NZE Solar PV Contractors	7	15 <sup>b</sup>	Phone interviews	Attempted census of list
NZE HERS Raters	5	12 <sup>b</sup>	Phone interviews	Attempted census of list
NZE Homebuyers	18	35	Phone and web surveys	Attempted census of list
Purchased home built in 2015	8	20		
Purchased home built before 2015	10	15		
Non-NZE Homebuyers	72	2,076	Web surveys	Attempted census of list
Energy efficient single-family homebuyers	58	739		
Single-family homebuyers (unknown if energy efficient)	11	703		
Multifamily homebuyers (unknown if energy efficient)	3	634		

<sup>a</sup> Excludes NZE and Non-NZE homebuyers for whom the team could not find contact information.

<sup>b</sup> Includes market actors the team initially identified as having experience with new NZE homes but who refused an interview or could not be reached for an interview, and excludes those who the team reached but who reported not having experience with a new NZE home.

## 5 Methodological Conclusions and Recommendations

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This baseline study of NZE market metrics and indicators involved significant complexity and, not surprisingly for a first numerical characterization of the market, the team encountered substantial challenges. In this section, we offer conclusions and recommendations to guide NYSERDA in undertaking future NZE market progress tracking studies.

**Conclusion 1:** The large number of market indicators explored in this study required lengthy data collection instruments, which resulted in multiple refusals to respond, some partial interviews, and a few respondents who had to skip questions to save time.

- **Recommendation 1a:** Field shorter data collection instruments in subsequent studies, accomplished either by reducing the number of market indicators to track or by posing different question sets to different subsets of the respondent groups.
- **Recommendation 1b:** Use web survey methods to survey market actors in future studies. NZE homebuyer responses to the web survey were much faster than responses to the phone interviews.

**Conclusion 2:** Because this is the first (baseline) study in what NYSERDA anticipates to be long term NZE market progress tracking, the team needed to ask several open-ended questions in interviews and surveys to determine the best answer choices to use in close-ended questions for future studies; this resulted in several qualitative baseline market indicators that cannot be generalized to the broader market.

- **Recommendation 2:** Use the categories of responses the team coded from the open-ended interview and survey questions to create close-ended questions and answer choices necessary to estimate quantitative indicators in future studies.

**Conclusion 3:** The team could not find a reliable, comprehensive, and current source of Non-NZE homebuyers who purchased a newly constructed, non-NZE home in New York State between July 2014 and March 2016 that did not receive incentives through NYSERDA's LRNC program. To achieve enough completed surveys from Non-NZE homebuyers, the team had to supplement the list of non-NZE homebuyers it purchased from Experian with NYSERDA's list of non-NZE ENERGY STAR homes that received LRNC incentives. Most of the completed surveys came from the NYSERDA LRNC list.

- **Recommendation 3a:** Conduct a thorough search through survey centers, realtors, government organizations (e.g. HUD, county property tax records), and marketing list providers (e.g. Hoovers, InfoUSA) for a reliable, comprehensive, and current list of Non-NZE homebuyers in New York State who purchased a newly constructed home that did not receive NYSERDA LRNC incentives.
- **Recommendation 3b:** Continue to use NYSERDA's list of Non-NZE ENERGY STAR homes that received incentives through NYSERDA's LRNC program to collect market indicator

estimates for comparisons to NZE homebuyers to stay consistent with methods used in this study until a sufficient source of Non-NZE homebuyers is available, at which time another baseline study should be performed for the market indicator estimates obtained from this group.

**Conclusion 4:** The team also could not find reliable and current data sources for two market indicator estimates: the population size of market actors working in *residential new construction* in New York State in 2015 and the number of *new homes built and/or sold by building type* in New York State in 2015. The team used proxy measures for both indicators from what data were available: national estimates of the percentage of market actors working in the residential (vs. non-residential) sector, and the number of residential building permits issued by building type.

- **Recommendation 4:** Conduct a thorough search of data sources for these two indicators before relying on the proxy measures used by the team for this study. More granular data for these indicators may become available in the future.