

Volume 1: Market Analysis for Zero Energy Modular in New York State

REPORT TO NYSERDA

**PREPARED BY
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Acknowledgements

This report is the first volume in a two volume series exploring the demand for and capacity to build zero energy modular homes in New York State. This research is supported by NYSERDA and the New York Community Trust.

Volume 1: Market Analysis for Zero Energy Modular Homes in New York State which assesses the market potential, defines the technical and economic costs and benefits of a ZEM pilot, inventories current market supports such as affordable home loan products and financial incentives for energy efficient homes, and explores whether there are existing modular builders that could build ZEM and to what extent new capacity needs to be developed. This study is the first step to lay the foundation for a pilot program design for ZEM homes in New York State.

Volume 2: ZEM Factory Initiative will develop the necessary tools to enable investments in new business and job opportunities building ZEM homes in a modular factory, and will contribute to community resiliency planning by providing a more durable and affordable housing option for low-moderate income people. The final report will help interested parties understand how to most efficiently and effectively set up and operate a modular factory which can build homes according to the ZEM home specifications. Volume 2 is expected to be released in early 2019.

Upon completion, these two resources will bring together all of the components for successful market launch into one package that can be used in New York and also be shared with other jurisdictions to jump start activities which bring the ZEM solution to scale. VEIC would like to thank the many affordable housing advocates, financing specialists, modular factory owners, and government officials who responded to VEIC's inquiries and participated in the stakeholder events listed in Appendix 3. Their expertise was invaluable input when describing the NYS market for ZEM Homes. Finally, VEIC would like to thank the staff at NYSERDA for their partnership, guidance, and feedback during the research and information gathering process for this report.

Executive Summary

VEIC is pleased to have the opportunity to assess the viability of Zero Energy Modular (ZEM) homes as an affordable housing solution which could be advanced by NYSERDA for the benefit of the State's low-moderate income residents and to support the achievement of its ambitious clean energy and carbon reduction goals. The scope of this study entitled: Volume 1: Market Analysis for Zero Energy Modular Homes in New York State included:

- Researching the existing manufactured home inventory and annual sales of new manufactured homes in New York,
- Assessing the regulatory and policy landscape governing manufactured homes,
- Analyzing existing home mortgage products for appropriateness to ZEM homebuyers in multiple contexts,
- Understanding what energy efficiency, renewable energy, and affordable housing incentives are available which could offset the cost of ZEM homes for low-moderate income homebuyers,
- Interviewing affordable housing advocates and developers to gauge appropriateness of and interest in ZEM,
- Calculating the costs and benefits of ZEM to assess long-term affordability, and
- Collecting information about local programs and service providers that could support ZEM development, including modular factories.

The overarching finding of our research and stakeholder engagement is that zero energy modular construction would help address the need for affordable housing in NYS. Furthermore, this study confirms that there is significant interest in and a market for ZEM. This study particularly focuses on the opportunity ZEM presents as an alternative to manufactured housing and single family home construction, though zero energy modular construction can be applied in other contexts such as multifamily construction as well. ZEM also presents workforce and economic development opportunities to grow the green building market in the State.

When released in early 2019, Volume 2: ZEM Factory Initiative will help potential business owners and social entrepreneurs understand how to most efficiently and effectively set up and operate a modular factory that builds ZEM homes to meet the demand identified throughout this report.

VEIC recommends that NYSERDA proceed to developing a ZEM pilot program which builds from the research and recommendations provided in this report. The pilot should be funded to run for at least three years and be designed to leverage the myriad resources identified, while also developing additional resources and capacity where necessary, such as modular factories..

While NYSERDA will be on the cutting edge in moving forward such a pilot – a space we know NYSERDA commonly occupies - they would not be going it alone as their neighbors in states like Vermont and Massachusetts have past and present experiences with developing and implementing ZEM programs to draw upon. VEIC stands at-the-ready to support NYSERDA in further developing a ZEM initiative for New York.



Acronym Directory

ACH.....	Air changes per hour
ACS.....	American Community Survey
AHS.....	American Housing Survey
ASHP.....	Air-source heat pump
ccASHP.....	Cold-climate air-source heat pump
CDI.....	Community Development Institute
CFPB.....	Consumer Financial Protection Bureau
DE ZeMOD.....	Delaware Zero-Energy Modular Program
EE / RE.....	Energy efficiency and renewable energy
EIA.....	U.S. Energy Information Administration
EPA.....	U.S. Environmental Protection Agency
FHA.....	Federal Housing Administration
GSE.....	Government sponsored enterprises
HCR.....	Homes and Community Renewal
HERS.....	Home Energy Rating System
HOME.....	HOME Investment Partnerships Program
HP.....	Heat pump
HUD.....	U.S. Department of Housing and Urban Development
LIPA.....	Long Island Power Authority
LMI.....	Low and moderate income
LR NCP.....	Low-rise Residential New Construction Program
MMH.....	Mobile and manufactured home(s)
MMHR.....	Mobile and Manufactured Home Replacement Program
NEEP.....	Northeast Energy Efficiency Partnership
NYS.....	New York State
NYS CXHE.....	New York State Coalition for Excellence in Homeownership Education
NYSERDA.....	New York State Energy Research and Development Authority
PSEG-LK.....	Public Service Electric and Gas Company Long Island
PV.....	Photovoltaic
REV.....	Reforming the energy vision
ROC.....	Resident-owned community
RPL.....	Real Property Law
RHS.....	Rural Housing Service
SBC.....	System Benefit Charge
SONYMA.....	State of New York Mortgage Agency
USDA.....	U.S. Department of Agriculture
VEIC.....	Vermont Energy Investment Corporation
VRV / VRV.....	Variable refrigerant flow / variable refrigerant volume
ZEM.....	Zero energy modular

Introduction

For many low- and moderate-income New Yorkers, mobile or manufactured homes (MMH¹) provide the only path to homeownership. Low purchase prices make MMH an affordable option for many households, especially in rural areas. Although the initial purchase price of a MMH can make this option seem attractively affordable, other costs associated with these structures, especially the ongoing costs of energy, contribute to higher long-term costs of occupying MMH, as a renter or an owner. Most MMHs, especially older units, have significantly higher energy costs than other types of housing, approximately double those of site-built homes on a per-square foot basis. The thermal properties, including poor air-sealing and insufficient insulation, lead to high heating and cooling costs that raise the overall costs of occupancy, significantly burdening low- and moderate-income residents. Monthly utility bills of \$500 or more during peak energy use periods in summer and winter are not unusual². In addition to high direct energy costs, MMH is commonly associated with higher indirect costs related to the health effects associated with poor indoor air quality and a lower level of comfort.

An emerging alternative to traditional manufactured housing is zero energy modular homes (ZEMs). ZEMs fit onto the footprint of a MMH. These homes have lower ongoing operating costs than site-built housing and can be constructed and sited more quickly. All-electric and highly efficient, ZEMs are often outfitted with rooftop solar arrays and use about as much energy as they produce each year, resulting in low or no monthly energy bills for residents. ZEMs were created in Vermont, after Tropical Storm Irene disproportionately destroyed a large number of MMHs, highlighting the vulnerability of MMHs to certain types of natural disasters. ZEM homes are designed for long-term affordability. They have a higher upfront cost, but dramatically lower energy costs. Occupants can obtain additional long-term savings by being able to finance with conventional mortgage financing, rather than the high-cost personal property financing that is often used for MMHs.

As modular housing, ZEMs are distinct from manufactured housing. HUD defines manufactured housing as a home built in a factory to HUD's Manufactured Home Construction and Safety Standards (HUD Code).³ These homes must be built on a permanent chassis and be transportable. In contrast, modular homes, are factory-built homes that are required to conform to local building codes and standards, rather than federal standards, and are assumed to be permanent structures, similar to site-built homes. Modular homes generally qualify for standard residential mortgage financing, are built on privately owned land (rather than leased), and appreciate in value over time.⁴ In contrast, manufactured homes are often treated similar to personal property, such as a vehicle. They are financed via personal or chattel loans, which generally have shorter terms and higher interest rates than loans backed by real property. Manufactured homes generally do not appreciate in value over time.

In this study, we examine the feasibility of bringing ZEMs to New York State (NYS). Our experiences in Vermont and Delaware suggest that ZEM might be a valuable option to add to New York's affordable housing portfolio. Our analysis considers the current state of manufactured

¹ Throughout this report, *MMH* will be used to refer to mobile and manufactured homes, with mobile homes being those constructed prior to the promulgation in 1976 of manufactured housing standards by the U.S. Department of Housing and Urban Development (HUD) and manufactured homes being those constructed post-1975 to that standard.

² See Table 5 & 6 for data on average energy bills for LMI homeowners and renters.

³ 24 *Code of Federal Regulations* part 3280.

⁴ Note that there are exceptions to each of these statements, hence the qualification of "generally." Site-built and modular homes may not qualify for conventional mortgage financing; site-built and modular homes may be built on leased land; and, site-built and modular homes may depreciate in value.



housing in New York, potential ZEM development scenarios and market size, as well as potential financial and energy savings that ZEMs would provide. Like many states, New York struggles with an increasing demand for, and inadequate supply of, affordable housing. Through this work, we assess the opportunities and barriers of ZEM as an affordable housing solution.

The purpose of this study is to assess the feasibility of launching a ZEM program in New York. Key questions we address are:

1. What is the current status of manufactured housing in NYS?
2. What are the federal, state, and local laws governing mobile, manufactured, and modular homes and MMH communities.
3. In which areas of the state would a ZEM program be most useful?
4. What existing programs and incentives could facilitate ZEM development?
5. What is the market potential of ZEM to replace aging MMH? What land and building ownership structures are the most promising?
6. How much money will ZEM save occupants relative to traditional manufactured housing? How much energy will ZEM save occupants, and what is the value of those energy and environmental benefits to the occupants and to the State? What are the potential avoided energy costs and emissions if NYSERDA were to implement a ZEM program?
7. If NYSERDA decides to move forward with a ZEM program, what are the next steps?

Statewide Housing Needs

New Yorkers are challenged to find quality affordable housing, as both renters and owners.

A 2017 report on housing affordability estimated that New York State has a deficit of more than 750,000 units of housing that are affordable to households earning 50 percent or less of area median income. Or, for every 100 households at or below that income level, there are only 50 units of housing that are affordable and available to a household with that income.⁵

As wages stagnate or decline and housing prices continue to rise, many households are faced with housing costs that consume a larger and larger proportion of their household budget. A 2014 report by New York's Office of Budget and Policy Analysis notes that the number of New York households paying more than 30 percent of their income for housing rose by about 10% from 2000 to 2012: to 50 percent of renters, and to 34 percent of homeowners.⁶ Nearly 30 percent of renters in New York State are severely burdened by housing costs, spending more than 50 percent of their income on housing. Bronx and Greene counties were identified as having the highest rental housing burden in the State. Other counties with high rental housing burdens (resulting from high housing costs and / or low household incomes) included Orange, Rockland, and Ulster. For homeowners, housing burdens tend to be highest in counties in and around New York City. Homeowner housing burden tends to be lower in more rural, upstate areas. The Office of Budget and Policy Analysis cites low wage and economic growth, increasing real estate tax burden, and limited housing supply as key drivers of the lack of affordable housing in the State.

⁵ National Low Income Housing Coalition, "The gap: A shortage of affordable homes," March 2017, Appendix A, p. 18 (http://nlihc.org/sites/default/files/Gap-Report_2017.pdf).

⁶ New York State Office of Budget and Policy, "Housing affordability in New York State," New York Office of the State Comptroller, 2014. https://www.osc.state.ny.us/reports/housing/affordable_housing_ny_2014.pdf.



Delaware, Otsego, Schuyler, Steuben, Tioga, and Tompkins. The report draws attention to the challenges presented by older MMHs:

*The Region's manufactured home (mobile home) stock also plays a role with respect to housing quality. Mobile homes are a common housing option for farm workers and the adult children of property owners in rural areas. In fact, participants said mobile homes are often the only affordable housing option for residents, particularly young families. It was stated that many of these homes are aged and in substandard condition. They also said funding is needed to repair mobile homes that are sited in parks. Participants from Chenango said that County has the highest concentration of mobile homes in the State. Along the same line, Tioga participants said close to 18 percent of that County's housing stock is comprised of mobile homes.*⁸

In a focus group held in preparing that assessment, meeting participants expressed desire for the State to provide financing mechanisms to support mobile home park development as an affordable housing option.

When focus group attendees discussed the challenges of energy affordability, some noted that weatherization and efficiency programs are sometimes not sufficient to keep energy costs affordable for MMH residents. Energy costs can be more than residents' mortgage payments. Both renters and owners expressed confusion over the programs offered by local gas and electric utilities. These are challenges common throughout rural NYS and suggest that lowering utility costs is integral to ensuring that homes remain affordable for the long term.

ZEM has emerged as an appropriate affordable housing option for rural New York, in large part because it addresses affordability of both housing and energy. The low upfront cost of a traditional MMH addresses housing affordability, initially providing a relatively inexpensive option. However, research shows that monthly energy costs can be exorbitant and the comments above demonstrate the poor condition common among existing MMH stock. New York residents of manufactured homes spend nearly twice as much on energy per square foot of living space as do residents of site-built homes.⁹ Residents are clearly looking for an alternative: replacing old MMH with ZEM lowers total, long-term ownership costs for occupants.

Federal Regulations of Manufactured and Modular Housing

At the federal level, manufactured housing is regulated by HUD's Office of Manufactured Housing. HUD defines a manufactured home as one built in a factory to HUD standards. These homes must be built on a permanent chassis and be transportable, although they are rarely actually moved after delivery. Data from the 2011 American Community Survey, reported in a study on eradicating substandard manufactured housing, indicate that nationally 79 percent of manufactured homes are located where they were first sited.¹⁰

Prior to 1976, there were no federal standards for manufactured housing.¹¹ In 1976, HUD established the Manufactured Home Construction and Safety Standards, which superseded state and local building codes for this particular type of housing. This code sets minimum standards for fire safety, construction (including ventilation and allowable materials), plumbing, and heating and

⁸ NYS Division of Housing & Community Renewal, *Southern Tier Regional Report: Statewide affordable housing needs study*, February 2009, <http://www.nyshcr.org/Publications/HousingNeedsStudy/SouthernTier.pdf>.

⁹ [Note: to be completed in final report.]

¹⁰ Furman, Matthew, "Eradicating substandard manufactured homes: Replacement programs as a strategy," co-published by the Harvard Joint Center on Housing Studies and NeighborWorks America, November 2014.

¹¹ HUD Manufactured housing standards, https://www.hud.gov/program_offices/housing/rmra/mhs/faqs.



cooling systems.¹² The differences in manufactured housing before and after 1976 are notable and as a general rule, HUD will not issue a certification label for a manufactured home built before 1976. Every manufactured home that is for sale or lease must display a red certification label on each transportable section. The most recent update to federal manufactured home construction standards were implemented nearly 25 years ago in 1994. Following Hurricane Andrew, HUD set new standards, principally focused on wind-load and energy efficiency.

As of 2011, approximately 26 percent of existing manufactured homes in the United States were built before 1976 and predate the HUD standard. In the Mid-Atlantic Region, which includes NYS, an estimated 120,000 manufactured homes, or 28 percent, were built before 1976. These homes are now over 40 years old and generally in poor condition. They typically have poor insulation and air leaks are common, leading to high energy bills for heating and cooling. Further, these older units frequently have poor indoor air quality because of caustic interior building materials, mold, and mildew. In New York, over 46,000 manufactured homes are estimated to be older than 38 years (built before 1980).¹³

On average, manufactured homes use twice as much energy per square foot than site-built houses,¹⁴ and four times more than a ZEM home (gross, before any generation from onsite solar PV). While the federal housing standards applied to manufactured housing clearly improved quality and safety, failures to keep standards up to date with advances in building technologies and widely accepted energy codes have impeded industry progress to make manufactured homes more efficient¹⁵.

As modular housing, ZEMs are required to conform to all relevant local and state standards of construction and efficiency, similar to site-built homes. When these codes are updated, often by reference to national or international codes or standards, the updates are integrated into both modular and site-built construction requirements. New York State's energy codes are equivalent to 2012/2015 International Energy Conservation Code.¹⁶ Modular housing is not regulated at the federal level.

State Regulations of Manufactured and Modular Housing

One objective of this study is to assess the feasibility of using ZEMs as a replacement for aging manufactured homes on owned land and within MMH communities. In order to do so, we must consider the definitions and differences between MMH and modular, and any regulatory and zoning differences between these housing types. We are also interested in understanding how MMH community operations and sales are regulated. In short, we are interested in answering:

- What consumer protections are in place at the state and local levels for MMH owners and residents, whether residing in a community of similar housing or not. Would those protections change if a ZEM replaces a MMH?

¹² See *Code of Federal Regulations* 3280- Manufactured home construction and safety standards, <https://www.gpo.gov/fdsys/pkg/CFR-2010-title24-vol5/pdf/CFR-2010-title24-vol5-part3280.pdf>.

¹³ Furman, M., "Eradicating substandard manufactured homes: Replacement programs as a strategy," report by Harvard Joint Center for Housing Studies and NeighborWorks America, http://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/w15-3_furman.pdf.

¹⁴ "How to eliminate the worst housing stock in Appalachia," *Frontier Housing*, 2012, <http://www.frontierhousing.org/mhdr/docs/EliminateWorstHousingUShandout0909b.pdf>.

¹⁵ The Department of Energy, Office of Energy Efficiency and Renewable Energy recently held an open comment period a tier standard for HUD energy code governing Manufactured Housing, but not a standard based on recent versions of IECC. The HUD code was last revised in 1994.

¹⁶ <https://www.energycodes.gov/status-state-energy-code-adoption>.



- Are definitions of modular homes, MMH, and MMH communities determined at the state, county, or local level? Might any of those definitions preclude modular as a replacement for a MMH?
- What zoning provisions at the state or local level may affect the placement of ZEMs? Are modular homes allowed or required to be placed on permanent foundations in areas zoned for MMH?
- Are there any conditions under which MMH be considered real property and therefore qualify for mortgage products tailored to low- and moderate-income households?
- Are there laws regulating the sale of privately owned MMH communities?

State Laws

Real Property Definition

Under New York State's Real Property Law (RPL), a modular home is always considered real property. A MMH, on the other hand, is considered real property for tax purposes but may be classified as personal property in other contexts. While RPL does not contain a succinct definition of *real property*, it is defined in NYS Estates, Powers, and Trusts Law as comprised of both land and fixtures (i.e., the improvements on it, including buildings permanently fixed to the property).

Real Property Tax Law does provide an explicit definition of *manufactured homes* as real property for tax purposes, providing, "[t]he value of any trailer or mobile home shall be included in the assessment of the land on which it is located."¹⁷ A private mobile home park owner is responsible for property taxes on both the land and the manufactured homes that are sited on the land. When a land owner is tax exempt but the owner of a MMH is not, the homeowner must pay taxes on the structure. Unlike some states, there is no recurring personal property tax in New York. Although manufactured homes are not registered with the Department of Motor Vehicles in NYS, the DMV issues the Certificate of Title for manufactured homes of model year 1995 and later.

Some states have a process to convert a manufactured home certificate to a real property title once it is permanently affixed to owned land; however, NYS does not allow such a title purging.¹⁸

Consumer protections for MMH owners in MMH parks

Occupants of MMH in parks have tenant protections outlined in Section 233 of RPL, which protects park occupants for a variety of issues such as eviction, undue rent increases, and unreasonable disruption of services for basic utilities and access to their homes. The definitions included in the RPL are specific to MMH. It is unclear if these protections would be transferred to a ZEM located in a manufactured housing park.

Community Right-to-Purchase Law

In NYS, residents of a MMH community have a right to organize and purchase a community if it is to be sold.¹⁹ Under this law,

A prospective purchaser of a manufactured home community must give the community owner a certification stating whether the purchaser intends to discontinue using the property for manufactured home lot rentals within 60 months after closing. If yes, the community owner must notify the officers of any homeowners association

¹⁷ NYS Real property law (Section 102 (12)(g)).

¹⁸ https://www.nclc.org/images/pdf/manufactured_housing/cfed-titling-homes.pdf.

¹⁹ NYS Real property law, Art. 7 (Landlord and Tenant), Sec. 233-A (Sale of Manufactured Home Parks) (<https://www.nysenate.gov/legislation/laws/RPP/233-A>).



of the price, terms, and conditions of the proposed sale or any counteroffer. If there is no homeowners association, the community owner must notify all the homeowners. In either case, the homeowners have the right to purchase the community (through a homeowners association) if they deliver an offer meeting the same price, terms, and conditions within 120 days.²⁰

To date, only eight parks with 756 homes have been purchased by resident associations. One park's purchase is still pending: New Beginnings MH Association located in Beekmantown. See Table 4 for a complete list of resident owned communities.

Local Laws Define Manufactured and Modular Homes and Zoning

New York State affords local governments great latitude in governance of local matters, and, with some caveats, local laws are often described as having equal status to State law. Municipalities can enact a variety of regulations addressing mobile, manufactured, and modular homes, and are also enabled to define each of these categories of housing.²¹ Relevant regulations are typically found in the zoning laws of a municipality, but subdivision, sanitation, and mobile home-park laws may also apply.

Not all municipalities have zoning laws, and those without zoning may have other relevant regulations. In addition, Native Americans maintain jurisdiction over planning and development on tribal lands, and the Adirondack Park Agency issues permits for homes placed on private land within the boundaries of the Park. County governments have less control over local land use but may require water or wastewater construction permits. As modular, rather than MMH, ZEM would be subject to the same zoning and local regulations as site-built housing.

Local zoning laws may limit the siting of MMH to certain zones or districts, including limiting siting to MMH parks when sufficient justification is provided.²² Additional requirements may include that homes have a minimum square footage or minimum lot size per residence, as long as such requirements are reasonable. There have been cases of municipalities enacting very restrictive rules, such as limiting the issuance of mobile home permits to one per year, and these have been upheld in court.

If local ordinances fail to define modular as different from site-built, then a modular home could be located anywhere a site-built single-family home is allowed. In addition to zoning ordinances, municipalities may enact subdivision review, site plan review, sanitation laws, or other ordinances specifically related to MMHs and MMH parks addressing waste, parking areas, water drainage, or building locations.

Since municipalities have discretion in defining mobile, manufactured, and modular homes in each locality, as opposed to centralized definitions at the state level, it is impossible to know with certainty that modular homes can replace manufactured homes in every town under any circumstance. In fact, in New York State, **“there is simply no single definition of the term mobile home.”**²³

In order to better understand how these local definitions might affect replacing MMHs with ZEMs, we did a detailed review of zoning codes in Beekmantown, which has a Resident Owned

²⁰ <https://www.nclc.org/issues/state-by-state-information.html#ny>.

²¹ NYS Department of State, “Municipal regulation of mobile homes,” Rev. 2010, <https://www.dos.ny.gov/lg/publications/Municipal%20Regulation%20of%20Manufactured%20Homes.pdf>.

²² Ibid.

²³ Ibid., emphasis added.



Community (ROC), a prime opportunity for ZEMs. Beekmantown also qualifies for special State financing as target areas, and can receive EE and RE incentives.

A Closer Look at Zoning in Beekmantown

Beekmantown, home to 5,550 residents, is located six miles north of Plattsburgh in Clinton County. Its rural nature, proximity to a small city, and mixture of farm and forest lands make it typical of many towns in upstate New York. The Census Bureau estimates that there are 568 mobile and manufactured homes in Beekmantown; 153 are located in registered parks. The Town's zoning law offers insight into the challenges of placing ZEMs into existing MMH parks, with implications for other localities.

Defining Mobile, Manufactured, and Modular Homes in Beekmantown

Zoning laws in New York State allow each municipality to establish definitions for different structure types within its boundaries. Beekmantown's zoning law defines dwellings, modular homes, mobile homes, and mobile home dwellings, including single-wide and double-wide mobile home dwellings. (Manufactured homes are not defined.) Mobile homes are described as lacking a permanent foundation, while the definition for mobile home dwellings explicitly cites HUD Code and may be manufactured or delivered in one or more sections. Thus, in Beekmantown, mobile home dwellings are actually what HUD and others would call manufactured homes. Modular homes, on the other hand, are defined as prefabricated dwellings delivered to the site in two or more sections and permanently assembled.

Notably, these definitions are ambiguous for a modular home delivered in one section. A single-section ZEM, for example, would not fit the modular home definition (which requires two or more sections) or the mobile home definition (which requires it to be towed on its own chassis) or the mobile home dwelling definition (which requires meeting HUD Code). Without a clear definition, local code officials may have wide latitude in deciding on structure classification, based on whatever they wished to use as a criterion.

Zoning for Mobile Home Parks in Beekmantown

Beekmantown's zoning law highlights the challenges of applying zoning definitions to manufactured and modular homes, and to manufactured home parks. A "mobile home park" includes any lot that is home to two or more mobile homes used as dwellings, while a "mobile home subdivision" is a parcel of two or more lots, wherein each lot is occupied by a single mobile home. The current zoning map for the town contains two mobile home subdivisions, each hosting just one or two mobile homes. In fact, none of Beekmantown's three registered mobile home parks are in its Mobile Home Subdivision district. One is located in the Mixed Use district; the other two parks are located in the Rural Use district. While these parks do not comply with setbacks specified in current zoning regulations, existing parks may expand within the same lot provided they comply with the zoning law's standards for parks.

Placing a Modular in an Existing Park

In 2018, residents of Country Sky Mobile Home Park organized New Beginnings Mobile Home Association as a resident-owned community (ROC) responsible for purchasing and operating the park. Cooperative Development Institute (CDI) is providing technical and financing assistance to the ROC. The park is currently home to approximately 50 homes. Community members have expressed interest in filling vacant home sites with ZEMs.

Beekmantown's zoning is unclear on the matter. Double-wide manufactured homes are allowed only in certain zones, and single-wide manufactured homes are allowed in just two zones. However, modular homes fall outside these definitions, and can be treated as single-family



dwellings. The New Beginnings site is located in the Mixed Use District, which does allow single-family dwellings, but also requires lot sizes and setbacks that will require specific town approval. Accordingly, the addition of ZEMs to this park will likely require obtaining an area variance from the Zoning Board of Appeal.

The New Beginnings ROC is located in a targeted area for special incentives from the State of New York Mortgage Agency (SONYMA). NYSEDA's Affordable Solar Program, available through the NY-Sun initiative, provides additional incentives for households earning less than 80 percent of area median income. In Clinton County, a 4-person household earning \$71,312 or below annually is eligible for these additional incentives. Additional incentives for residential new construction may be available from NYSEDA or from New York State Electric and Gas Corporation, which provides electricity service.

New York's Manufactured Housing Landscape

There are 192,890 MMHs in NYS, as estimated in the 2016 American Community Survey.²⁴ While often thought of as a rural housing type, mobile and manufactured homes are found in every county of the State, ranging from an estimated 230 in Putnam County to 8,557 in Oswego County. They are, in fact, a common housing type near many urban areas around the State, and constitute 10 percent or more of housing units in 23 of the state's 62 counties. MMH can be single-wide or double-wide. In total, approximately 356,000 New York residents live in MMHs, with 74 percent of those residents living in owner-occupied units and 26 percent living in renter-occupied units. Chenango and Schuyler counties have the highest proportion of MMH (21%), more than ten times the statewide proportion of two percent. Annual sales of manufactured homes in New York were fairly constant between 2011 and 2017, ranging from a high of 1,532 in 2012 to a low of 1,313 in 2014.

Table 1. Counties in New York with the greatest numbers of MMH units.

County	Total MMH units
Oswego	8,557
Saratoga	8,038
Jefferson	7,491
Steuben	7,286
Oneida	6,581
St. Lawrence	5,951
Erie	5,628
Ulster	5,372
Cattaraugus	5,270
Clinton	5,254
Tompkins	2,073
Statewide	192,890

Source: 2016 ACS 5-Year Estimates

Table 2. Counties in New York with the highest percent of MMHs.

County	MMH as a percent of all housing units
Chenango	21%
Schuyler	21%
Tioga	16%

²⁴ 2016 American Community Survey 5-year estimate, Table 2. The Census does not differentiate between mobile and manufactured homes.



County	MMH as a percent of all housing units
Oswego	16%
Steuben	15%
Allegany	15%
Clinton	15%
Seneca	14%
Otsego	13%
Cattaraugus	13%
Tompkins	9%
Statewide	2%

Source: 2016 ACS 5-Year Estimates

MMH parks with three or more homes occupied year-round must register with New York State Homes and Community Renewal. Registrations for 2016 total 1,874 parks throughout the State, with each having, on average, 37 occupied sites and nine non-occupied sites. Approximately 36 percent of the State's MMHs are located in parks, totaling more than 68,000 occupied homes. An additional 18,000 park sites are not occupied. The remaining 64 percent of MMHs are located on owned or leased land with just one or two MMH, including farm properties. Between 2011 and 2016, the number of owner-occupied units declined by seven percent, while renter-occupied units increased by four percent. In 2016, the estimated average rent for a MMH in New York State was \$714.

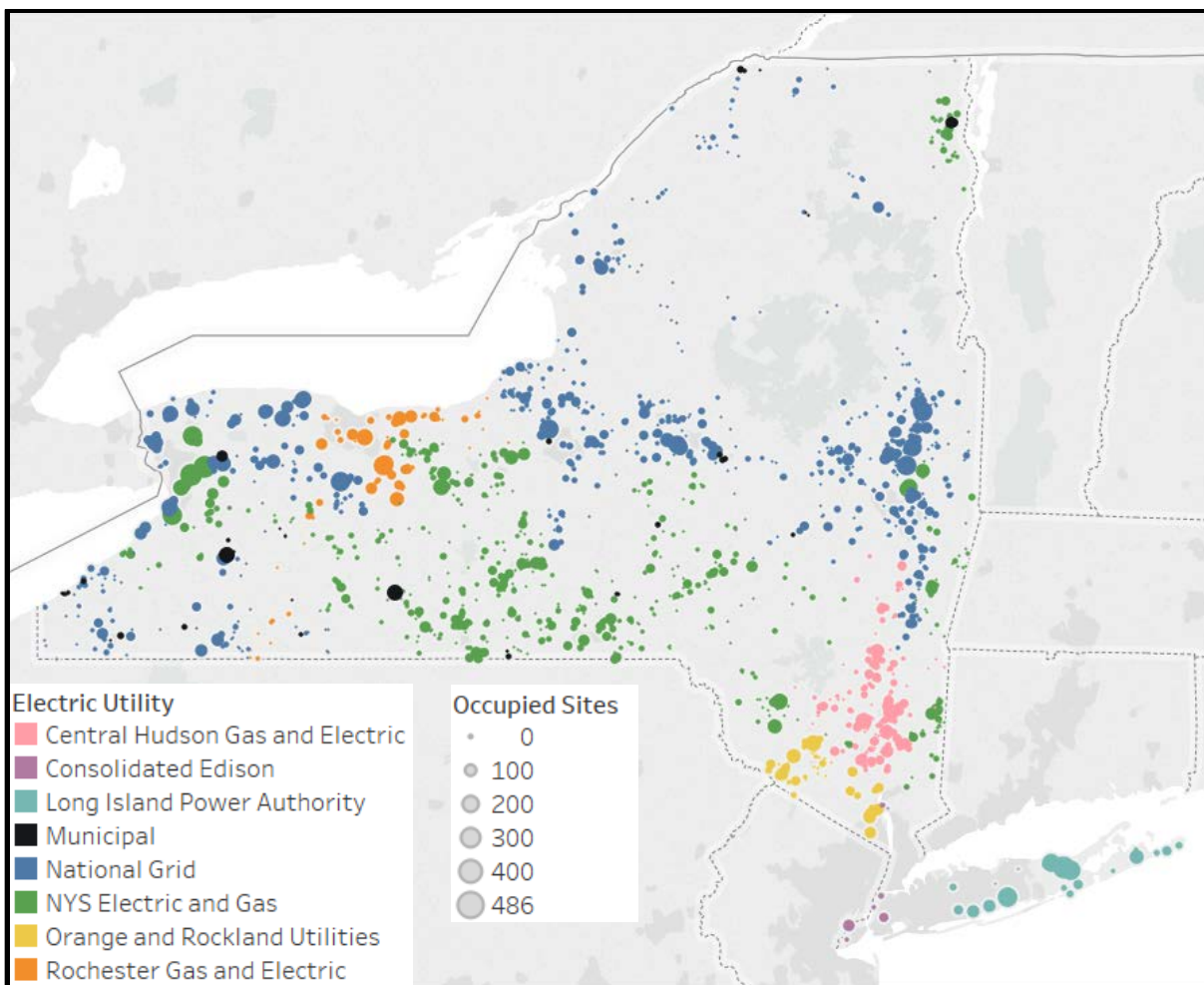
The census of registered MMH parks was overlaid with the NYS utility electric service grid to determine the numbers and sizes of MMH parks by electric service provider. Table 3 presents those results.

Table 3. Registered MMH parks by electric utility.

Electric Utility	Parks	% of total	Site capacity	% of total	Sites occupied	% of total
National Grid	783	42%	35,905	42%	28,134	41%
NYS Electric and Gas	647	35%	26,905	31%	21,010	31%
Central Hudson Gas and Electric	197	11%	7,399	9%	6,308	9%
Rochester Gas and Electric	91	5%	5,600	6%	4,165	6%
Orange and Rockland Utilities	60	3%	3,599	4%	3,012	4%
Long Island Power Authority*	42	2%	4,745	5%	4,030	6%
Consolidated Edison	8	0%	339	0%	2,95	0%
Municipal*	46	2%	1,913	2%	15,30	2%
Totals	1,874	100%	86,405	100%	68,484	100%

In urban and suburban counties, MMHs are more likely be located in parks and less likely to be located on private land. For example, in four counties – Dutchess, Erie, Putnam, and Suffolk – each of which contains or is near major a city, more than 80 percent of MMHs are located in parks. The map of MMH parks shows the prevalence of parks in the more densely populated portions of the state (Figure 2). These parks tend to host a greater proportion of occupied-to-vacant lots. The largest number of park-based MMHs are found in communities near the New York State Thruway and in eastern Long Island. There are also a number of sizable park communities in the Southern Tier; near Plattsburgh; in Saratoga County; and near Watertown.





Source: 2016 HCR Mobile Home Park Registrations. For illustrative purposes only

Figure 2. Registered mobile home parks in New York; dot size indicates number of occupied sites.

A Resident-Owned Community (ROC) is a neighborhood of MMHs that is owned by a cooperative of residents who live there and govern the operations of the park. Unlike investor-owned parks, ROCs exist for the sole purpose of preserving, improving, and maintaining manufactured home communities for the benefit of the residents. In 2008, ROC-USA was formed to provide financing and technical assistance to enable the transition to resident ownership²⁵. When an investor-owned park is placed on the market, a ROC-USA affiliate can assist residents to organize and purchase the community. ROC-USA partners with regional nonprofit affiliates to provide resident groups with support during and after the conversion to resident ownership.

VEIC identified nine ROCs in New York, all of them located outside of the New York City / Westchester County / Long Island area. All of these communities were converted to cooperatives within the past ten years, most with the assistance of the PathStone Corporation, a community development non-profit based in Rochester. PathStone has expressed interest in bringing ZEMs to the parks that they assist and has recommended a focus on vacant lots within the strongest of these communities. CDI is the ROC-USA affiliate serving New York’s North Country and the entire state of Vermont. VEIC has worked closely with CDI on placing ZEMs in Vermont ROCs.

²⁵ <https://rocusa.org/>



Table 4. Resident-Owned Manufactured Home Communities in New York.

Community name	Location	Region	Co-op conversion	Number of homes	Population	Technical assistance provider
Kayadeross Acres	Milton	North Country	Nov 2016	141	All ages	PathStone Corp.
Lakeville Village	Geneseo	Southern Tier	Aug 2016	50	55+	PathStone Corp.
Marilla Country Village	Alden	Western	Dec 2011	145	All ages	PathStone Corp.
Meadow Valley Park	Unadilla	Central	Oct 2010	54	All ages	PathStone Corp.
Champion MHP	Elbridge	Central	Dec 2008	157	All ages	PathStone Corp.
The Woodlands Community	Hornellsville	Southern Tier	Jun 2016	96	All ages	PathStone Corp.
Venture Lake Estates	Hyde Park	Hudson Valley	Mar 2014	44	55+	PathStone Corp.
Newtown Creek Community	Horseheads	Central	Jan 2018	69	All ages	Northcountry Coop. Foundation
New Beginnings MH Association	Beekmantown	North Country	Sale pending	40	All ages	Cooperative Development Inst.
Total homes				796		

Source: Data provided by Resident Owned Communities USA (ROC USA): <https://rocusa.org/>.

ZEM Scenarios for New York State

Based on the market data collected and experience with ZEMs in other states, we discuss below a variety of scenarios for ZEMs in NYS based on home and land ownership structures.

Owned Unit, Owned Land

For the owned unit, owned land scenario, home buyers must have the ability to purchase both the home and the land, or have access to land for the home through family subdivision or deeded rights. In addition to the costs of land and the ZEM, upfront costs would also include utility connections, and foundation and other necessary site preparation work. This option does have high upfront costs when the land is not already owned. This is a common ownership model in NYS with the addition of a MMH onto land already owned by a family member.

Owned Unit, Leased Land

In privately owned MMH parks, homes are placed on land leased by the park owner to the homeowner. Generally, financing for MMH located on leased land is not favorable, with use of chattel loans secured by personal property, rather than secured by real property. These loans are characterized by high interest rates and short terms. Because homeowners do not own the land, they often have little control over park owner decisions to raise lot rents or sell the park. Residents do have the right to organize and purchase the park if an owner decides to sell, but have few protections on lot rent increases. Moving the home is generally not an option because of the expense of moving a home once it is placed and the prohibition in many MMH parks on accepting relocations. Even at high cost, occupants often choose to finance a MMH purchase, rather than rent, because monthly costs of renting and home purchase are similar. Although this arrangement provides a path to homeownership, it can also leave homeowners vulnerable: they, rather than a rental property owner, are responsible for upkeep on a unit that may deteriorate.



Owned Unit, Coop Land

MMH can also be located in ROCs. ROCs are less common than privately owned parks but are becoming more common in New York, with eight new ROCs established in the past 10 years. ROCs allow MMH owners to participate in the ownership of the land beneath their homes, thereby having more control over costs and disposition, in an arrangement similar to cooperative ownership of multifamily buildings. Homeowners are afforded more control over the land and access to more favorable financing through traditional lenders or lenders focused specifically on cooperatives. Because ROCs offer long term leases, lenders consider ROCs more stable than privately owned parks and are thus more willing to finance such homes. With more than 125 ROCs, New Hampshire provides a good model of the benefits and mechanisms of ROCs.

Rented Unit, Rented Land

Finally, MMH can also be structured as rental housing. According to the 2016 American Community Survey, 26 percent of New York's MMH is renter occupied. Under this scenario, someone is renting both the land and their MMH from the MMH park owner, who could have acquired the MMH either by purchasing a new MMH, a used MMH or by default when a MMH owner either abandoned the home or if they were evicted for lack of lot payment.

Demographics and Energy Burden of MMH Occupants in New York State

The 2015 American Housing Survey (AHS) estimates that there are 37,600 MMH households with a primary mortgage. The median level of remaining principal owed on these mortgages is \$46,000. The median principal owed as a percent of the home's value is 109 percent, meaning that more than half of these mortgaged owners could be considered "underwater." That figure is approximately 55 percent for other housing types.

Occupants reported that MMH units were "severely inadequate" in 8,200 cases, and another 9,400 MMHs in the State were classified as "moderately inadequate." Often-cited were problems with heat, water, electricity, pests, mold, and leaks. These inadequate units might provide an excellent primary or secondary target for ZEM replacement.

The 2015 AHS also provides demographic data that is useful for characterizing and understanding the energy burden of MMH occupants in NYS:

- The average annual income of a third of MMH households (62,600) in NYS is less than \$20,000.
- 45 percent (85,300) have household income less than 60 percent of state median income, which would make them eligible for assistance from the New York State Weatherization Assistance Program.
- Nearly one in four of these households (44,000) is severely overburdened with housing costs that exceed 50 percent of income.

In 2016, Governor Cuomo announced a new energy affordability policy initiative to reduce the energy burden of low- and moderate-income (LMI) New York residents to below six percent.²⁶ NYSEDA commissioned APPRISE, Inc., to characterize the energy burden of LMI households in the State. The resulting Special Topic Report provides a detailed characterization of the LMI market in NYS, with data on income, burden, housing type, and heating fuel type, ending with a discussion of how energy efficiency and energy assistance programs can work to reduce energy burdens for LMI households. The report notes that the average energy burden of low income

²⁶ May 19, 2016, Press release from the Office of the Governor, <https://www.governor.ny.gov/news/governor-cuomo-announces-new-energy-affordability-policy-deliverrelief-nearly-2-million-low>.



households in NYS is 12.9%, double that of moderate income households and nearly six times that of non-LMI households. The report also breaks down energy burden by housing type and for LMI households living in “mobile homes” the average energy burden was 11.5% - the highest of all housing types (see Table 5).²⁷

Table 5. Energy Burden for LMI Households by Housing Unit Type

Housing Unit Type	Percent of LMI Households	Average Energy Bill	Average Income	Average Energy Burden
Single Family	48%	\$3,557	\$34,370	10.4%
Small Multifamily	24%	\$2,644	\$29,227	9.0%
Large Multifamily	24%	\$1,567	\$25,696	6.1%
Mobile Home	4%	\$3,093	\$26,804	11.5%
All LMI Households	100%	\$2,839	\$30,726	9.2%

Source: ACS (2013-2015) / Households that pay energy bills directly to energy suppliers

Source: APPRISE, undated, Table 4.5, page 9.

The higher energy burden for MMHs may, in part, be explained by heating fuel type. APPRISE broke out energy burden by heating fuel type, and the two fuels commonly used to heat MMHs had the highest burdens, as shown in the table below from that report.

Table 6. Energy burden for LMI households by main heating fuel.

Main Heating Fuel	Percent of LMI Households	Average Energy Bill	Average Income	Average Energy Burden
Natural Gas	65%	\$2,681	\$31,117	8.6%
Fuel Oil	13%	\$4,477	\$34,892	12.8%
Electricity	15%	\$1,857	\$25,246	7.4%
Propane	4%	\$3,503	\$29,970	11.7%
Wood/Coal	2%	\$3,288	\$33,633	9.8%
All LMI Households	100%	\$2,839	\$30,726	9.2%

Source: ACS (2013-2015) / Households that pay energy bills directly to energy suppliers

Source: APPRISE, undated.

The State’s goal of reducing LMI energy burden to less than six percent is paired with a commitment to expanding access for low-income households to clean energy, energy efficiency and energy assistance programs. However, with respect to households living in MMH, there are limits and difficulties to the ability of low income energy efficiency programs to retrofit MMH. The federally-funded Low-Income Weatherization Assistance Program (WAP) has perfected many techniques that reduce energy use significantly, though never quite to the level of a stick-built home on an energy use per square foot basis. Wall cavities of MMH are often 2-4” in depth, which does not provide sufficient room to add insulation to the levels that are generally required by code in northern climates. Sealing ductwork and insulating the “belly” provides generally good savings,

²⁷ APPRISE, Inc., “Low-To-Moderate-Income Market Characterization Study Special Topic Report on Household Energy Burden,” NYSERDA, undated, <https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/LMI-Special-Topic-Rpt---Energy-Burden.pdf>.



but too often, over time, the belly fabric may rip or degrade, exposing ductwork directly to outside air. Replacement of NYS's oldest MMH with sturdier, healthier housing may be the best long-term solution to reduce energy burden for households living in MMHs.

Financing for MMHs and ZEMs

Conventional mortgage financing can be used to finance modular homes on owned land; this method would be available for ZEM. Both public and private lenders consider modular homes equivalent to conventional stick-built and site-built homes. Loan rates and terms for modular homes are the same as those available through conventional single-family financing and programs designed for LMI home buyers.

Both mortgages and chattel loans are used by homeowners to purchase manufactured homes on owned or leased land. (See above discussion, in Demographics section, for data on percent of MMHs with mortgages and average outstanding balances.) A chattel loan is a loan that is collateralized by an item of personal property (such as a MMH) as opposed to a mortgage that requires real property as security. Other significant differences between chattel loans and mortgages include upfront fees, length of the loan, interest rates and consumer protections.

The Home Mortgage Disclosure Act (HMDA) requires financial institutions of a certain size to disclose loan characteristics of mortgages. Higher-than-average interest rates are tracked by HMDA-required reporting, with the benchmark being the average prime offer rate (APOR). Loans that exceed APOR by more than 1.5 percentage points are tracked and reported. In analyzing lending for MMH, the CFPB reported that,

Manufactured housing loans are less than three percent of all owner-occupied originations, and the average loan sizes are much smaller than for mortgages on site-built homes. A much higher percentage of these loans were higher-priced compared with loans on site-built homes. Among manufactured housing home-purchase loans, 75.0 percent of conventional loans and 58.3 percent of FHA-insured loans were higher priced in 2017. In addition, among those conventional manufactured housing home-purchase loans that were higher priced, 53.1 percent exceeded the higher-priced threshold by five or more percentage points (Table 8B).²⁸

²⁸ Consumer Financial Protection Bureau, "Manufactured-housing consumer finance in the United States," September 2014, <https://www.consumerfinance.gov/data-research/hmda/learn-more>.



TABLE 8B: DISTRIBUTION OF LOANS WITH APOR SPREAD ABOVE 1.5 PERCENTAGE POINTS, BY PROPERTY TYPE, PURPOSE AND LOAN TYPE, 2017 (PERCENT)

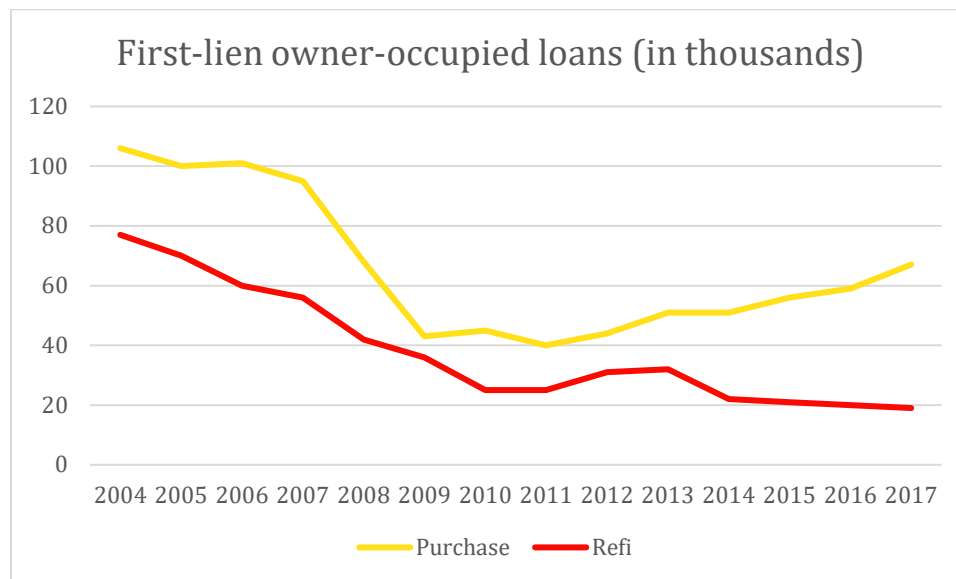
Property type, purpose and type of loan	1.5-1.99	2-2.49	2.5-2.99	3-3.99	4-4.99	5 or more
Site built homes: Purchase, conventional	59.1	22.4	8.1	6.2	2.8	1.3
Site-built homes: Purchase, FHA ⁽¹⁾	71.9	22.3	4.6	0.9	0.3	0.0
Site-built homes: Purchase, VA/RHS/FSA ⁽²⁾	67.0	7.2	1.8	11.8	11.9	0.3
Site-built homes: Refinance, conventional	54.1	17.3	9.3	10.6	5.3	3.4
Site-built homes: Refinance, FHA ⁽¹⁾	77.2	14.2	4.2	2.2	0.4	1.8
Site-built homes: Refinance, VA/RHS/FSA ⁽²⁾	91.2	7.0	0.6	1.0	0.2	0.0
Manufactured homes: Purchase, conventional	6.2	4.6	7.6	14.5	14.0	53.1
Manufactured homes: Purchase, FHA ⁽¹⁾	54.2	30.1	6.6	2.2	0.4	6.4
Manufactured homes: Purchase, VA/RHS/FSA ⁽²⁾	84.5	6.6	5.3	1.8	1.8	0.0
Manufactured homes: Refinance, conventional	30.4	15.6	12.5	17.7	9.7	14.0
Manufactured homes: Refinance, FHA ⁽¹⁾	66.6	21.6	8.1	3.3	0.1	0.4
Manufactured homes: Refinance, VA/RHS/FSA ⁽²⁾	77.1	20.0	2.4	0.5	0.0	0.0

Note: First-lien mortgages for one- to four-family owner-occupied homes.

(1) Loans insured by the Federal Housing Administration.

(2) Loans backed by guarantees from the U.S. Department of Veterans Affairs, the Rural Housing Service, or the Farm Service Agency.

The number of mortgage-backed loans for MMH has decreased quite dramatically in the last 15 years, with the largest decrease coming during the Great Recession. In 2004, there were more than 100,000 loans made for MMH, but by 2009, the number was just over 40,000. The number of refinancings nationally has also decreased. Each of the trajectories does seem to have leveled off in the last three years, at approximately 60,000 purchases annually and 20,000 refinancings.



Source: Bureau of Consumer Financial Protection, 2018, data from Table 1A.

Figure 3. Number of first-lien loans for owner-occupied MMH purchases and refinancing, 2004 – 2017.

Chattel Loan Products

According to the Consumer Finance Protection Bureau (CFPB) 2012 HMDA data, five companies (21st Mortgage, Vanderbilt Mortgage, Triad Financial Services, U.S. Bank, and San Antonio Federal Credit Union) provided more than 52 percent of the chattel loans used to purchase manufactured housing nationally. Online research indicates that 21st Mortgage, Vanderbilt Mortgage, Triad Financial Services offer chattel loans in NYS and those loans can be used to

place homes on owned land or in manufactured home communities. Loans on MMHs in leased land communities have wide variation on both term and rate, with terms ranging from 10 to 15 years and interest rates typically in the range of 6 percent to 9 percent depending on overall credit quality, age of home, collateral type, loan amount, and loan-to-value ratio.

SONYMA Mortgage

The State of New York Mortgage Agency (SONYMA) provides financing and programs designed to help first-time LMI New Yorkers become homeowners. Additional programs at the regional, county, and local levels assist with down payment and closing costs for this market. SONYMA's first-time homebuyer programs are available for double-wide manufactured homes located on land owned by the borrower as the double-wide is considered "permanently attached to real property."²⁹ NYS banks and credit unions also follow this policy for making loans on manufactured homes. However, SONYMA has recently announced a new program in partnership with NYS's Homes and Community Renewal (HCR) which will support purchase of any manufactured home on leased or owned land so long as the home will be sited on a permanent foundation and the terms of the lease are at least as long as the mortgage. This new program will also be made available to qualified purchasers of ZEMs either in parks or owned land.³⁰

The following SONYMA programs might also be sources of assistance to aspiring ZEM homeowners who will be purchasing land in addition to their home or siting their home on land they already own:

- **Achieving the Dream and Low Interest Rate Programs** provide qualified first-time home buyers with low down payment mortgage financing (1-3 percent down payment is required, with some additional assistance potentially available). Qualified buyers are those with steady income below a threshold that ranges from \$50,000 to \$90,000, depending on specific location within the state.³¹
- **ENERGY STAR Labeled Homes Incentive** provides low-interest rates for ENERGY STAR Labeled homes, as well as down payment assistance up to \$15,000. Homes must be located in SONYMA target areas.³²

In federally recognized target areas, the SONYMA program requirements are less strict. For instance, in a target area, programs are not restricted to first-time homebuyer and household income limits are higher. Target areas are Census tracts and counties deemed economically distressed and include areas across the State.³³

FHA Title 1 Manufactured Home Loan Program

Lenders that participate in Federal Housing Administration (FHA) programs can offer loans to purchase manufactured homes, lots, or a combination of homes and lots. FHA provides the mortgage insurance for such purchases. Prior to the recent launch of the SONYMA-HCR program described above, this mortgage-assistance program was the only mortgage product identified that will provide financing for a MMH on a leased lot. Rates and terms are negotiated between borrower and private lender, within parameters mandated by the federal government (see Table

²⁹ <http://www.nyshcr.org/assets/documents/1819.pdf>

³⁰ http://www.nyshcr.org/Topics/Lenders/Lenders/HCR_Manufactured-Homes-Brochure-v1_8.5x11_Bleed_8.13.18.pdf

³¹ <http://www.nyshcr.org/Topics/Home/Buyers/SONYMA/AchievingtheDreamProgram.htm>

³² <http://www.nyshcr.org/Topics/Home/Buyers/SONYMA/ENERGYSTARLabeledHomes.htm>

³³ Census tracts are geographic units that encompass between 1,200 and 8,000 people. Generally, they are county subdivisions. There are 4,919 Census tracts in New York State.



7). There are different lending amounts and terms depending on whether the purchase is for one home or multiple homes and whether the home is being financed with land or not.

Table 7: FHA nationwide loan limits and terms

Title 1 Loan Program	Purpose	Nationwide loan limits	Maximum loan term
Manufactured home loan (unit only)	Purchase or refinance	\$69,678	20 years, plus 32 days
Manufactured home lot loan	To purchase and develop a lot on which to place a manufactured home	\$23,226	15 years, plus 32 days
Combination loan for lot(s) and home(s)	Purchase or refinance manufactured home and lot on which to place the home	\$92,904	Single unit & lot: 20 years, plus 32 days Multi-unit & lot: 25 years, plus 32 days

For loans on manufactured homes being placed on leased land, HUD requires the community owner to provide an initial lease term of three years and written notices 180 days in advance if the owner wants to terminate the lease.³⁴

Fannie Mae and Freddie Mac Duty to Serve

As Government Sponsored Enterprises (GSE), Fannie Mae and Freddie Mac have a “duty to serve” markets associated with LMI families, including manufactured housing markets. This requirement was put in place by the 2008 Housing and Economic Reform Act and implemented by the Federal Housing Finance Agency (FHFA) in December 2016 by the Duty to Serve Underserved Markets rule.³⁵

The rule calls on GSEs to develop Underserved Markets Plans to address specific market sectors, and according to information provided by Fannie Mae on those plans related to manufactured housing, examples of activities to be carried out by the plan include:

- Increase the purchase volume of conventional manufactured housing loans
- Enhance existing products to offer more flexible financing for modern, high-quality manufactured homes
- Purchase and test a pool of chattel loans—personal property loans that make up 80 percent of MMH financing today—subject to approval by our regulator³⁶

Depending on the results of these intended improvements, new financing options may become available for manufactured home buyers on both owned land and leased land.

USDA Rural Development 502 Housing Direct Loan Program

Section 502 of the Housing Act of 1949, authorizes the Rural Housing Service (RHS) to provide financing to low and very low-income persons who cannot obtain credit from other sources, in order to obtain adequate housing in rural areas. Section 502 funds may be used to buy, build, rehabilitate, improve, or relocate an eligible single-family dwelling and improve related facilities for use by the borrower as a permanent residence. Pursuant to federal regulation, in New York, 502 loans are only available for homes located on land owned by the occupant. Manufactured

³⁴ https://www.hud.gov/sites/documents/TI_MH_ALLOWLOANPAR.1.2017.PDF.

³⁵ <http://www.fanniemae.com/resources/file/aboutus/pdf/duty-to-serve-faqs.pdf>.

³⁶ Ibid.



and modular homes that are on a permanent foundation are eligible, provided they are located on land owned by the occupant.

In 2016, VEIC hosted a group of USDA staff from outside Vermont on a tour of the ZEM homes located in a park owned by the Lamaille Housing Partnership, a nonprofit affordable housing provider in central Vermont. Mortgages through the Section 502 Program were a key resource for ZEM buyers in Vermont, directly providing financing to home buyers living in ROCs and parks owned by nonprofit housing organizations, as well as giving other lenders confidence in ZEM homes. Staff from the USDA NY office followed up with VEIC and discussed seeking federal authorization to offer the 502 mortgage pilot in NYS. However, such authorization was never requested so there are currently no mortgage programs offered by the USDA NY office for manufactured or modular homes located on leased land regardless of the lease terms or duration.³⁷ Thus, at this stage, NY's USDA loan programs can only be used for placement of ZEM on land privately owned by the occupant.

The following table summarizes terms and opportunities for financing MMHs and ZEMs in New York.

Table 8. Terms and opportunities for financing ZEMs.

	Typical terms	Single-wide MMH		ZEM	
		Owned land	Leased land	Owned land	Leased land
SONYMA ³⁸	30 year 4.5% interest Down payment assistance available up to \$15,000			X	
USDA	Up to 33 years for very low income As low as 1% No down payment required	X		X	Potential Pilot program for ROC
FHA (for MMH)	20 years	X	X		
Chattel	10 to 15 years 6 to 9% interest	X	X		

Financing for Cooperative Purchasing of Manufactured Home Parks

NYS HCR has recently launched a new program – the Manufactured Homes Advantage Program - to provide financing and technical support to manufactured home park owners, buyers, and residents which want to preserve and maintain parks as affordable housing. The program will provide financing to these groups of up to \$40,000 per site to purchase, rehabilitate, and develop infrastructure.³⁹ In addition to financing, the program will also provide technical resources to encourage and facilitate resident cooperative ownership of these parks. HCR reports that it already has several parks interested in the program. Resident-Owned Communities USA (ROC-USA) also provides technical assistance with cooperative conversion through local affiliate groups in NY. As more parks access the program and transition to cooperatives, the market for ZEM homes will grow.

³⁷ Personal communication with Brian S. Murray, Area Director, Central/Northern Region USDA Rural Development.

³⁸ HCR recently launched a program to extend mortgage products to MMH owners under certain circumstances.

³⁹ http://www.nyshcr.org/Topics/Lenders/Lenders/HCR_Manufactured-Homes-Brochure-v1_8.5x11_Bleed_8.13.18.pdf



Existing Affordable Housing Programs

NYS devotes significant federal and state resources to the development and rehabilitation of homes for LMI households. The State's past performance and goals for the future years are articulated in the New York Consolidated Plan for Housing & Community Development for the period 2016 - 2020.⁴⁰ Counties and areas of the state deemed eligible receive funding directly from HUD based on formulas. Other areas, deemed 'non-entitlement jurisdictions', are eligible for competitive, non-formula funds, managed by the state. The Community Development Block Grant (CDBG) and HOME Investment Partnership (HOME) programs serve counties and localities in the state that are not entitled to receive allocations of these funds directly from HUD. These non-entitlement counties and localities comprise the New York State Entitlement Jurisdiction (NYSEJ). The NYSEJ includes 49 of the State's 62 counties, all the localities within the 49 counties except 22 localities that receive formula entitlements directly from HUD, and another 53 localities scattered throughout Dutchess, Nassau, Orange, Rockland, and Suffolk counties. The NYSEJ does not include New York City, Buffalo and Erie counties, Rochester and Monroe counties, Syracuse and Onondaga counties, as well as 41 other local HUD-entitlement jurisdictions.

These federal resources are used to create and preserve affordable housing for very low, low, and moderate-income New Yorkers. Overall, a nominal amount of funding is dedicated to the largest segment of the unsubsidized affordable housing market: mobile and manufactured housing. Development of ZEM homes is an eligible use for CDBG and HOME funds, although commonly these funds are used for more communal activities such as upgrading parks, rather than to assist individual homeowners. Assistance of individual households is administratively more expensive and ultimately reaches fewer people. In order for ZEM to be an eligible use of formula-based funds, this housing type would need to be mentioned explicitly or at least alluded to in a reference to MMHs in the state's housing plan.

The New York State Affordable Housing Corporation (AHC) is another potential ZEM program partner. AHC administers the Affordable Home Ownership Development Program (AHOD Program), which provides grants to governmental, not-for-profit, and charitable groups to build, acquire / rehabilitate, or improve homes for LMI families.⁴¹

Affordable Housing Developers

NYS has an extensive network of for-profit and nonprofit affordable housing developers that could potentially purchase and redevelop a manufactured home community with ZEM homes using either an ownership or rental model.

HCR provides funding to a statewide network of community-based housing organizations. The network includes every nonprofit affordable housing developer and offers potential partnerships designed to acquire manufactured home parks.⁴²

Some of the groups have already worked programmatically to replace substandard MMHs in NYS:

- Adirondack Community Housing Trust: <http://www.adkhousing.org/about.asp>
- Catskill Mountain Housing Development Corp.: <http://cmhdc.org/housing-programs/>

⁴⁰ New York State Consolidate Plan for Federal Fiscal Years 2016-2020 & Annual Action Plan for the program year 2016, as submitted to U.S. Department of Housing & Urban Development.

⁴¹ NYS Affordable Housing Corporation: <http://www.nyshcr.org/Topics/Municipalities/AHCGrants/>

⁴² <http://www.nyshcr.org/Programs/NPP/HousingOrgs.htm>.



- Otsego Rural Housing Assistance; <http://otsegoruralhousing.org/manufactured-mobile-home-replacement-program/>
- PathStone Corp.: <http://pathstoneenergyinfo.org/>
- Ithaca Neighborhood Housing Services: <https://ithacanhs.org/about-inhs/>
- Seneca Nation of Indians: <https://sni.org/departments/housing-authority/>
- Akwasasne Housing Authority: <http://www.aha-nsn.gov/ahaprojects.asp>

HCR Mobile and Manufactured Home Replacement Program

In 2017, New York's Housing Trust Fund Corporation launched a pilot Mobile and Manufactured Home Replacement Program (MMHR) administered through the Office of Housing and Community Renewal. The MMHR program assists homeowners to replace dilapidated MMHs that are sited on land owned by the homeowner, with a new manufactured, modular or site-built home. Grants are only available to households that own their MMHs outright, with no outstanding loan balances. Program guidelines do not allow the replacement home to be financed. MMHR grants are available up to \$100,000, which is not sufficient to cover the full cost of a ZEM home. However, if homeowners are able to finance the remaining portion or other resources could augment these program funds (e.g., down payment assistance), this program could provide a key piece of funding for ZEM replacement of old MMHs. Two million dollars in MMHR funds have been awarded to housing non-profits to replace 28 MMHs in 8 counties. All replaced units must meet NYS or local codes, as appropriate.⁴³

Homeownership Counseling & Education Programs

The New York State Coalition for Excellence in Homeownership Education (NYS CXHE) is a group of not-for-profit housing counseling agencies that represent all areas of the State. The coalition includes more than 150 agencies which offer comprehensive housing counseling services, including pre-purchase counseling, financial education, post-purchase assistance, and foreclosure prevention services.⁴⁴ To ensure the success of the NYS ZEM pilot program, a strong connection must be established with housing counselling agencies such as NYS CXHE and HomeSmart NY in the target areas of the State.

Energy Efficiency & Renewable Energy Programs

A successful ZEM program will need to access energy efficiency (EE) and renewable energy (RE) rebates and incentives available for new construction, solar PV, and any other EE / RE programs targeted for the LMI sector.

NYSERDA offers EE and RE incentives for utility service areas that pay into New York's systems benefit charge (SBC). Utility SBC funds administered by NYSERDA include those from:

- Central Hudson Gas & Electric Corporation
- Consolidated Edison Company of New York Inc.
- New York State Electric and Gas Corporation
- National Grid
- Rochester Gas and Electric Corporation

⁴³ NYS Homes and Community Renewal: <http://www.nyshcr.org/Press/news170330.htm>.

⁴⁴ See <http://www.homesmartny.org/>.



- Orange and Rockland Utilities Inc.

The NYS Department of Public Service lists 42 additional electric utilities many of which are municipally owned and operated through a city or village.⁴⁵ The utilities are scattered throughout NYS with the largest contiguous area being served by Public Service Electric and Gas Company Long Island (PSEG-LI), which operates Long Island Power Authority’s (LIPA) transmission and distribution system. PSEG-LI and many of the municipal utilities do not administer a Residential New Construction incentive (RNC) program, but do in some cases provide incentives for residential high performance products that would be included in a ZEM home, such as heat pump water heaters and other major appliances. While the proportion of manufactured homes as a percent of all homes is small on Long Island, Suffolk County does contain a comparable number of manufactured homes to other parts of the state and should be considered when developing an incentivized MMH replacement program.⁴⁶

Given the NYSEERDA-administered programs are the primary EE / RE programs in NYS, the following section focuses on incentives available through those programs. Individual utility sponsored incentives (e.g., PSEG-LI) are noted where applicable.

A ZEM home would qualify for NYSEERDA’s Low-rise Residential New Construction Program (LR NCP) Tier 3 incentives. Table 9 shows the applicable Tier 3 requirements. Eligibility for the NYSEERDA program participation assumes:

- Participating ZEM factory builders will become ENERGY STAR Builder Partners
- Participating ZEM factory builders will partner with HERS Rater Provider(s) and a HERS Rating Certificate will be provided for each home

Table 9. NYSEERDA LR NCP Tier 3 Incentive requirements applicable to ZEM.

NYSEERDA LR NCP Requirement (PON 3717)
ENERGY STAR v3.1 Certified
HERS ≤ 10 with PV*
HERS ≤ 40 before PV (>1500 sf)**
HERS ≤ 50 before PV (≤1500 sf)**
Air leakage max 5 ACH50 (cz4); 4 ACH50 (cz 5,6)
Ductless mini-split heat pump (NEEP ccASHP spec)
VRF/VRV for multi-split HP
Heat Pump Water Heater – ENERGY STAR Certified

*Remote net metering may meet PV requirement upon approval by NYSEERDA

**May be eligible to meet 7 point higher HERS threshold when using REM/Rate v15 or later

Table 10 provides an overview of EE incentives that are currently available and applicable to a ZEM program initiative.

Table 10. Current energy efficiency incentives applicable to ZEM.

Qualifying product / performance level	Market rate incentive	LMI incentive	Source
LR NCP Tier 3 (1-2 family homes)	\$4,000	\$4,200	NYSEERDA
RESNET Accredited Provider Incentive	\$100		NYSEERDA
Cold Climate ASHP	\$200 - \$500		CHG&E, Con Edison, ORU
Heat Pump Water Heater	\$400 - \$450		CHG&E, Con Edison, NGrid, ORU
WiFi Thermostat	\$20 - \$135		All NYSEERDA utilities

⁴⁵ <http://www3.dps.ny.gov/W/PSCWeb.nsf/All/03627EFC626529EE85257687006F39CD?OpenDocument>

⁴⁶ ~4800 as per 2016 American Community Survey 5-Year Estimates, US Census Bureau

Depending on the utility service territory, a ZEM homeowner may be eligible for up to \$1000 in additional product incentives. Additional rebates or point of sale discounts are available for other high performance products such as LED lighting technologies and advanced power strips from most utilities. While PSEG-LI does not offer an RNC program, incentives up to \$1335 are available for products and appliances that would be installed in a ZEM.⁴⁷

A ZEM home with solar PV or connected to a community solar installation could be eligible for rebates, financing, and tax credits. Table 11 provides an overview of RE incentives that are currently available and applicable to a ZEM program initiative.

Table 11: Current renewable energy incentives applicable to ZEM.

Qualifying product / performance level	Market rate incentive	LMI incentive	Source
PV ⁴⁸	\$2,450 (upstate) \$2,800 (Con Edison)	\$4,900 (upstate) \$5,600 (Con Edison)	NY-SUN

In addition to rebates, federal and state tax credits are available for PV system installations. The Federal tax credit of 30 percent is available through 12/31/2019.⁴⁹ A New York State tax credit of 25 percent is also available.⁵⁰ Unlike NYSEDA's LR NCP on-site PV waiver, the NYS tax credit applies only to PV systems located on the residence. NYS also has a property tax abatement program exempting PV systems from real property taxation.⁵¹

Financing for Energy Efficient and Renewable Technologies

NYSEDA offers two ways to finance EE and RE improvements. The On-Bill Recovery Loan⁵² is a way to pay for energy improvements on your utility bill. The program requires that monthly payments do not exceed the monthly energy cost savings. The loan amounts range from \$1,500 to \$25,000 with terms of five, 10, or 15 years and the balance can be transferred if the home is sold. The Smart Energy Loan product has the same terms as the On-Bill Recovery Loan, but it is paid by the borrower every month and stays with the borrower if the home is sold.

Appraisals

As ZEMs are introduced into the market, the value of ZEM homes may not be immediately understood, and real estate appraisers must be educated on the characteristics of ZEMs and how these homes can fit into the classifications that appraisers routinely use in modeling and assessing value, such as green and energy efficiency features, comparable sales and neighborhood conformity. If ZEMs are undervalued by appraisers who may equate them with MMH, or not fully understand the value of solar and energy efficiency upgrade, then the value to support mortgage lending will not be apparent, and loans will be rejected on that basis.

⁴⁷ <https://www.psegliny.com/page.cfm/Efficiency>

⁴⁸ The rebates listed assume a 7 kW system and per watt incentive of \$0.35 for upstate New York and \$0.40 for ConEd <https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Contractors/Residential-Small-Commercial-MW-Block>.

⁴⁹ <https://www.irs.gov/forms-pubs/about-form-5695-residential-energy-credits>.

⁵⁰ https://www.tax.ny.gov/pit/credits/solar_energy_system_equipment_credit.htm.

⁵¹ https://www.tax.ny.gov/pdf/current_forms/orpts/rp487_fill_in.pdf.

⁵² <https://www.nyserda.ny.gov/All-Programs/Programs/Residential-Financing-Options>.



Green Appraisals

When appraising any property, it is of primary importance to ensure the appraiser is qualified to work with that property type. Appraisers are selected by the financial institution that is originating a loan as part of the assurance needed that that loan-to-value ratio supports the lending. While a builder or home buyer does not select the appraiser, they may notify the lender that a competent appraiser for a special property type is necessary. For a zero energy home, the relevant documentation to guide the appraisal is the Residential Green and Energy Efficient Addendum⁵³ as well as the final Home Energy Rating System (HERS) report, both of which would be completed by one of the primary parties to the transaction (e.g., builder, HERS Rater). Appraisers typically do not have the expertise or sufficient information to complete this addendum without documentation from one of the primary parties.

The Appraisal Institute (AI) maintains a public registry of appraisers that are qualified to work with green and sustainable property types. Appraisers who have completed courses and passed exams in the Valuation of Sustainable Buildings Professional Development Program are maintained in the AI Professional Development Program Registry.⁵⁴ Outside of the Professional Development Program, additional AI members who are qualified to work with green / sustainable properties can be found in the main registry by selecting 'Sustainable Green Buildings' in the Residential Property Types filter.⁵⁵ In NYS, there are currently 12 appraisers listed in the Professional Development Registry and an additional six in the main registry that are designated as qualified to work with sustainable / green residential property types. The majority of these, however, are located in the NYC / Long Island region. Therefore, additional Green Appraisers are needed in the regions of NYS that are the focus of the ZEM study.

Comparable Sales

The most common appraisal approach is the Sales Comparison approach. Using this approach, appraisers find comparable properties, preferably those that have been sold recently within the local market. This poses a couple of problems for the ZEM. While a ZEM is built to the same footprint of a MMH, and is often placed within a MMH park, a MMH is not appropriate for use as a comparable property. As discussed above, MMH construction is not subject to local codes, therefore the baseline construction requirements are fundamentally different than for a ZEM.

This makes it difficult to find appropriate comparable properties. Ideally, comparables for ZEM would include other ZEMs and/or small homes built to a zero energy or high performance specifications. When the current market does not have adequate comparable properties, as is the case currently in NYS, the Cost Approach can be utilized in the appraisal to document the actual cost of the property being appraised and inform adjustments within the Sales Comparison appraisal. The ability to select appropriate comparables, and to apply adjustments relies on an appraiser trained to understand the ZEM housing type.

Neighborhood Conformity

Additionally, when appraising ZEM Homes, the issue of non-conformance may arise. The ZEM will be unique to the neighborhood in which it is placed. Assessing conformity for ZEM in a MMH park could be related to the type of construction (modular versus manufactured), the renewable energy equipment, or the aesthetics, although some ZEM models look like new manufactured

⁵³ <https://www.appraisalinstitute.org/assets/1/7/ResidentialGreenandEnergyEfficientAddendum.pdf>.

⁵⁴ https://www.myappraisalinstitute.org/findappraiser/green_sustainability_residential.aspx.

⁵⁵ <https://www.myappraisalinstitute.org/findappraiser>



homes. For ZEM as urban infill, the new home may have a different physical appearance than the homes in the surrounding neighborhood. Whether or not this adversely affects the appraisal is a decision of the appraiser. For these reasons it is critical that a competent appraiser, one that has been trained in valuing the unique features of ZEM homes is selected to conduct the appraisal.

For a ZEM program to be successful in New York, program support for the appraisal industry is critical. In Vermont, where stakeholders and advocates have been supporting ZEM since 2013, the cost of ZEM appraisals remains to be \$750-1,000⁵⁶. The higher cost is due in part to the additional data gathering and documentation required for ZEM, as well as the green appraisal process itself being new and simply taking more time. Ideally, NYSEDA and partners in this effort will be able to support the green appraisal industry by offering training and education, direct financial support to appraisers to off-set the cost of completing the AI Valuation of Sustainable Buildings Professional Development Program, and potentially offering further incentive to completing a target number of green appraisals annually. Developing a pool of competent green appraisers must also include regional competency.

Sandra Adomatis is a well-known and active AI member since 1985 and is an approved instructor for a number of AI courses⁵⁷. Additionally, Sandra has developed her own courses specifically addressing solar PV valuation and the emerging housing market⁵⁸, where she defines the “3-Ms”: Modular, Manufactured, and Mobile. Efficiency Vermont hosted Sandra at the 2018 Better Buildings by Design Conference where these two appraiser courses were offered alongside the traditional conference tracks⁵⁹. Both sessions were well attended and received very positive feedback.

Strong program support for the appraisal industry, utilizing the many existing resources, must go hand in hand with efforts to launch a ZEM program. The Appraisal Institute, in collaboration with the Building Codes Assistance Program (BCAP), the National Association of Home Builders (NAHB) and other stakeholders, recently developed a two-page flyer titled, Appraised Value and Energy Efficiency: Getting it Right⁶⁰. This flyer provides an easy reference for the steps required to help ensure all the pieces are in place help solve the ZEM valuation puzzle.

Benefits of Modular Construction

Modular homes, as opposed to site-built, are constructed in a modular factory in boxes called “modules” that are transported on a trailer to the site where they are placed on a foundation. The majority of construction, painting and finish work happens in the factory. For homes built with multiple boxes, assembly, exterior finishes, and other details are completed on site. The maximum size of the boxes or modules is guided by local transportation restrictions and requirements. For example, a factory won’t build a 15 foot wide box if the local department of transportation only allows for 14 foot wide boxes to travel on roadways.

Modular factories currently produce about 2% of new single family housing nationwide with the remaining percent being site-built. In the Northeast, about 5% of new homes are currently built in a modular factory, down from 10% in 2008. Relative to other census regions, the Northeast has the highest percent of single family modular construction with modular construction accounting for about 1% of new homes in the South, 2% in the Midwest, less than 0.5% in the West⁶¹.

⁵⁶ A typical appraisal in the Vermont market is \$500-600, Efficiency Vermont.

⁵⁷ <http://www.adomatisappraisalservice.com/classes.html>

⁵⁸ <http://www.adomatisappraisalservice.com/Nov%202017%20Homegrown%20descriptions%20by%20Adomatis.pdf>

⁵⁹ <https://contractors.efficiencyvermont.com/bbd/bbd-2018>

⁶⁰ https://www.appraisalinstitute.org/assets/1/29/AI-BCAP_Flyer.pdf

⁶¹ <https://www.census.gov/construction/chars/completed.html>



Residential homes have been built in factories for over a hundred years, and in recent years modular has been getting another look from local and national affordable housing advocates as a possible solution to the housing crisis. As new construction costs soar in rural and urban areas across the United States, modular construction offers a potential solution for cost containment and reduced construction time. These benefits are achieved through a fixed decision making timeline, controlled construction environments, and economies of scale – all of which can save between 10-20% on costs and 30-50% on construction time⁶².

Fixed decision making timelines

- Unlike site built construction where change orders are the norm, the design and construction process in a modular factory follows a strict process and timeline.
- On site construction designers and building owners can make changes after construction has started which usually result in higher costs.
- For modular construction, all of the design decision are made, materials are ordered, and the contract price is fixed before construction starts.

Controlled construction environment

- A modular factory is set up to create an organized and efficient space for workers that follows the construction process.
- At construction sites, tools are moved daily from a storage box or truck to the work area, wasting time every day to get set up.
- Modular construction is never delayed by weather.
- Modular reduces time on site, which has several benefits - in particular for infill projects as there is less impact on neighbors – and it reduces the risk (and cost) of vandalism on construction equipment and the home under construction.

Economies of scale

- Design and engineering time per home is reduced by using standard construction plans repeatedly.
- Although modular home are overbuilt to meet transportation guidelines, they still use less construction materials than site built homes where construction materials are custom cut each time, creating additional waste over the planned, modular material preparation and process.
- The on-site construction industry and employment is cyclic with people getting hired and laid off, creating the need to train new workers at the beginning of every construction cycle.
- Factories are able to create a pipeline of projects, and when they are able to maintain a steady pipeline, workers can have stable employment, feel like they're part of a team, and understand expectations and processes. In the Northeast, onsite construction slows in the winter months. In an ideal world, a factory would have a pipeline and enough capital to build, wrapped to be watertight, and store modules outside the factory until site construction is ready for module delivery.

Because modular construction has a different processes and timelines than site built, ZEM partners such as affordable housing developers and mortgage lenders must be willing to modify

⁶² Disruptive Development: Modular Manufacturing in Multifamily Housing.
http://turnercenter.berkeley.edu/uploads/A.Stein_PR_Disruptive_Development_-_Modular_Manufacturing_in_Multifamily_Housing.pdf



existing internal processes and retrain staff to ensure projects can harness the cost reduction benefits. This is an important consideration for a ZEM pilot partners.

Modular Factories Serving New York State

A cornerstone market support for any ZEM initiative is to identify a modular factory willing to build a home sized to replace MMH that meets the stringent quality and construction standards to achieve zero energy. Ideally the factory would be located in NYS, but an out of state factory could build homes for a NYS ZEM pilot program. Modular factories, like any business, will have existing business plans and strategies to reach an identified target market and they may or may not be willing to modify those plans to build ZEM homes. In addition through our experience in Vermont and Delaware, modular factories have worked for years to distinguish their product from MMH, which are sold at a lower price point because code compliance is less stringent allowing for lower cost materials than required to meet local codes governing modular construction.

With these items in mind, VEIC first developed a list of questions to ask modular factory owners to help our team understand the potential to recruit their factories to build ZEM homes. We then identified eight modular factories through online research and stakeholder engagement. Appendix 3 contains the responses from the factory employees. The paragraphs below summarize the findings.

High Performance Modular Builders

Solar Home Factory, Geneva NY

The Solar Home Factory is an emerging, vertically integrated housing developer that builds zero energy multifamily housing in their own modular factory. In 2017, they built eight single family homes. The Solar Home Factory was also awarded \$1.2 million to develop Lake Tunnel Solar Village, a 32-unit townhouse and condo development in Geneva, NY. For that project, the Solar Home Factory will work in partnership with Lake Tunnel Solar Village to manage the housing development from permitting through to post occupancy homeowner and tenant support. Each townhouse will be two modules stacked, with a total of 64 modules assembled on site. This project is expected to break ground in the summer of 2018.

Zero energy homes are core to the Solar Home Factory's mission. Their homes are designed and will be constructed with a super insulated envelope and all-electric mechanical systems such that roof-mounted solar panels can generate as much electricity as the occupants use on an annual basis. The homes will be outfitted with LED lighting and high efficiency appliances, including a heat pump dryer. A small battery storage system is planned to provide the homes with backup electricity during outages.

The factory is designed to build 64 modules a year that are primarily planned to be assembled into townhouse or multifamily buildings.

Vermod, Wilder VT

Vermod builds exclusively zero energy modular homes and has constructed more than 75 such homes over the past six years. It offers one, two and three bedroom models and has experience with fully accessible units. The company typically installs PV panels on homes in the factory, and all of its units use air source heat pumps for heating and cooling. In addition to owned-land placement, the company has partnered with Efficiency Vermont, that state's energy efficiency utility, to replace homes in mobile home parks. Vermod is willing to become certified to deliver homes to NYS once a ZEM home is ordered. Their research into the NYS process and experience in Massachusetts indicates that third party certification can take about six months.



General Modular Builders

Westchester Modular, Wingdale NY

Founded in 1986, Westchester Modular is a Dutchess County-based modular homebuilder with models in diverse architectural styles ranging from 1,000 to 4,500 square feet as well as multifamily structures. The company serves Northeastern states through a network of builders who complete finish work on-site. There are currently 10 New York-based regional builders located in Central New York, the Hudson Valley, and Long Island. Modular homes are typically built to the ENERGY STAR level; higher performing construction, as well as LEED certification is available. Although based in the Hudson Valley, the company's modular homes have been installed from New Jersey to Maine, including on Connecticut tribal lands of the Mashantucket Pequot Tribe. VEIC spoke to Westchester Modular and they expressed interest in learning more about ZEM.

New Era Modular, Strattanville PA

Founded in 1992, New Era constructs modular homes up to 3,000 square feet and sells through a network of independent builders across the northeast. It has experience with energy efficient construction, although it is unclear whether non-fossil fuel heating systems are offered. New Era is a subsidiary of national manufacturer Champion Home Builders.

Preferred Building Systems, Claremont NH

Preferred Building Systems manufactures custom modular homes for the six New England states, and has experience with Passive House construction. It does not currently manufacture homes for the New York market, but could choose to enter; the factory is 65 road miles from the New York state border. The company only sells to wholesale builders.

Huntington Homes, East Montpelier VT

Located in Central Vermont, the company has regional experience constructing modular homes for five New England states in partnership with local contractors for site, foundation, and finishing work. Its portfolio includes a large number of luxury homes, including customized homes, but also produces models as small as 800 square feet. According to its website, last year 25% of all homes were "zero energy ready" by relying entirely on air source heat pumps for heating and cooling.⁶³

KBS Builders, Inc.

KBS was established in 2001 and has modular factories located in South Paris and Waterford, ME. Serving New England, KBS provides modular construction for residential, commercial, and industrial new construction buildings. Their website does not mention energy efficient or zero energy construction.

Titan Homes, Sangerfield, NY

Located in Central New York, Titan constructs both single- and double-section manufactured homes as well as modular homes at its large (150,000 square feet or greater) factory. It is a subsidiary of Michigan-based Champion Homes, one of the nation's largest manufactured and modular home builders. Approximately 50% of the homes from this factory are modular construction.

⁶³ <https://huntingtonhomesvt.com/the-modular-difference/>



Startup Companies

UpHomes, Hudson Valley NY

Founded in 2016, UpHomes is currently completing its first modular home. Its homes are designed to be customizable and emphasize energy efficiency (claiming 30% more efficient than state code) through high performance materials. It is unclear if the company's model home is complete. VEIC emailed and called UpHomes but did not receive a reply.

FullStack Modular, Brooklyn NY

FullStack Modular is a Brooklyn-based startup company focused on using technology to integrate modular construction for multi-story urban buildings. Backed by venture capital, it aims to offer multifamily developers the benefits of modular construction combined with extensive building information systems. The CEO has previous experience constructing a 32-story pre-fabricated residential tower in Brooklyn.

B&B Micro Manufacturing, North Adams MA

Based in the Berkshires, B&B builds both mobile "tiny houses" as well as small stick-built and modular houses. The company was established in 2016, and its website now claims more than 40 employees who produce 10-15 tiny homes per month. Tiny homes typically meet standards set by the Recreational Vehicle Industry Association rather than HUD code for manufactured homes. It is currently taking pre-orders for modular homes. The company is located 12 road miles from the New York state border.

Summary

Based on VEIC's research and outreach to various builders, there appear to be several current modular factories that may be able to produce ZEM (with training and technical support); however, more work needs to be done to gauge their level of interest and ability to meet the needs of NYS communities that may be best served by a ZEM pilot. VEIC also heard interested from individuals and organizations about opening a new modular factory building ZEM for the affordable housing market. Those conversations were very preliminary and more stakeholder engagement is needed. This work should be incorporated in the design of a ZEM pilot.

ZEM Cost-Benefit Analysis

For homebuyers, the initial purchase cost of a home is often the only metric used when determining affordability and one of the main reasons MMHs are attractive to LMI buyers. In this section of the report, we dissect, analyze, and compare the monthly costs of a new manufactured home to a new ZEM home. Inputs include the first cost of the home, financing terms, energy costs, energy efficiency and renewable energy rebates, net metering and utility programs.

We compare three scenarios:

1. A homebuyer purchases a new all electric ZEM
2. A homebuyer purchases a new HUD code MMH
3. A person is living in a MMH, with no mortgage

The result of the analysis is a monthly cash flow graph from the perspective of the homebuyer.



Model Assumptions

First Cost

The first cost of the home is the largest value and has the greatest impact on the monthly cash flow. The estimated cost of the MMH built to HUD code standard used in the analysis is an average value for a new single-wide home for the Northeast Region according to the US Census.⁶⁴ The Model Manufactured Home Installation Standards require manufactured homes to be placed on a permanent foundation and to be properly anchored to that foundation like single-family homes; therefore, we assume both the MMH and ZEM foundations are structurally equivalent and cost the same to install.⁶⁵ Delivery and set-up costs are less for the MMH than the ZEM because the MMH is pulled to the site on a metal chassis and the ZEM requires a crane to lift the ZEM off a flatbed truck and place it on the foundation. ZEM construction material costs vary and each site will have unique considerations and development requirements. ZEM cost used in this analysis were developed verbally and in conjunction with Vermod in April 2018.⁶⁶ Over the past 3 years, Vermod in Vermont, and Beracah Homes in Delaware have both experiences approximately a 20% annual increase in material costs. VEIC acknowledges that construction costs are volatile and we used the best available data at the time to estimate ZEM home construction and installation costs. We exclude land costs because we assume they are the same and land prices vary widely depending on market.

For sites where solar PV is not optimized due to shading, building configuration or site orientation, a zero energy ready modular home could be installed instead. The comfort, durability, thermal and mechanical characteristics of the home would be exactly the same as ZEM, but solar PV would not be installed. The zero energy ready modular home would have same base cost as a ZEM, and would not include installation and equipment cost of solar PV. The electric utility costs would be a factor in the monthly cashflow for the homeowners.

ZEMs qualify for energy efficiency and renewable energy rebates, which buy down first costs of the home, but MMH do not. For this analysis, we assume the homes are in a utility that participates in NYSERDA programming and that the homebuyer qualifies for LMI incentive levels, which are higher than market-rate offerings.

Table 12: Estimated first costs of and available credits for MMHs and ZEMs⁶⁷.

	Built to HUD Standards	ZEM
Factory home purchase price	\$72,442	\$150,000
Sales tax	\$1,739	\$3,600
Foundation and site work	\$10,000	\$10,000
Delivery and set-up	\$2,000	\$7,000
Solar installation (5 kW PV)	NA	\$18,750
NYSERDA LR NCP	NA	(\$4,200)
NY SUN solar rebate	NA	(\$6,000)
SONYMA down payment assistance		(\$15,000)
Net first cost	\$86,180	\$164,150

⁶⁴ <https://www.census.gov/data/tables/time-series/econ/MMHs/average-sales-price.html>.

⁶⁵ <https://www.ecfr.gov/cgi-bin/text-idx?SID=a2c5655a37054c584f7dd6a0ed240fb8&node=pt24.5.3285&rgn=div5%20->

⁶⁶ Peter Schneider conversation with Steve Davis and Kristen Connors. Vermod Home Prices have risen since economic analysis was run in April.

⁶⁷



Energy Use and Generation

To estimate energy use and energy costs for the HUD MMH and ZEM home, we used REM/Rate™ energy modeling software. REM/Rate is a RESNET accredited software tool for the Home Energy Ratings System (HERS) and an industry standard for home energy analysis. The software requires inputs on climate zone, energy costs, building construction characteristics, window areas and efficiencies, HVAC equipment efficiencies, and appliance efficiencies to estimate annual energy use and costs. REM/Rate also models renewable energy systems including solar photovoltaics (PV) and solar thermal to calculate the amount of energy consumption offset by renewables.

MMH energy efficiency standards are prescribed by the Code of Federal Regulations (CFR) Title 24 – Housing and Urban Development (HUD) Part 3280 Manufactured Home Construction and Safety Standards, Subpart F Thermal Protection. Unlike the International Energy Conservation Code (IECC), which provides prescriptive R-values and U-factors for individual assemblies, the HUD Code prescribes an overall coefficient of heat transmission (Uo) that the manufactured home must not exceed. Therefore, the level of efficiency for individual assemblies in the home may vary as long as combined they meet the (Uo) standard for the region in which the home is installed. Component assemblies modeled for the HUD home are described in Table 13 below and meet the Uo-0.079 requirement for HUD Region 3.

The ZEM technical specifications used in the energy modeling are the same as the specifications used in Vermont and recommended for all three of the New York State climate zones. The building envelope characteristics were developed using Passive House principles and adapted for the size and shape of a typical mobile home. The solar PV was sized to meet the overall annual usage of the home as predicted by the REM/Rate modeling software.

The existing MMH energy consumption is the actual pre-weatherization energy usage and costs collected by Vermont Office of Economic Opportunity for 143 MMH located in Vermont. The building characteristics and equipment efficiencies used to model the homes are listed in the table below.

Table 13: Building characteristics of MMH and ZEM homes.

	HUD (existing and new)	ZEM
Envelope		
Floor	R-22	R-40
Walls	R-19	R-42
Windows	U-0.35	U-0.21
Doors	R-6	R-5
Ceiling	R-30	R-60
Infiltration	8 ACH50	0.60 ACH50
Mechanicals		
Heating	75 AFUE	13.5 HSPF
Cooling	13 SEER	30.5 SEER
Hot Water	0.92 EF	2.75 EF
Duct Insulation	R22/R8	n/a
Duct Leakage	12%	n/a
Ventilation	Exhaust; 50 cfm, 50 w	Balanced, 50 cfm, 62w
Lights & Appliances		
Efficient Lighting	34%	100%
Appliances	Conventional	ENERGY STAR+

Photovoltaic System (PV)		
Climate Zone 4		5 kW
Climate Zone 5		6 kW
Climate Zone 6		7.5 kW

Fuel cost assumptions for New York were obtained from NYSERDA's monthly average pricing reports in Table 14.

Table 14: Energy rates assumed for models

Fuel	Unit	Cost
Electricity	kWh	\$0.18
Oil	Gal.	\$3.22
Propane	Gal.	\$3.22

Source: <https://www.nyscrda.ny.gov/Researchers-and-Policymakers/Energy-Prices>. Accessed April 2018.

A total of 54 scenarios were modeled in REM/Rate. HUD and ZEM base models were run in each of New York's three climate zones. The HUD home was modeled with four different primary heating systems: electric resistance, electric furnace, oil furnace, and propane furnace. Additionally, the HUD homes was modeled to the Uo-0.079 HUD specification required for Region 3 as well as to the specification modeled by the Pacific Northwest National Lab (PNNL) for the U.S. Department of Energy (US DOE) Manufactured Home Working Group. The PNNL analysis represents more typical manufactured home installations. For purposes of this report, the HUD specification was utilized in the energy cost comparison. All scenarios were also modeled to the 2016 Energy Conservation Construction Code of New York State (ECCCNYS) specification.

Financing

For the analysis, we assumed the ZEM buyer qualified for SONYMA ENERGY STAR Labeled Homes mortgage. This mortgage was chosen to use as an example because it provides low-interest rates for ENERGY STAR Labeled homes, as well as a down payment assistance loan (DPAL) up to \$15,000. The DPAL buys down the first cost of the home. Homebuyers pay a small percent of interest for the DPAL, which is incorporated in the primary mortgage. Homes must be located in SONYMA Target Areas on owned land.⁶⁸

An MMH on owned land, on the other hand, would historically only qualify for a chattel loan with short terms and high interest rates. As discussed earlier in the report, 75 percent of chattel loans used for MMH purchase are 5 points above the APOR and also generally require a down payment.⁶⁹

Table 15: Financing terms

	Interest rate	Term (years)	Down payment
ZEM	4.25%	30	0
MMH	9.00%	15	10%

⁶⁸ <http://www.nyshcr.org/Topics/Home/Buyers/SONYMA/ENERGYSTARMortgageInterestRates.htm>.

⁶⁹ https://s3.amazonaws.com/files.consumerfinance.gov/f/documents/bcfd_hmda_2017-mortgage-market-activity-trends_report.pdf.

Results

Comparing the monthly financing and energy costs between a new HUD MMH, existing MMH, and ZEM shows that a new HUD home costs about \$200 dollars a month more to own and operate than the ZEM. The savings for ZEM are from both reduced energy costs and better financing.

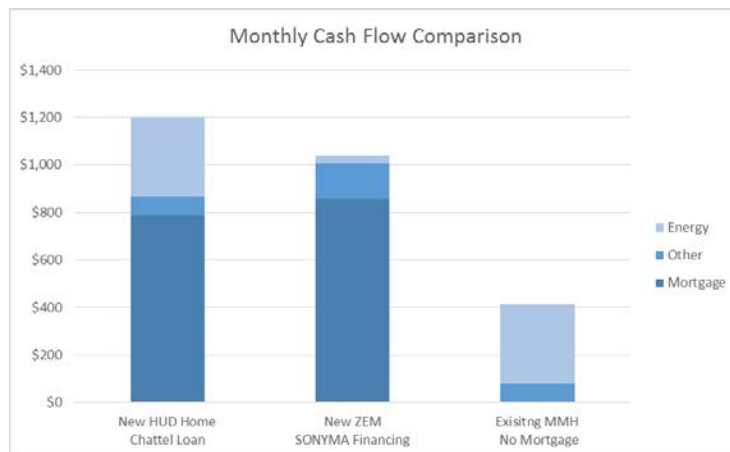


Figure 4: Monthly cash flow of new HUD MMH, ZEM and existing MMH

When defining affordability as 30 percent of income spent on housing, the HUD home with monthly expenses of \$1,201 (\$14,416 annually) is affordable to homebuyers earning \$48,052 per year and the ZEM home with month expenses of \$1,040 (\$12,481 annually) is affordable to homebuyers earning \$41,602 per year. The existing MMH with \$415 a month in expenses (\$4,975 annually) is affordable for households earning \$19,385 a year.

Non-Energy Benefits

In addition to reduced energy costs, ZEMs also offer non-energy benefits, including improved occupant health and comfort. MMHs are known to have poor indoor air quality and air sealing. Prone to higher levels of mold and indoor volatile organic compounds, MMHs can be particularly harmful to those already vulnerable to respiratory ailments, including children, the elderly, and those who are already ill. A 2017 study based on a decade of data gathered through the National Health and Nutrition Examination Survey found that people living in MMHs were 40 to 50 percent more likely to suffer from respiratory problems than those living in other housing types such as site-built homes and apartments.⁷⁰ In contrast, a survey of ZEM occupants in Vermont found that those who were former occupants of MMH experienced improved air quality and ventilation in their ZEM homes, as well as improved health in themselves and their family members.⁷¹

Statewide Energy and Economic Impacts of ZEM Development

ZEM is a promising affordable housing solution that will also bring benefits by reducing energy use and GHG emissions, and supporting local green jobs building these new homes.

⁷⁰ Prevent Medicine Reports. 2017: Different types of housing and respiratory health outcomes: <https://www.sciencedirect.com/science/article/pii/S2211335517300992>.

⁷¹ University of Vermont Center for Rural Studies. 2017. Assessment of the market of energy efficient factory built homes in Vermont: <https://www.vhcb.org/pdfs/UVM-Center-for-Rural-Studies-HPMMH-Report-May-2017.pdf>.



ZEM Development Opportunities

From the findings to date, we have analyzed potential development scenarios, estimated potential market sizes for ZEM, and identified each sector's most relevant opportunities and barriers. The market is estimated in terms of technical potential, which is the total potential for a new technology not tempered by customer economics or preferences. In the context of ZEM, the technical potential considers the full number and type of homes that ZEM has been designed to replace.

Homeownership or Rental in Existing Communities or on Owned Land⁷².

Owned Unit, Owned Land, Replacement or New Unit

There are approximately 90,000 owned MMH on owned land in NYS, many of which are old and in need of replacement. We estimate that there are an additional 900 new MMH units purchased each year that are placed on owned land. ZEM as a replacement for MMH on owned land can access traditional mortgage financing with the most favorable mortgage product being the USDA Rural Development 502, which is available for LMI. The replacement market has the advantage of reduced first cost because ZEM homebuyers can use existing foundations and infrastructure for replacement units. However, it also has the added cost of removal and disposal of the existing unit. Many of the existing MMH are owned outright and homeowners may be adverse to talking on debt; therefore, targeting this segment could carry a high administrative burden working with individual customers and is more difficult to scale than working with cooperatives.

Owned Unit, Leased Land, Replacement Unit

The estimated technical potential for replacing an owned unit on leased land is 68,000 units, which includes placement on vacant lots. Although the size of the market makes this an appealing opportunity for a pilot, the insecure land tenure and the inability to qualify for traditional mortgage financing makes the economics challenging. Historically this would not be a good market for pilot work because private park owners generally only offer short term leases that do not allow for mortgage financing. However, as HCR's Manufactured Home Advantage Program (referenced in the Existing Affordable Housing Programs section of this report) launches and enables more of these parks to offer long lease terms to their residents and HCR offers mortgage financing, this could become an excellent pilot population for ZEM.

Owned Unit, Co-op / ROC, Replacement Unit

The estimated technical potential for replacing owned units that are located in parks owned by cooperatives or ROCs is approximately 1,000 units, including vacant lots. These units create an opportunity for a pilot because of the security of land tenure and the somewhat lower first cost due to foundations and other infrastructure already in place. Principal barriers to participation in a pilot will be finding lending institutions willing to offer conventional mortgage products on leased land for ZEM homes, although as noted above, SONYMA's partnership with HCR to offer loans to residents of parks with long-term lease structures may help to alleviate that barrier. Working with one or two selected coops or ROCs that offer longer-term tenures might be an acceptable condition for additional financing institutions to offer attractive financing for ZEMs. This strategy that has worked in Vermont.

⁷² VEIC derived the estimated values for the development scenarios using data from 2016 American Community Survey, ROC USA, and the HCR Mobile Homes Community Registration data found on line. The data and calculations are found in the appendix file Estimated Benefits of ZEM 20180918.xls

Rented Unit, Rented Land - Replacement

Rental units on rented land account for 26 percent of all MMH in NYS or approximately 50,000 MMHs. These units are found in private MMH communities and on individually owned land. Under both scenarios, the home and land are rented as a package under one lease. As a pilot opportunity, this market would be complicated to implement, but fill a gap for LMI affordable rental units. The economics of this scenario are challenging, and would require partnerships with investors and affordable housing developers who could target communities who can take advantage of tax credits and financing offered in targeted areas such as Opportunity Zones. .

Table16: Summary of conditions and potential for ZEM pilot program.

Ownership	Market	Technical potential	Potential for pilot program
Owned Unit, Owned Land	Replacement Unit	90,884	Medium
	New Unit, New Land	892	Medium
Owned Unit, Leased Land (Resident Owned Community or Coop)	Replacement Unit	796	High
	New Units	7	High
	Vacant Lot	194	High
Owned Unit, Leased Land (Private)	Replacement Unit	51,122	Low
	New Units	660	Low
	Vacant Lot	16,866	Low
Rented Unit Owned & Leased Land	Replacement	49,894	Low
Total MMH (includes sales of new homes and vacant lots)		211,314	

Source: Calculation method uses 2016 American Community Survey 5 yr estimates, Census Manufactured Home Survey, and 2016 HCR Mobile Home Park Registrations. Calculation table found in Appendix 5 – Estimate Benefits of ZEM.

Park Conversion, Homeownership and Rental

Converting existing MMH parks to coops, resident owned communities, or rental developments has high potential for ZEM over the long term. Park conversions to coop would provide residents with more secure land tenure. Longer leases and more secure tenure could then encourage partnerships with financial institutions to bring conventional long-term mortgage financing to community residents, at a much lower cost than the chattel loans they are currently using. This strategy has been used in Vermont, with sustained long-term commitment from affordable housing developers, policy makers, public and private mortgage lenders, utilities, and energy efficiency and renewable energy agencies. The technical potential of this market is about 70,000 units.

Park Purchase, Owned Home, Leased Land

There are several development models that can be used to promote converting existing MMH parks into cooperative ownership.

- ROCUSA and its local NYS affiliates, Pathstone Corp, Cooperative Development Institute, and North Country Coop Foundation, have converted nine communities with about 800 homes to ROCs. ROC affiliates can access financing from ROC Capital, a subsidiary of ROC USA, or other low-rate financing to facilitate low-cost purchase of the land and infrastructure. Funding for necessary infrastructure improvements can be included in the financing package to update sewer, water, and road infrastructure. Technical assistance



is provided to the community for the life of the loan. Initial discussions with ROCUSA about ZEM have brought limited interest; high upfront ZEM costs are perceived as a barrier.

- Any affordable housing developer, public housing authority, or municipality could access Community Development Block Grant (CDBG) and HOME Investment Partnership (HOME) programs to purchase and redevelop a park with ZEM.
- The newest opportunity which has been discussed elsewhere in this report is HCR's Manufactured Homes Advantage Program. Much like the ROCUSA technical and financial assistance, this program offers a Manufactured Home Park Preservation Loan with access to low-cost capital to purchase and rehabilitate parks for long-term affordability, meaning that the purchasers must agree to keep the park affordable for the full term of the 30-year loan.⁷³

The target demographic for ZEM is homebuyers between 80 – 120 percent of area median income, which is a bracket of income that generally can qualify for a mortgage and for which the full cost of ZEM is considered affordable according to our benefit-cost assessment. Redevelopment of parks can happen in phases; first filling the vacant lots with ZEM, then offering them as replacement alternatives to residents looking to replace an existing MMH with a new home.

Park Purchase, Rental

In the case of a park purchase with ZEM rental placements, the former comments about the use of CDBG or HOME funds apply, as do the comments about the target demographic (detailed in section above).

⁷³ http://www.nyshcr.org/Topics/Lenders/Lenders/HCR_Manufactured-Homes-Brochure-v1_8.5x11_Bleed_8.13.18.pdf



Table 17: Examples of park conversion, homeownership and rental.

McKnight Lane, Waltham Vermont	Developed by Addison County Community Trust in partnership with Cathedral Square Corporation. Site was formerly an abandoned mobile home park and brownfield with significant soil contamination. Designed for low-income rental housing with tenant eligibility based on 60% of area median income. 7 ZEM duplexes with 14 two- and three-bedroom homes which include solar PV and battery storage. VEIC, Clean Energy States Alliances, High Meadows Fund, and Green Mountain Power partnered to purchase and install battery storage at no cost to the developer.
Southwood Mobile Home Park, Charlottesville, Virginia	Habitat for Humanity of Charlottesville, VA Purchased Southwood in 2007. In midst of 10-year stakeholder engagement and redevelopment plan. Considering ZEM for homeownership and rental.
Ponderosa Mobile Home Park, Boulder Colorado	City of Boulder purchased mobile home park in 2017. Planning infrastructure upgrades in 2018. Working to identify a long term ownership structure such as resident-owned or nonprofit.
Evergreen Mobile Home Park, Hardwick, Vermont	Park owned and redeveloped by Lamoille Housing Partnership, an affordable housing nonprofit in central Vermont. 2 existing ZEM homes were set in 2014. 11 new ZEM homes will replace abandoned mobile homes to serve as affordable rental housing (2 homes will be fully ADA accessible).

Infill in Urban Downtowns

Although the initial scope of work for this study was ZEM as a replacement for MMH, abandoned properties (also known as Zombie properties) quickly emerged as a promising market for ZEM. Zombie properties are a considerable problem for many cities and their residents. This has become a much bigger problem since the Great Recession when home values dropped precipitously in many areas and homeowners found themselves owing more on their mortgages than their homes were worth. Zombie properties generate no tax revenue, and therefore contribute to perennial municipal budgetary gaps. Syracuse, for example, loses an estimated \$7 million annually on foregone property taxes on 2,000 zombie properties. Second, zombie properties are detrimental to community development efforts, with negative impacts on property values, criminality, and private investment. Although urban infill is a different market than MMH replacement, there is interest in exploring the benefits of ZEM in this application.

The cost of new construction of a traditional stick-built home to replace the zombie is approximately \$250,000. This cost is unaffordable to most low-income homebuyers. Debt-to-income (DTI) ratio requirements will limit the loan amount for most buyers at approximately \$120,000.

Estimated Benefits of ZEM

Having established the technical potential of ZEM with likely development scenarios, we can estimate long-term benefits of a ZEM pilot program. Our understanding of the market conditions in NYS allows us to estimate how many ZEM homes over the course of 11 years can replace:



- Existing manufactured homes
- New manufactured homes
- Abandoned homes on urban lots

Estimated energy use of the baseline homes was calculated in REM/Rate. For baseline purposes, 60 percent of homes are assumed to be heating with fuel oil and 40 percent with liquid propane gas. Emission factors for fuel oil and propane are from EIA and the emission factor for electricity is from US EPA. Calculations and details are found in Estimated Benefits of ZEM spreadsheet in the Appendix. High-level assumptions include:

- 10,000 ZEM homes installed over the course of 11 years
 - 7,000 ZEMs replacing existing manufactured homes, or 4 percent of the technical potential
 - 1,500 ZEMs purchased instead of new manufactured homes, or about 10 percent of the technical potential
 - 1,500 ZEMs installed in urban infill, where there is a vacant property or abandoned lot⁷⁴

Table 18. Estimated ZEM benefits, 2019 - 2030

Summary Table Estimated ZEM benefits 2019-2030	
Number of Years	11
Number of Homes	10,000
Electric Savings (kWh)	68,435,697
Oil Savings (gal)	2,845,738
Propane Savings (gal)	2,834,211
Energy Cost Savings	\$28,942,986
Avoided Emissions (lbs. CO2)	185,107,471

ZEM Pilot Infrastructure Needs

Our work indicates there is enough demand for a ZEM program. In order to launch a ZEM pilot, VEIC has identified through its research and stakeholder engagement for this market assessment several elements important for success and to what degree they currently exist or would need to be developed for a ZEM pilot. This section contains a summary of those results and our recommended next steps.

Modular Factory

ZEM homes need to be built relatively close to where they will be delivered in order to reduce the economic and environmental costs of transporting the home over long distances and our preliminary research indicates that NYS factories will have lower permitting costs than homes delivered from out of state. Identifying a modular factory to work with may include partnering with an existing factory that is willing and able to add ZEMs to its product line, or identifying a partner willing to start a new factory. During this phase of work, VEIC was not able to identify a NYS modular factory immediately willing to build ZEM homes for an affordable housing pilot. Vermod, a Vermont based modular factory is willing to partner on a NYS ZEM pilot to deliver homes to NYS.

⁷⁴ Although we have not characterized the technical potential of the infill market, we believe 1,500 over the course of 11 years is a small percent of the abandoned properties.

Since a ZEM pilot would be part of a larger market transformation effort, it will be important to promote growth in modular factory capacity. One resource to help that effort will be Volume 2: ZEM Factory Initiative, a reference manual to help potential factory owners understand startup costs, staffing and space requirements to set up and operate a ZEM factory.

Financing for ZEM homes

The program will need to identify financing partners able and willing to offer mortgages for ZEMs on leased and owned land and which have a long enough payback period and low rates to ensure affordability for the homebuyer. SONYMA offers several loan products that could be used to finance ZEM homes on owned land or in parks with long term leases. USDA Rural Development 502 Housing Direct Loan Program could be used to finance ZEM homes on owned land in rural areas served by USDA, and potentially on leased land in those same rural areas if USDA were to adjust existing program offering to include ZEMs in parks with long term leases, a modification that was made for the Vermont ZEM program.

Financing for Park Conversion

Parks that transition from private ownership to cooperative models often need significant upgrades and it is best if the financing for those upgrades can be rolled into the overall financing for the park purchase. Otherwise, it can be a struggle to both provide a competitive purchase offer and then subsequently maintain an adequate capital fund for improvements to park infrastructure. Not uncommonly, at the time of sale, privately owned parks require extensive upgrades to water and septic systems, and may be plagued by abandoned homes. These costs must be considered in the purchase price and financing package; otherwise, newly formed cooperatives are stuck either raising residents' fees or deferring maintenance. HCR's newly launched Manufactured Homes Advantage Program creates new opportunities and resources for NYS parks to transition to non-profit or resident ownership with minimum lease terms of 30 years.

Homebuyer Recruitment

As ZEM is a new product, a dedicated and multi-pronged effort needs to be made to attract new homebuyers. An important recruitment tool is a ZEM model home that can be toured by potential homeowners and partners and allows interested parties to experience the quality and comfort of the home. Partnerships with homebuyer counseling services offered by affordable housing and community action agencies, and HCR's new Manufactured Homes Advantage Program would be a way to leverage existing services to promote ZEM and recruit homebuyers.

General Contractor

For each ZEM development, an organization will need to be responsible for construction oversight and completion. This will include securing permits, compliance with zoning, site prep, foundation installation, utility connection and completing site cleanup and landscaping. This general contracting role could be filled by the factory if they provide turn key services. It could also be filled by an affordable housing developer.

Grants/Incentives

ZEM homes are approximately twice the cost of new manufactured homes and about 5 to 10%⁷⁵ more than standard built new construction. And while lower energy and maintenance costs of ZEM lower the monthly expenses, grants, utility incentives and other financial assistance is

⁷⁵ Clean Energy Fund Investment Plan: New Construction Chapter. Submitted by NYERDA. Revised April 9, 2018.



needed to make these homes affordable for low income home buyers. Our expectation is that as the market for ZEM grows and builders refine their systems for producing them, that costs will come down; however, financial incentives will be necessary until that market is more fully developed. NYSERDA and affordable housing providers in NYS have current programs, such as cash incentives for EE and RE, down payment assistance grants, and affordable financing products which, if applied to the purchase cost of a new ZEM, can achieve affordability for the target market.

Secure Land

ZEMs need to be placed on owned land or in parks with long-term leases, such as resident owned cooperatives or parks owned by a nonprofit. This is due to the need to utilize long-term mortgage financing to achieve monthly affordability for the low-moderate income home buyer. There currently are a handful of these parks in NYS and there are emerging opportunities to work with organizations like HCR, SONYMA, and ROC USA to increase the number of parks that offer this long-term housing stability.

Other Market Supports

Other market supports that support a successful ZEM program include:

- Net metering, so that residents can access credits to excess generation during months when solar production is less than consumption
- Appraisals which appropriately value the ZEMs based on other modular, not manufactured, home comparables and energy efficiency characteristics
- Installers of energy efficient equipment and renewable energy systems
- Home energy raters to qualify the efficiency of the home's construction in order to qualify for relevant incentives

The results of our market study show that NYS has some of each of these market supports, but that more will need to be done to shore up individual markets, especially in the area of appraisals addressing zero energy construction, comparable sales and neighborhood conformity.

Conclusions and Recommendations

There is a strong need for new affordable housing solutions in NYS and ZEM provides an excellent opportunity to meet that demand in a way that also advances the State's clean energy goals. VEIC recommends that NYSERDA proceed to the design and implementation of a pilot program, which will be the first step in a long term market transformation effort to bring clean energy to NYS affordable housing. VEIC is actively supporting ZEM programming in Vermont, Delaware, and Massachusetts and would be pleased to support NYSERDA as well should it decide to proceed to design and launch a ZEM pilot program.

Key considerations and recommended next steps include:

Collect Input from Potential Homebuyers

In the Market Assessment phase of work, VEIC did not do outreach to potential homebuyers as it was not included in the project scope. During pilot program design, VEIC recommends talking with potential single family homebuyers and residents of mobile home communities to understand their needs, perceptions of zero energy homes, and attitudes towards taking on debt. This is a critical step when designing outreach and homebuyer marketing campaigns.



Work with a Range of Potential ZEM Development Scenarios and Sites

Many organizations which VEIC connected with over the course of this study expressed interest in ZEM as an affordable housing solution both for single family development and mobile home replacement. It is well known in affordable housing circles that development is slow and therefore encouraging multiple paths in parallel will accelerate the adoption of ZEM, and this is well aligned with stakeholder feedback. Ideally, a number of different development options will be explored at once, and multiple homes will be recruited since developing a single site all the way through to completion can take a year or more. This type of program needs to have continuous learning integrated into the process and partnerships that can help leverage outside resources to be successful. New York would be well-served to consider multiple locations for ZEM siting, as well as a variety of ZEM development and ownership models, including rental.

VEIC initially designed ZEM as a clean, healthy, and resilient alternative to manufactured housing for residents of mobile home parks and for people that are interested in placing or replacing a manufactured home on a single family lot and have learned there is demand across single family and rental affordable housing markets as well. We recommend that NYSERDA pursue these paths simultaneously to improve overall market adoption and long term transformation.

Mobile Home Park Track

For the park track, NYSERDA should establish partnerships with entities that it can work with to:

- Gain access to these communities – for example, establishing a partnership with Pathstone or CDI to identify existing coops that are financially stable and have a few vacant lots that could be filled with ZEMs
- Provide financial resources – to new homebuyers to purchase a ZEM, as well as to finance the transition of privately-owned parks to ROCs or non-profit ownership. HCR's Mobile Home Advantage Program and SONYMA's mortgage products for MMH homebuyers are intriguing opportunities to explore, assuming these entities are willing to extend the benefits of their programs to ZEM homebuyers.

Single Family Track

For the single family track, the pilot program should establish relationships with affordable housing developers interested in providing clean energy to their clients and willing to modify their typical development schedule to match modular factory process which varies from site build with respect to financing and decision making timelines. The upfront cost of ZEM compared to code construction is higher and can deter affordable housing developers who do not fully understand how energy bills from code construction homes drive up the total cost of ownership compared to ZEM. VEIC has had excellent success working with Habitat for Humanity in Vermont and Massachusetts to provide ZEMs to eligible homebuyers. Habitat is a full service affordable housing developer. They can fill the role of financing, land acquisition, and homebuyer liaison. Our experience with Habitat chapters is they are interested in modular to increase capacity, and decrease risk exposure for volunteers. Modular factories can deliver a water tight, zero energy home without completing interior finishes. This allows Habitat homebuyers to dedicate hours completing their home which is core to the habitat self-help model.

Another opportunity that should be investigated is how ZEM could support urban infill projects. This could be in partnership with HCR has expressed interest in further exploring ZEM.



Identify and Develop Factory Capacity

VEIC's assessment of the existing modular factory building resources in NYS did not identify any existing builders with a strong interest in developing the skills and infrastructure to build ZEM, though a couple expressed some interest in learning more. A ZEM pilot could be served by Vermont's current builder depending on the location of the initial pilot market(s); however, we recommend that additional effort be invested in further engaging affordable housing developers and entrepreneurs that may be motivated to launch a new modular factory. VEIC's work funded by the New York Community Trust will provide valuable technical information and guidance to stakeholders interested in launching a factory. The ZEM Factory Initiative scope of work is found in Appendix 9

Launch Pilot in "Shovel-Ready" Markets

The pilot should be launched in areas that are primed for this opportunity. Demonstrating success in communities with the most existing supports and least program barriers will increase the scale of adoption and provide an example to other communities to follow. For example, the pilot will need to be offered only in cities and towns that offer net metering and EE/RE incentives in order to bring down the first cost of the home. The pilot should also target areas with financially stable coops, infill opportunities, or planned Habitat developments. And finally, consideration needs to be given to the location of modular building resources, with a focus on targeting communities that meet the above criteria while also be situated within a reasonable distance from the builder.

Train Appraisers in ZEM Valuation

As noted in this report, appropriate valuation of ZEM is critical to ensuring that the appropriate type and amount of financing is available to homebuyers. Traditional approaches to comparables and neighborhood conformity are not appropriate for this new housing type and so the program will need to ensure that appraisers are engaged and informed as the pilot is launched. In NYS the network of "green appraisers" is mainly concentrated in the NYC area, so pilot activities will need to include training of appraisers in the target markets that will be served.

Provide Building Science Technical Assistance and Verify Performance

As existing modular factories transition from standard building practices to meet the ZEM specification and new modular factories emerge to meet increasing demand for ZEM homes, building science and construction support should be provided to factories during early years of the ZEM pilot to ensure homes are built to operate as zero energy. Monitoring ZEM home's post occupancy will provide valuable data on energy performance (use and production) and indoor air quality that can be used to ensure program is delivering healthy, zero energy homes as promised.

Support Homeowners Post Occupancy

Homebuyer education on the operation and maintenance of their ZEM home is a key ingredient to ensuring that the program meets its goals for energy savings, affordability, and comfort. The ZEM pilot should deliver post-occupancy training and technical assistance to answer homeowner questions. Conducting post occupancy customer satisfaction surveys and feedback can inform future program offerings.

Provide Adequate Resources to Propel a Program's Launch

VEIC has learned through our experiences in Vermont, Delaware and Massachusetts, that program design, launch, and maintenance takes dedicated resources in the form of staff, time,



and budget. The early years need adequate supply of all of these to ensure the various pieces described above pieces come together seamlessly and that when barriers arise, there is support available to quickly find solutions. This support can come through effective collaboration and partnerships with other interested parties, but it also should include a clear articulation of the program roles and responsibilities to ensure a positive and uncomplicated experience for homeowners and the general market.

VEIC's experience has shown that approximately six months should be dedicated to the program design effort and that program launch and early implementation can take about three years. Confirmed support for the program – both financial and staffing – will be necessary to bring this new product into the market. The level of program implementation staffing and other supports may be able to begin ramping down after the initial three years depending on market adoption.

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Appendix 1 – Energy Modeling Method Memo



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veic.org

TO: John Scicchitano and Chris Coll
 FROM: Alison Donovan, Leslie Badger, and Peter Schneider
 DATE: April 16, 2018
 UPDATED: May 20, 2018
 RE: ZEM Market Assessment – Technical Specifications & Economic Analysis of ZEM

The ZEM market Assessment for NYSERDA is organized into four focus areas:

1. Market demand for ZEM
2. Technical Specifications of ZEM
3. Economic Analysis of ZEM for Homeowner
4. Existing Factories to build ZEM

In this memo we outline our initial thinking on the *Technical Specifications on ZEM* and propose the method to calculate energy savings for ZEM, which will be one of the inputs for *Economic Analysis of ZEM for Homeowner*.

We are sending you this memo to get NYSERDA’s early feedback on the methodology and also understand what type of data NYSERDA or HCR may have in house that could improve our analysis.

Energy Savings and Modeling Method

Modeling Consideration	Details	Comments/ Questions
Software	VEIC will use REM/Rate™ ver 15.6.1 energy modeling software	
ZEM Home Technical Specifications	ZEM model with current Vermont specification. Equipment modifications, as needed, to meet NYSERDA RNC program.	Assumes compliance with ENERGY STAR to access RNC incentives We believe the same ZEM technical specification is appropriate and cost effective for all NY climate zones but will test that theory during modeling
Three Baseline Scenarios for ZEM energy savings	<ol style="list-style-type: none"> 1. Manufactured home baseline - New HUD Manufactured Home 2. Manufactured home baseline - Existing manufactured home 	For #1, Technical Specifications found below For #2, Data provided is a sample of Vermont existing manufactured homes actual fuel history pre-weatherization, not based on modeling. Will like to get data from NY actual MMH
Software	VEIC will use REM/Rate™ ver 15.6.1 energy modeling software	
ZEM Home Technical	ZEM model with current Vermont specification. Equipment	Assumes compliance with ENERGY STAR to access RNC incentives

Modeling Consideration	Details	Comments/ Questions
Specifications	modifications, as needed, to meet NYSERDA RNC program.	We believe the same ZEM technical specification is appropriate and cost effective for all NY climate zones but will test that theory during modeling
	3. Infill baseline - New home modeled to New York energy code ECCCNY-2016.	For #3, REM/Rate generated consumption data for each scenario modeled to ECCCNY-2016
Baseline Scenarios Heating Fuel/System	Heating fuels: Electric Baseboard, Electric Furnace, Propane Furnace, Oil Furnace	A single typical baseline fuel/system type, propane furnace, has been selected for comparison to ZEM. Any baseline may be selected for further analysis.
Physical Configurations	Model one ZEM configurations: Single wide	Same size and geometry used in all REM model configurations. Actual Vermont manufactured home data represents a variety of sizes and configurations
Climate Zones	Model each fuel/system combination in 3 NY IECC climate zones: 4A, 5A, 6A	A single climate zone, 6A, has been selected for the report. Any climate zone may be selected for further analysis.
Reporting Results	<ul style="list-style-type: none"> • Monthly cash flow • Summary results for highest level use case presented in report body • Detailed inputs and results presented as spreadsheet appendix to report 	

NOTES

- Assumptions and static ZEM spec will be the basis for discussion/feedback
 - Do we want to consider alternative spec, mechanicals etc.
- Utilize VT actual data (OEO/baseline and Vermod/ZEM) as reference to validate modeling and/or use to create adjustment factor to modeled results for final report.

Summary Technical Specifications for ZEM and HUD New Manufactured Home

	HUD	ZEM
Envelope		
Floor	R-22	R-40
Walls	R-19	R-43
Windows	U-0.35	U-0.21
Doors	R-6	R-5
Ceiling	R-30	R-60
Infiltration	8 ACH50	0.60 ACH50
Overall heat transfer coefficient (Uo)	0.079	0.036
Mechanicals		
Heating	75 AFUE	13.5 HSPF
Cooling	13 SEER	30.5 SEER
Hot Water	0.92 EF	2.75 EF
Duct Insulation	R22/R8	n/a
Duct Leakage	12%	n/a
Ventilation	Exhaust; 50 cfm, 50 w	Balanced, 50 cfm, 62w
Lights & Appliances		
Efficient Lighting	34%	100%
Appliances	Conventional	ENERGY STAR+
PV System		
Climate Zone 4	n/a	5 kW
Climate Zone 5		6 kW
Climate Zone 6		7.5 kW

Appendix 2 – Subscription Data Set

The US Census Bureau collects publicly-available data on residents and housing in a uniform, representative fashion. Proprietary consumer datasets about MMH residents and offer complimentary insight into residents' economic status and borrowing ability. NYSEDA shared InfoGroup and CoStar MMH data sets with VEIC, and compared the data to Census which showed large discrepancies in the numbers. After careful analysis, VEIC chose to use Census data and that rationale is presented below.

Subscription Data Profiles of MMH Residents

The InfoGroup dataset for New York State covers more than 25,000 adult residents categorized as living in mobile home parks. This dataset contains less than 20% of MMH residents statewide, however, suggesting that individual profiles are unavailable for many residents or that MMH units are miscategorized as other housing types. (In addition, multiple adults can live in one MMH unit.) Such errors or omissions in large scale consumer data are to be expected. These databases are intended to be used for target marketing and profiling rather than statistical analysis.

The data include income estimates for all park-residing adults. Nearly 59% of profiled park residents earn more than \$40,000 annually, and 32% earn more than \$70,000 annually. While debt and monthly expenses are unknown, the data confirm that park residents include many moderate-income residents with sufficient credit for long-term financing at market rates.

The dataset also reports the mortgage interest rate for 9,533 of the 25,577 individuals profiled. However, only 363 individuals have mortgages issued between January 2010 and February 2018, with average interest rates of 4.2%. (Over the same time, average annual mortgage rates for 30-year fixed mortgages ranged between 4.7 and 3.7%.¹)

It is unlikely this sample is representative of MMH owners who have financed their homes for three reasons. First, the mortgage data is collected from public land records, and thus excludes financing products offered for personal property rather than real property. Second, the records do not include mortgage terms and origination costs. In addition, data from the last eight years is available for only 4% of MMH owners, and 36% of home values are listed above \$150,000. These valuations are unlikely for such a high share of park-sited manufactured homes.

Overall, despite its limited statistical application, the proprietary dataset suggests that many MMH park residents are moderate income households that would be deemed creditworthy and eligible for financing.

Park Ownership Turnover and Commercial Real Estate Transactions

CoStar provides data on real estate transactions for all categories of commercial and industrial properties. Property data is drawn from commercial multiple listing services for properties placed on the open market for sale. Properties that are transferred in other ways, such as through private sales or bequests, may not be included in the dataset.

CoStar's data for New York State mobile home parks consists of 434 parks, which is less than a quarter of known parks; sale dates are available for 211 parks. Between 2010 and 2017 (inclusive), 179 park sales were recorded, an average of 22 per year. Recent years appear to have more complete data. Total annual sales in 2015-2016 averaged 36, which indicates approximately 2% of parks are sold on the open market per year. Actual turnover is higher, but a precise figure is unknown due to incomplete data. (For example, a number of parks that have

¹ FreddieMac, <http://www.freddiemac.com/pmms/pmms30.html>

become Resident Owned Communities over the past decade have missing sale dates or sale prices in the dataset.)

Appendix 3 – Stakeholder Outreach

The primary goal of stakeholder engagement for the Market Analysis for Zero Energy Homes in New York State was to gather critical knowledge of the market and insights on the opportunities and barriers. Stakeholder engagement provides information for NYSERDA when moving forward with pilot program design in several key ways:

- Strengthen the foundation for broad-based support through information sharing
- Gain valuable insight on challenges affordable housing developers face
- Input from stakeholders will help prioritize recommendations and next steps
- Identify influential supporters or detractors early in the process
- Identify champions who have the potential to be ZEM pilot partners

Interested Parties

This memo documents the stakeholder meetings that happened through our market research work

Completed Outreach

- **Tompkins County Climate Protection Initiative (TCCPI)**– On March 30, 2018, VEIC attended TCCPI monthly meeting and presented on ZEM initiative and market research work plans. Approximately 25 people attended the session.
- **Low Income Forum on Energy (LIFE) Annual Conference** – On May 23, 2018, VEIC presented ZEM at a session facilitated by NYSERDA. Approximately 30 people attended session.
- **Akwesasne Housing Authority (AHA) EcoVillage** – On April 24, 2018 VEIC was invited to participate in final design charrette facilitated by Sustainable Native Community Collaborative (SNCC). At the meeting, SNCC presented their work with AHA to explore a 44-unit EcoVillage on two parcels of land currently owned by AHA. Building to zero energy modular standard and creating a local ZEM Factory were discussed as a way to create affordable housing and create local jobs.
- **LIFE Webinar** – On August 15, 2018, VEIC in partnership with NYSERDA, presented the findings of the market assessment report during a LIFE webinar and ask audience for input on several key questions. The coalition that makes up the LIFE network is a long-standing group of advocates, program implementers and funders working to help low-income New Yorkers on housing and energy issues who will all receive the webinar announcement through the LIFE list serve. We believe the webinar is an efficient way to solicit input on the ZEM Market Assessment and cast a wide net to surface potential ZEM supporters.
- **Tompkins County Legislature's Housing Committee**- On September 17, VEIC and NYSERDA remotely participated in the housing committee meeting remotely to answer questions about ZEM housing and potential to open a local ZEM factory in Tompkins County.

Name	Title	Organization
Jerimiah Ward	Cooperative Development Specialist	Cooperative Development Institute
Cam Hebda	Manufactured Housing Cooperative Program Manager	Pathstone
Retha Herne	Director	Akwesasne Housing Authority
Lucille G. White	Director of Planning	Seneca Nation of Indians Seneca Housing Authority
Megan McDonald	Deputy Commissioner	Tompkins County Department of Planning and Sustainability
Martha Robertson	Chairperson, County Legislator Chair of the Program Oversight Committee of the Community Housing Development Fund	Tompkins County Legislature
Joe Bowes	Director of Real Estate Development	Ithaca Neighborhood Housing Services INHS
Rachel Wieder	Director, Special Initiatives	Homeownership and Community Development, Homes and Community Renewal
Dina Levy	Senior Vice President, Single Family and Community Development	SONYMA, Homes and Community Renewal
Joseph Kunkel	Executive Director	Sustainable Native Communities Collaborative
Nathaniel Corum	Design Director	Sustainable Native Communities Collaborative
Ed Rosenthal	Consultant	Independent Consultant Board member of Sustainable Native Communities Collaborative
Sage Green	Community Energy Planning Specialist	Push Buffalo
Chris Leo	President, Office of Community Renewal	Homes and Community Renewal
Ann Peterson	Director, HOMES Program	Homes and Community Renewal
Lawrence Krajieski	Executive Director	Catskill Mountain Housing Development Corporation (HCR MMRP grant recipient)
Tim Peters	Executive Director	Ostego Rural Housing Assistance Corp (HCR MMRP grant recipient)
Michelle Larkin	Executive Director	Rebuilding Together Saratoga (HCR MMRP grant recipient)
Johanna Anderson,	Executive Director	Ithaca Neighborhood Housing Services (INHS)
Scott Reynolds,	Deputy Director	INHS
Bruce Misarski	Community Development Director	Housing Assistance Program of Essex (HCR MMRP grant recipient)
Melissa Furnia	Finance and Housing Director	Friends of the North Country (HCR grant recipient)
Jennifer Perry	Energy Project Coordinator	ANCA
Margo Janack	Chief Marketing & Outreach Officer	NYS Health Connect



Factory Interviews

Existing and Potential Factory Owners - In July and August 2018, VEIC exchanged emails and had telephone conversations with existing modular factories.

Factory Name/ Contact	Contact Information	Notes	
Huntington Homes Jason Webster, Owner	344 Fassett Rd. East Montpelier, VT 05651 Regional Office: Greenfield, MA jason@huntingtonhomesvt.com 802) 479-3625 www.huntingtonhomesvt.com	Survey Status	Completed
		Target Market	Custom single family
		No. of Employees	75
		Estimated Annual Production	70 homes a year
		Estimated transportation costs	\$700-\$2700 per box
		Does Factory build to Zero Energy?	Yes. Client driven. <ul style="list-style-type: none"> • ENERGY STAR v3.1 - Yes • DOE Zero Energy Ready Homes - Yes • LEED for Homes - Yes • Passive House - no
		Willing to complete homes turnkey	Yes, only northern New England
Delivery	NY 3 rd party approval is time consuming and onerous. Adds at least a month to the process plus added insurance complications with subcontractors.		
Willing to partner with NY ZEM Pilot?	Uncertain		
KBS Homes Stephan Page & Mike Cordwell	Sales 300 Park St South Paris, ME spage@kbs-homes.com (207)-739-2400 www.kbs-homes.com	Survey Status	Incomplete, additional contact was made on 9/17/18, no response to date.
New Era Modulares	451 Southern Ave Strattanville, PA (800) 678-5581 https://www.neweramodulares.com/energy-efficient	Survey Status	Incomplete, additional contact was made on 9/13/18, no response to date.
Preferred Building Systems Bryan Huot, CEO	143 Twistback Road PO BOX 1 Claremont, NH 03743 bhuot@preferredbuildings.com 1-888-756-3946	Survey Status	Completed
Target Market	Custom single family		
No. of Employees	65-90		
Annual Production	80-150		
Estimated transportation costs	Depends		



Factory Name/ Contact	Contact Information	Notes	
	www.preferredbuildings.com	Does Factory build to Zero Energy?	Yes. Client driven. <ul style="list-style-type: none"> ENERGY STAR v3.1 - Yes DOE Zero Energy Ready Homes - Yes LEED for Homes - Yes Passive House - TBD
		Willing to complete homes Turnkey	No desire to go turnkey. They build and supply modules to a builder who controls job site and completes home to certificate of occupancy
		Delivery	New England
		Willing to partner with NY ZEM Pilot?	Uncertain
Solar Home Factory Ryan Wallace, CEO	Sales Office 44 Castle St Geneva, NY 14456 Factory 33 Forge Ave Geneva, NY 14456 Cell: (315) 290-3111 Office: (315)-230-4070 ryan@solarhomefactory.com	Survey Status	Completed
		Target Market	Zero energy townhouse, multifamily
		Annual Production	2017: 8 Homes 2018: 32 Condo Units (Under Contract)
		Estimated transportation costs	\$1900 per modular, \$3800 per home
		Does Factory build to Zero Energy?	Yes. That's the business model <ul style="list-style-type: none"> ENERGY STAR v3.1 – under review² DOE Zero Energy Ready Homes - Yes LEED for Homes - no Passive House - yes
	www.solarhomefactory.com	Willing to complete homes Turnkey	Yes
		Delivery	NY
		Willing to partner with NY ZEM Pilot?	Uncertain
Titan Homes (Champion Enterprise Inc) Fred Ashforth, Director of Sales and Marketing	951 NY-12 Sangerfield, NY 13455 fashforth@championhomes.com (315) 841-4122 https://www.titanhomesny.com/	Survey Status	Incomplete, additional contact made on 8/20/18 and 9/14/18, no response to date.
		Titan homes builds 50% manufactured housing and 50% modular. Doesn't build zero energy homes	

² Ryan's reply to this question was "under review". We didn't get a chance to clarify response and note that if a home meets ZERH, it also meets ENERGY STAR.

Factory Name/ Contact	Contact Information	Notes	
		Fred reviewed ZEM specs and passed me along to New Era Modulares - said they couldn't build to that specification.	
UpHomes Libby Zemaitis, CEO, Blake Goble, Design Director and Founder	contact@uphomes.me (845)-418-4843	Survey Status	Incomplete. Additional contact made in early September, no response to date.
Vermod Homes Kristen Connors, Office Manager	2677 Route 5 Wilder, VT kristen@vermodhomes.com 802-295-0042 www.vermodhomes.com	Survey Status	Completed
		Target Market	Zero energy, affordable
		No. of Employees	16
		Max Annual Production	22 homes a year
		Estimated Transportation costs	Custom calculation. Undetermined for NY
		Does Factory build to Zero Energy?	Yes, Zero energy is Vermod's construction standard <ul style="list-style-type: none"> • ENERGY STAR v3.1 - Yes • DOE Zero Energy Ready Homes - Yes • LEED for Homes - Yes • Passive House - Yes
		Willing to complete homes Turnkey	Yes
		Delivery	VT, NH, MA, NY (pending)
Willing to partner with a NY ZEM pilot?	Yes		
Westchester Modular Homes Gerry Hatcher, Plant Manager	gatcher@westchestermodular.com (845) 832-9400 www.westchestermodular.com	Survey Status	Incomplete. Discussed Westchester's work and ZEM with Gerry Hatcher, Plant Manger. Contacted for the Director of Sales, no response to date.

Appendix 4 - Energy Modeling – Detailed Inputs and Results

Reference file: NY MH Energy Modeling_Final Report-NYSERDA_20180918.xlsx

All energy modeling was completed using REM/Rate™ software version 15.6.1. A total of 54 scenarios were run. All scenarios were run in each of each of New York's three IECC climate zones – 4, 5 and 6.

The HUD baseline home was modeled with four primary heating fuel/system combinations: electric resistance, electric furnace, propane furnace and oil furnace. The HUD baseline was modeled to two different efficiency specifications. The primary specification, and the one referenced in the body of this report, is the HUD standard prescribed by the Code of Federal Regulations (CFR) Title 24 – Housing and Urban Development (HUD) Part 3280 Manufactured Home Construction and Safety Standards, Subpart F Thermal Protection. A second HUD baseline specification was modeled based on a 2014 analysis conducted by the Pacific Northwest National Lab (PNNL) for the U.S. Department of Energy (US DOE) manufactured home working group. While the PNNL analysis is likely more representative of typical manufactured home installations, the HUD specification model adheres to the technical requirements pertaining to the construction of manufactured housing.

All ZEM homes were modeled to the same efficiency specification using an electric Cold Climate Air Source Heat Pump (ccASHP) for the primary heating fuel/system. ZEM specifications vary only in the Photovoltaic (PV) system capacity. ZEM models were constructed to approximate zero net energy, therefore the PV system size varied by climate zone. Finally, all scenarios were modeled to the 2016 Energy Conservation Construction Code of New York State (ECCCNYS) specification.

Energy cost data was calculated based on average energy prices for New York State³.

The tables that follow provide detailed inputs and results of the modeling analysis. Additionally, two summary charts provide a comparison of fuel use and costs across the scenarios for an example home sited in IECC climate zone 6 using propane heat as the primary heat source for the HUD home. These charts also include a reference home obtained from Vermont Office of Economic Opportunity (VT OEO) data on actual energy use of pre-weatherized manufactured homes in Vermont. All of Vermont is in IECC climate zone 6.

³ <https://www.nyserda.ny.gov/Researchers-and-Policymakers/Energy-Prices>

Table 1. Detailed inputs for HUD manufactured home modeled to HUD specification

Inputs			HUD (HUD Region 3 Uo-0.079)	
			Value	Description
Climate Zone ⁽¹⁾	4A		Mineola..... HDD 5041, CDH 6042	
	5A		Syracuse..... HDD 6577, CDH 5167	
	6A		Watertown..... HDD 7491, CDH 3032	
General	Dimensions		14x70'	
	Conditioned Floor Area		980	
	Volume		7840	
	Housing Type		Mobile Home	
	Number Bedrooms		2	
	Foundation Type		Open crawl space	
Envelope	Floor		R-22	2x6, 16oc, Grade III, carpet
	Wall		R-19	Standard wood frame, 2x6, 16oc, Grade III
	Windows		U-0.35; SHGC: 0.50	170 sf, 17% WFR
	Door		R-6	Two 21sf steel doors
	Ceiling		R-30	2x10, 16oc, Grade III
	Mechanical Systems	Heating	Electric	100% Eff
Propane				
Oil			75 AFUE ⁽²⁾	Furnace, 100kBtuh (100%)
Cooling			13 SEER	Air Conditioner, 2 ton
Hot Water			0.92 EF	Electric tank, 50 gal, Fed Std (=0.9307-(0.0002*Vr))
Duct Insulation			90% @ R22; 10% @ R8	Location: MH belly, assumes surrounded R value except for crossover trunk at R8 (consistent w PNNL analysis); Supply @ 264; return @ 49 (est per REM), PNNL assumed 210sf supply for 924 sf single wide
Duct Leakage			12 CFM25/100 sf CFA	
Low Flow (<-2 gmp)			None	
Infiltration			8.0 ACH50	Consistent w PNNL analysis
Ventilation			Exhaust Ventilation	50 cfm, 12 hr/day, 50 watts
Lights & Appliances	CFL/LED		34%	Consistent w PNNL analysis
	Refrigerator		413 kWh/yr	ENERGY STAR Calculator value for 'conventional model' top mounted freezer
	Dishwasher		307 kWh/yr	ENERGY STAR Calculator value for 'conventional model'
	Range/Oven		n/a	Electric
	Washer		Medium Efficiency	REM preset (LER 487 kWh/yr)
	Dryer		3.11 CEF	Federal Std (per ES appliance savings calculator)
Renewable Energy	PV System	cz4	n/a	
		cz5	n/a	
		cz6	n/a	
Comments				
(1)	MH distribution by climate zone and REM/Rate Location city documented in file 'NYS MH by CZ.xlsx'			
(2)	The standard for manufactured home furnaces manufactured after November 19, 2015 is 80 AFUE. For purposes of this analysis, the older standard is used for MH furnaces manufactured before that date.			

Table 2. Detailed inputs for HUD manufactured home modeled to PNNL specification (2014)

Inputs			
			HUD (PNNL)
			Value Description
Climate Zone ⁽¹⁾	4A		Mineola..... HDD 5041, CDH 6042
	5A		Syracuse..... HDD 6577, CDH 5167
	6A		Watertown..... HDD 7491, CDH 3032
General	Dimensions		14x70'
	Conditioned Floor Area		980
	Volume		7840
	Housing Type		Mobile Home
	Number Bedrooms		2
Foundation Type		Open crawl space	
Envelope	Floor		R-22 2x6, 16oc, Grade III, hardwood
	Wall		R-13 Standard wood frame, 2x4, 16oc, Grade III
	Windows		U-0.52; SHGC: 0.50 170 sf, 17% WFR
	Door		R6 Two 21sf steel doors
	Ceiling		R-30 2x10, 16oc, Grade III
Mechanical Systems	Heating	Electric	100% Eff Baseboard (100%) Furnace, 100kBtuh (100%)
		Propane Oil	75 AFUE ⁽²⁾ Furnace, 100kBtuh (100%)
	Cooling		13 SEER Air Conditioner, 2 ton
	Hot Water		0.92 EF Electric tank, 50 gal, Fed Std (=0.9307-(0.0002*Vr))
	Duct Insulation		90% @ R22; 10% @ R8 Location: MH belly, assumes surrounded R value except for crossover trunk at R8
	Duct Leakage		12 CFM25/100 sf CFA
	Low Flow (<-2 gmp)		None
	Infiltration		8.0 ACH50 Consistent w PNNL analysis
Ventilation		Exhaust Ventilation 50 cfm, 12 hr/day, 50 watts	
Lights & Appliances	CFL/LED		34% Consistent w PNNL analysis
	Refrigerator		413 kWh/yr ENERGY STAR Calculator value for 'conventional model' top mounted freezer
	Dishwasher		307 kWh/yr ENERGY STAR Calculator value for 'conventional model'
	Range/Oven		n/a Electric
	Washer		Medium Efficiency REM preset (LER 487 kWh/yr)
	Dryer		3.11 CEF Federal Std (per ES appliance savings calculator)
Renewable Energy	PV System	cz4	n/a
		cz5	n/a
		cz6	n/a
Comments			
			⁽¹⁾ MH distribution by climate zone and REM/Rate Location city documented in file 'NYS MH by CZ.xlsx'
			⁽²⁾ The standard for manufactured home furnaces manufactured after November 19, 2015 is 80 AFUE. For purposes of this analysis, the older standard is used for MH furnaces manufactured before that date.

Table 3. Detailed inputs for Zero Energy Modular (ZEM) home based on Vermont specification

Inputs				
			ZEM	
			Value	Description
Climate Zone ⁽¹⁾		4A		
		5A		
		6A		
General	Dimensions		14x70'	
	Conditioned Floor Area		980	
	Volume		7840	
	Housing Type		Mobile Home	
	Number Bedrooms		2	
	Foundation Type		Open crawl space	
Envelope	Floor		R-40	2x10 , 16oc, Grade I, hardwood
	Wall		R-43	Double stud wood, 2x7, 24oc, Grade I
	Windows		U-0.21; SHGC: 0.27	170 sf, 17% WFR
	Door		<i>see window entry</i>	Two 21sf glazed
	Ceiling		R-60	SIPS, Grade I
Mechanical Systems	Heating	Electric	13.5 HSPF/2.3 COP	Ductless Minisplit (90%)/CERV (10%)
		Propane		
		Oil		
	Cooling		30.5 SEER/2.3 COP	Ductless Minisplit (50%)/CERV (50%)
	Hot Water		2.75 EF	HPWH, 50 gal
	Duct Insulation		none	
	Duct Leakage		none	
	Low Flow (<-2 gmp)		yes	
Infiltration		0.60 ACH50		
Ventilation		Balanced (CERV)	100% SRE/TRE; 50 cfm, 24 hr/day, 62w	
Lights & Appliances	CFL/LED		100%	
	Refrigerator		371 kWh/yr	ENERGY STAR Calculator value for ENERGY STAR top mounted freezer
	Dishwasher		270 kWh/yr	ENERGY STAR Calculator value for ENERGY STAR
	Range/Oven			Electric
	Washer		ENERGY STAR	REM preset (LER 96 kWh/yr)
	Dryer		4.5 CEF	Electric; Ventless Heat Pump
Renewable Energy	PV System	cz4	5 kW	250 sf, 96% inverter, 4% pitch
		cz5	6 kW	300 sf, 96% inverter, 4% pitch
		cz6	7.5 kW	386 sf, 96% inverter, 4% pitch
Comments				
⁽¹⁾ MH distribution by climate zone and REM/Rate Location city documented in file 'NYS MH by CZ.xlsx'				

Table 4. REM/Rate scenario results – Annual consumption in MMBtu

Run#	Building Name	Climate Location	Climate Zone	HDD65	CDH74	HERS Index	Heating Consumption (MMBtu)	Cooling Consumption (MMBtu)	Hot Water Consumption (MMBtu)	Lights & Appliances Consumption (MMBtu)	PV Consumption (MMBtu)	Total Consumption (MMBtu)
0	HUD-CZ4-Elec (BB)_HUD079	Mineola, NY	4A	5041	6042	117	24.36	3.46	7.06	14.70	0.00	49.57
1	HUD-CZ4-Elec (BB)_PNNL	Mineola, NY	4A	5041	6042	133	30.70	3.31	7.06	14.70	0.00	55.77
2	HUD-CZ4-Elec (FHA)_HUD079	Mineola, NY	4A	5041	6042	134	32.95	3.46	7.06	14.70	0.00	58.16
3	HUD-CZ4-Elec (FHA)_PNNL	Mineola, NY	4A	5041	6042	153	40.59	3.31	7.06	14.70	0.00	65.66
4	HUD-CZ4-Oil_HUD079	Mineola, NY	4A	5041	6042	99	43.79	3.46	7.06	14.70	0.00	69.00
5	HUD-CZ4-Oil_PNNL	Mineola, NY	4A	5041	6042	109	53.97	3.31	7.06	14.70	0.00	79.04
6	HUD-CZ4-Propane_HUD079	Mineola, NY	4A	5041	6042	99	43.79	3.46	7.06	14.70	0.00	69.00
7	HUD-CZ4-Propane_PNNL	Mineola, NY	4A	5041	6042	109	53.97	3.31	7.06	14.70	0.00	79.04
8	HUD-CZ5-Elec (BB)_HUD079	Syracuse, NY	5A	6577	5167	124	33.94	2.38	7.80	14.70	0.00	58.82
9	HUD-CZ5-Elec (BB)_PNNL	Syracuse, NY	5A	6577	5167	141	42.14	2.16	7.80	14.70	0.00	66.80
10	HUD-CZ5-Elec (FHA)_HUD079	Syracuse, NY	5A	6577	5167	142	44.58	2.38	7.80	14.70	0.00	69.46
11	HUD-CZ5-Elec (FHA)_PNNL	Syracuse, NY	5A	6577	5167	162	54.18	2.16	7.80	14.70	0.00	78.85
12	HUD-CZ5-Oil_HUD079	Syracuse, NY	5A	6577	5167	110	59.26	2.38	7.80	14.70	0.00	84.14
13	HUD-CZ5-Oil_PNNL	Syracuse, NY	5A	6577	5167	122	72.05	2.16	7.80	14.70	0.00	96.71
14	HUD-CZ5-Propane_HUD079	Syracuse, NY	5A	6577	5167	110	59.26	2.38	7.80	14.70	0.00	84.14
15	HUD-CZ5-Propane_PNNL	Syracuse, NY	5A	6577	5167	122	72.05	2.16	7.80	14.70	0.00	96.71
16	HUD-CZ6-Elec (BB)_HUD079	Watertown, NY	6A	7491	3032	121	39.79	1.59	8.11	14.70	0.00	64.20
17	HUD-CZ6-Elec (BB)_PNNL	Watertown, NY	6A	7491	3032	138	49.06	1.36	8.11	14.70	0.00	73.23
18	HUD-CZ6-Elec (FHA)_HUD079	Watertown, NY	6A	7491	3032	139	51.27	1.59	8.11	14.70	0.00	75.67
19	HUD-CZ6-Elec (FHA)_PNNL	Watertown, NY	6A	7491	3032	158	61.98	1.36	8.11	14.70	0.00	86.15
20	HUD-CZ6-Oil_HUD079	Watertown, NY	6A	7491	3032	111	68.15	1.59	8.11	14.70	0.00	92.56
21	HUD-CZ6-Oil_PNNL	Watertown, NY	6A	7491	3032	125	82.42	1.36	8.11	14.70	0.00	106.59
22	HUD-CZ6-Propane_HUD079	Watertown, NY	6A	7491	3032	111	68.16	1.59	8.11	14.70	0.00	92.56
23	HUD-CZ6-Propane_PNNL	Watertown, NY	6A	7491	3032	125	82.42	1.36	8.11	14.70	0.00	106.59
24	ZEM-CZ4-Elec (HP)	Mineola, NY	4A	5041	6042	-1	2.89	2.05	2.15	12.46	-20.18	-0.63
25	ZEM-CZ5-Elec (HP)	Syracuse, NY	5A	6577	5167	-3	4.94	1.48	2.38	12.46	-22.83	-1.57
26	ZEM-CZ6-Elec (HP)	Watertown, NY	6A	7491	3032	2	6.79	1.07	2.47	12.46	-21.94	0.86

Table 5. REM/Rate scenario results – Annual consumption in native fuel units

Run#	Building Name	Climate Location	Climate Zone	Heating (gal oil)	Heating (gal prop)	Heating (kWh)	Cooling (kWh)	Hot Water (kWh)	Lights&A (kWh)	PV (kWh)	PV (watts)
0	HUD-CZ4-Elec (BB)_HUD079	Mineola, NY	4A	0.00	0.00	7136.06	1012.84	2067.70	4307.31	0.00	
1	HUD-CZ4-Elec (BB)_PNNL	Mineola, NY	4A	0.00	0.00	8995.46	969.58	2067.73	4307.31	0.00	
2	HUD-CZ4-Elec (FHA)_HUD079	Mineola, NY	4A	0.00	0.00	9654.17	1012.84	2067.71	4307.31	0.00	
3	HUD-CZ4-Elec (FHA)_PNNL	Mineola, NY	4A	0.00	0.00	11893.76	969.58	2067.74	4307.31	0.00	
4	HUD-CZ4-Oil_HUD079	Mineola, NY	4A	302.68	0.00	547.27	1012.84	2067.71	4307.31	0.00	
5	HUD-CZ4-Oil_PNNL	Mineola, NY	4A	375.08	0.00	591.79	969.58	2067.74	4307.31	0.00	
6	HUD-CZ4-Propane_HUD079	Mineola, NY	4A	0.00	459.15	547.34	1012.84	2067.71	4307.31	0.00	
7	HUD-CZ4-Propane_PNNL	Mineola, NY	4A	0.00	568.99	591.88	969.58	2067.74	4307.31	0.00	
8	HUD-CZ5-Elec (BB)_HUD079	Syracuse, NY	5A	0.00	0.00	9944.67	698.31	2284.32	4307.31	0.00	
9	HUD-CZ5-Elec (BB)_PNNL	Syracuse, NY	5A	0.00	0.00	12346.44	634.02	2284.41	4307.31	0.00	
10	HUD-CZ5-Elec (FHA)_HUD079	Syracuse, NY	5A	0.00	0.00	13062.40	698.31	2284.37	4307.31	0.00	
11	HUD-CZ5-Elec (FHA)_PNNL	Syracuse, NY	5A	0.00	0.00	15875.83	634.02	2284.48	4307.31	0.00	
12	HUD-CZ5-Oil_HUD079	Syracuse, NY	5A	411.14	0.00	679.89	698.31	2284.37	4307.31	0.00	
13	HUD-CZ5-Oil_PNNL	Syracuse, NY	5A	502.07	0.00	736.76	634.02	2284.48	4307.31	0.00	
14	HUD-CZ5-Propane_HUD079	Syracuse, NY	5A	0.00	623.69	679.98	698.31	2284.37	4307.31	0.00	
15	HUD-CZ5-Propane_PNNL	Syracuse, NY	5A	0.00	761.63	736.86	634.02	2284.48	4307.31	0.00	
16	HUD-CZ6-Elec (BB)_HUD079	Watertown, NY	6A	0.00	0.00	11659.28	467.06	2376.95	4307.31	0.00	
17	HUD-CZ6-Elec (BB)_PNNL	Watertown, NY	6A	0.00	0.00	14373.37	399.03	2377.03	4307.31	0.00	
18	HUD-CZ6-Elec (FHA)_HUD079	Watertown, NY	6A	0.00	0.00	15020.87	467.06	2377.03	4307.31	0.00	
19	HUD-CZ6-Elec (FHA)_PNNL	Watertown, NY	6A	0.00	0.00	18159.08	399.03	2377.11	4307.31	0.00	
20	HUD-CZ6-Oil_HUD079	Watertown, NY	6A	473.40	0.00	758.49	467.06	2377.03	4307.31	0.00	
21	HUD-CZ6-Oil_PNNL	Watertown, NY	6A	574.81	0.00	822.57	399.03	2377.11	4307.31	0.00	
22	HUD-CZ6-Propane_HUD079	Watertown, NY	6A	0.00	718.14	758.60	467.06	2377.03	4307.31	0.00	
23	HUD-CZ6-Propane_PNNL	Watertown, NY	6A	0.00	871.97	822.68	399.03	2377.11	4307.31	0.00	
24	ZEM-CZ4-Elec (HP)	Mineola, NY	4A	0.00	0.00	845.75	600.03	630.83	3652.05	-5911.90	5000
25	ZEM-CZ5-Elec (HP)	Syracuse, NY	5A	0.00	0.00	1446.12	434.19	696.46	3652.05	-6688.21	6000
26	ZEM-CZ6-Elec (HP)	Watertown, NY	6A	0.00	0.00	1988.96	314.70	724.49	3652.05	-6429.04	7500

Table 6. REM/Rate scenario results – Annual costs based on average New York state energy prices

Run#	Building Name	Climate Location	Climate Zone	Heating			Cooling		Hot Water Costs (kWh)	Lights & Appliances		PV Costs (kWh)	Total Cons Cost	Total Prod Cost	Total Net Cost
				Costs (oil)	Costs (prop)	Costs (kWh)	Costs (kWh)	Costs (kWh)		Costs (kWh)					
0	HUD-C24-Elec (BB)_HUD079	Mineola, NY	4A	\$0	\$0	\$1,288	\$183	\$373	\$777	\$0	\$2,622	\$0	\$2,622		
1	HUD-C24-Elec (BB)_PNNL	Mineola, NY	4A	\$0	\$0	\$1,624	\$175	\$373	\$777	\$0	\$2,949	\$0	\$2,949		
2	HUD-C24-Elec (FHA)_HUD079	Mineola, NY	4A	\$0	\$0	\$1,743	\$183	\$373	\$777	\$0	\$3,076	\$0	\$3,076		
3	HUD-C24-Elec (FHA)_PNNL	Mineola, NY	4A	\$0	\$0	\$2,147	\$175	\$373	\$777	\$0	\$3,473	\$0	\$3,473		
4	HUD-C24-Oil_HUD079	Mineola, NY	4A	\$976	\$0	\$99	\$183	\$373	\$777	\$0	\$2,408	\$0	\$2,408		
5	HUD-C24-Oil_PNNL	Mineola, NY	4A	\$1,209	\$0	\$107	\$175	\$373	\$777	\$0	\$2,641	\$0	\$2,641		
6	HUD-C24-Propane_HUD079	Mineola, NY	4A	\$0	\$1,424	\$99	\$183	\$373	\$777	\$0	\$2,857	\$0	\$2,857		
7	HUD-C24-Propane_PNNL	Mineola, NY	4A	\$0	\$1,765	\$107	\$175	\$373	\$777	\$0	\$3,198	\$0	\$3,198		
8	HUD-C25-Elec (BB)_HUD079	Syracuse, NY	5A	\$0	\$0	\$1,795	\$126	\$412	\$777	\$0	\$3,111	\$0	\$3,111		
9	HUD-C25-Elec (BB)_PNNL	Syracuse, NY	5A	\$0	\$0	\$2,229	\$114	\$412	\$777	\$0	\$3,533	\$0	\$3,533		
10	HUD-C25-Elec (FHA)_HUD079	Syracuse, NY	5A	\$0	\$0	\$2,358	\$126	\$412	\$777	\$0	\$3,674	\$0	\$3,674		
11	HUD-C25-Elec (FHA)_PNNL	Syracuse, NY	5A	\$0	\$0	\$2,866	\$114	\$412	\$777	\$0	\$4,170	\$0	\$4,170		
12	HUD-C25-Oil_HUD079	Syracuse, NY	5A	\$1,325	\$0	\$123	\$126	\$412	\$777	\$0	\$2,764	\$0	\$2,764		
13	HUD-C25-Oil_PNNL	Syracuse, NY	5A	\$1,618	\$0	\$133	\$114	\$412	\$777	\$0	\$3,055	\$0	\$3,055		
14	HUD-C25-Propane_HUD079	Syracuse, NY	5A	\$0	\$1,935	\$123	\$126	\$412	\$777	\$0	\$3,373	\$0	\$3,373		
15	HUD-C25-Propane_PNNL	Syracuse, NY	5A	\$0	\$2,363	\$133	\$114	\$412	\$777	\$0	\$3,800	\$0	\$3,800		
16	HUD-C26-Elec (BB)_HUD079	Watertown, NY	6A	\$0	\$0	\$2,104	\$84	\$429	\$777	\$0	\$3,395	\$0	\$3,395		
17	HUD-C26-Elec (BB)_PNNL	Watertown, NY	6A	\$0	\$0	\$2,594	\$72	\$429	\$777	\$0	\$3,873	\$0	\$3,873		
18	HUD-C26-Elec (FHA)_HUD079	Watertown, NY	6A	\$0	\$0	\$2,711	\$84	\$429	\$777	\$0	\$4,002	\$0	\$4,002		
19	HUD-C26-Elec (FHA)_PNNL	Watertown, NY	6A	\$0	\$0	\$3,278	\$72	\$429	\$777	\$0	\$4,556	\$0	\$4,556		
20	HUD-C26-Oil_HUD079	Watertown, NY	6A	\$1,526	\$0	\$137	\$84	\$429	\$777	\$0	\$2,954	\$0	\$2,954		
21	HUD-C26-Oil_PNNL	Watertown, NY	6A	\$1,853	\$0	\$148	\$72	\$429	\$777	\$0	\$3,280	\$0	\$3,280		
22	HUD-C26-Propane_HUD079	Watertown, NY	6A	\$0	\$2,228	\$137	\$84	\$429	\$777	\$0	\$3,655	\$0	\$3,655		
23	HUD-C26-Propane_PNNL	Watertown, NY	6A	\$0	\$2,705	\$148	\$72	\$429	\$777	\$0	\$4,132	\$0	\$4,132		
24	ZEM-C24-Elec (HP)	Mineola, NY	4A	\$0	\$0	\$153	\$108	\$114	\$659	-\$1,067	\$1,034	-\$1,067	-\$33		
25	ZEM-C25-Elec (HP)	Syracuse, NY	5A	\$0	\$0	\$261	\$78	\$126	\$659	-\$1,207	\$1,124	-\$1,207	-\$83		
26	ZEM-C26-Elec (HP)	Watertown, NY	6A	\$0	\$0	\$359	\$57	\$131	\$659	-\$1,160	\$1,206	-\$1,160	\$45		

Table 7. REM/Rate scenario results – Annual consumption in MMBtu (ECCCNYS-2016 specification)

Export Type	Run#	Building Name	Climate Location	Climate Zone	Heating			Cooling Consumption (MMBtu)	Hot Water Consumption (MMBtu)	Lights & Appliances Consumption (MMBtu)	PV Consumption (MMBtu)	Total Consumption (MMBtu)	
					HDD65	CDH74	HERS Index						
20	0	HUD-C24-Elec (BB)_HUD079	Mineola, NY	4A	5041	6042	75	11.19	3.79	10.58	12.97	0.00	38.54
20	2	HUD-C24-Elec (BB)_PNNL	Mineola, NY	4A	5041	6042	75	11.19	3.79	10.58	12.97	0.00	38.54
20	4	HUD-C24-Elec (FHA)_HUD079	Mineola, NY	4A	5041	6042	83	15.07	3.79	10.58	12.97	0.00	42.41
20	6	HUD-C24-Elec (FHA)_PNNL	Mineola, NY	4A	5041	6042	83	15.07	3.79	10.58	12.97	0.00	42.41
20	8	HUD-C24-Oil_HUD079	Mineola, NY	4A	5041	6042	79	34.21	3.79	10.58	12.97	0.00	61.55
20	10	HUD-C24-Oil_PNNL	Mineola, NY	4A	5041	6042	79	34.21	3.79	10.58	12.97	0.00	61.55
20	12	HUD-C24-Propane_HUD079	Mineola, NY	4A	5041	6042	80	35.21	3.79	10.58	12.97	0.00	62.56
20	14	HUD-C24-Propane_PNNL	Mineola, NY	4A	5041	6042	80	35.21	3.79	10.58	12.97	0.00	62.56
20	16	HUD-C25-Elec (BB)_HUD079	Syracuse, NY	5A	6577	5167	77	15.40	2.85	11.42	12.97	0.00	42.64
20	18	HUD-C25-Elec (BB)_PNNL	Syracuse, NY	5A	6577	5167	77	15.40	2.85	11.42	12.97	0.00	42.64
20	20	HUD-C25-Elec (FHA)_HUD079	Syracuse, NY	5A	6577	5167	86	20.47	2.85	11.42	12.97	0.00	47.71
20	22	HUD-C25-Elec (FHA)_PNNL	Syracuse, NY	5A	6577	5167	86	20.47	2.85	11.42	12.97	0.00	47.71
20	24	HUD-C25-Oil_HUD079	Syracuse, NY	5A	6577	5167	82	40.42	2.85	11.42	12.97	0.00	67.66
20	26	HUD-C25-Oil_PNNL	Syracuse, NY	5A	6577	5167	82	40.42	2.85	11.42	12.97	0.00	67.66
20	28	HUD-C25-Propane_HUD079	Syracuse, NY	5A	6577	5167	84	41.73	2.85	11.42	12.97	0.00	68.97
20	30	HUD-C25-Propane_PNNL	Syracuse, NY	5A	6577	5167	84	41.73	2.85	11.42	12.97	0.00	68.97
20	32	HUD-C26-Elec (BB)_HUD079	Watertown, NY	6A	7491	3032	74	17.89	2.14	11.78	12.97	0.00	44.77
20	34	HUD-C26-Elec (BB)_PNNL	Watertown, NY	6A	7491	3032	74	17.89	2.14	11.78	12.97	0.00	44.77
20	36	HUD-C26-Elec (FHA)_HUD079	Watertown, NY	6A	7491	3032	83	23.56	2.14	11.78	12.97	0.00	50.45
20	38	HUD-C26-Elec (FHA)_PNNL	Watertown, NY	6A	7491	3032	83	23.56	2.14	11.78	12.97	0.00	50.45
20	40	HUD-C26-Oil_HUD079	Watertown, NY	6A	7491	3032	79	41.94	2.14	11.78	12.97	0.00	68.82
20	42	HUD-C26-Oil_PNNL	Watertown, NY	6A	7491	3032	79	41.94	2.14	11.78	12.97	0.00	68.82
20	44	HUD-C26-Propane_HUD079	Watertown, NY	6A	7491	3032	81	43.37	2.14	11.78	12.97	0.00	70.25
20	46	HUD-C26-Propane_PNNL	Watertown, NY	6A	7491	3032	81	43.37	2.14	11.78	12.97	0.00	70.25
20	48	ZEM-C24-Elec (HP)	Mineola, NY	4A	5041	6042	53	7.47	2.68	3.63	11.83	0.00	25.61
20	50	ZEM-C25-Elec (HP)	Syracuse, NY	5A	6577	5167	56	11.32	2.04	3.91	11.83	0.00	29.10
20	52	ZEM-C26-Elec (HP)	Watertown, NY	6A	7491	3032	56	13.89	1.53	4.03	11.83	0.00	31.27

Table 8. REM/Rate scenario results – Annual consumption in native fuel units (ECCCNYS-2016 specification)

Export Type	Run#	Building Name	Climate Location	Climate Zone	Heating (gal oil)	Heating (gal prop)	Heating (kWh)	Cooling (kWh)	Hot Water (kWh)	Lights&Appliances (kWh)	PV (kWh)
20	0	HUD-CZ4-Elec (BB)_HUD079	Mineola, NY	4A	0.00	0.00	3278.81	1110.79	3100.89	3800.49	0.00
20	2	HUD-CZ4-Elec (BB)_PNNL	Mineola, NY	4A	0.00	0.00	3278.81	1110.79	3100.89	3800.49	0.00
20	4	HUD-CZ4-Elec (FHA)_HUD079	Mineola, NY	4A	0.00	0.00	4415.06	1110.79	3100.89	3800.49	0.00
20	6	HUD-CZ4-Elec (FHA)_PNNL	Mineola, NY	4A	0.00	0.00	4415.06	1110.79	3100.89	3800.49	0.00
20	8	HUD-CZ4-Oil_HUD079	Mineola, NY	4A	236.44	0.00	427.57	1110.79	3100.89	3800.49	0.00
20	10	HUD-CZ4-Oil_PNNL	Mineola, NY	4A	236.44	0.00	427.57	1110.79	3100.89	3800.49	0.00
20	12	HUD-CZ4-Propane_HUD079	Mineola, NY	4A	0.00	372.12	362.30	1110.79	3100.89	3800.49	0.00
20	14	HUD-CZ4-Propane_PNNL	Mineola, NY	4A	0.00	372.12	362.30	1110.79	3100.89	3800.49	0.00
20	16	HUD-CZ5-Elec (BB)_HUD079	Syracuse, NY	5A	0.00	0.00	4511.61	834.52	3346.58	3800.49	0.00
20	18	HUD-CZ5-Elec (BB)_PNNL	Syracuse, NY	5A	0.00	0.00	4511.61	834.52	3346.58	3800.49	0.00
20	20	HUD-CZ5-Elec (FHA)_HUD079	Syracuse, NY	5A	0.00	0.00	5997.17	834.52	3346.58	3800.49	0.00
20	22	HUD-CZ5-Elec (FHA)_PNNL	Syracuse, NY	5A	0.00	0.00	5997.17	834.52	3346.58	3800.49	0.00
20	24	HUD-CZ5-Oil_HUD079	Syracuse, NY	5A	280.53	0.00	457.68	834.52	3346.58	3800.49	0.00
20	26	HUD-CZ5-Oil_PNNL	Syracuse, NY	5A	280.53	0.00	457.68	834.52	3346.58	3800.49	0.00
20	28	HUD-CZ5-Propane_HUD079	Syracuse, NY	5A	0.00	441.51	415.25	834.52	3346.58	3800.49	0.00
20	30	HUD-CZ5-Propane_PNNL	Syracuse, NY	5A	0.00	441.51	415.25	834.52	3346.58	3800.49	0.00
20	32	HUD-CZ6-Elec (BB)_HUD079	Watertown, NY	6A	0.00	0.00	5241.45	625.75	3451.28	3800.49	0.00
20	34	HUD-CZ6-Elec (BB)_PNNL	Watertown, NY	6A	0.00	0.00	5241.45	625.75	3451.28	3800.49	0.00
20	36	HUD-CZ6-Elec (FHA)_HUD079	Watertown, NY	6A	0.00	0.00	6903.31	625.75	3451.28	3800.49	0.00
20	38	HUD-CZ6-Elec (FHA)_PNNL	Watertown, NY	6A	0.00	0.00	6903.31	625.75	3451.28	3800.49	0.00
20	40	HUD-CZ6-Oil_HUD079	Watertown, NY	6A	291.50	0.00	458.14	625.75	3451.28	3800.49	0.00
20	42	HUD-CZ6-Oil_PNNL	Watertown, NY	6A	291.50	0.00	458.14	625.75	3451.28	3800.49	0.00
20	44	HUD-CZ6-Propane_HUD079	Watertown, NY	6A	0.00	458.78	433.75	625.75	3451.28	3800.49	0.00
20	46	HUD-CZ6-Propane_PNNL	Watertown, NY	6A	0.00	458.78	433.75	625.75	3451.28	3800.49	0.00
20	48	ZEM-CZ4-Elec (HP)	Mineola, NY	4A	0.00	0.00	2188.18	784.70	1064.64	3465.11	0.00
20	50	ZEM-CZ5-Elec (HP)	Syracuse, NY	5A	0.00	0.00	3317.54	598.01	1146.32	3465.11	0.00
20	52	ZEM-CZ6-Elec (HP)	Watertown, NY	6A	0.00	0.00	4069.78	447.35	1181.14	3465.11	0.00

Table 9. REM/Rate scenario results – Annual costs based on average New York state energy prices (ECCCNYS-2016 specification)

Export Type	Run#	Building Name	Climate Location	Climate Zone	Heating Costs (oil)	Heating Costs (prop)	Heating Costs (kWh)	Cooling Costs (kWh)	Hot Water Costs (kWh)	Lights & Appliances Costs (kWh)	PV Costs (kWh)	Total Cons Cost	Total Prod Cost	Total Net Cost
20	0	HUD-CZ4-Elec (BB)_HUD079	Mineola, NY	4A	\$0	\$0	\$592	\$200	\$560	\$686	\$0	\$2,038	\$0	\$2,038
20	2	HUD-CZ4-Elec (BB)_PNNL	Mineola, NY	4A	\$0	\$0	\$592	\$200	\$560	\$686	\$0	\$2,038	\$0	\$2,038
20	4	HUD-CZ4-Elec (FHA)_HUD079	Mineola, NY	4A	\$0	\$0	\$797	\$200	\$560	\$686	\$0	\$2,243	\$0	\$2,243
20	6	HUD-CZ4-Elec (FHA)_PNNL	Mineola, NY	4A	\$0	\$0	\$797	\$200	\$560	\$686	\$0	\$2,243	\$0	\$2,243
20	8	HUD-CZ4-Oil_HUD079	Mineola, NY	4A	\$762	\$0	\$77	\$200	\$560	\$686	\$0	\$2,285	\$0	\$2,285
20	10	HUD-CZ4-Oil_PNNL	Mineola, NY	4A	\$762	\$0	\$77	\$200	\$560	\$686	\$0	\$2,285	\$0	\$2,285
20	12	HUD-CZ4-Propane_HUD079	Mineola, NY	4A	\$0	\$1,154	\$65	\$200	\$560	\$686	\$0	\$2,666	\$0	\$2,666
20	14	HUD-CZ4-Propane_PNNL	Mineola, NY	4A	\$0	\$1,154	\$65	\$200	\$560	\$686	\$0	\$2,666	\$0	\$2,666
20	16	HUD-CZ5-Elec (BB)_HUD079	Syracuse, NY	5A	\$0	\$0	\$814	\$151	\$604	\$686	\$0	\$2,255	\$0	\$2,255
20	18	HUD-CZ5-Elec (BB)_PNNL	Syracuse, NY	5A	\$0	\$0	\$814	\$151	\$604	\$686	\$0	\$2,255	\$0	\$2,255
20	20	HUD-CZ5-Elec (FHA)_HUD079	Syracuse, NY	5A	\$0	\$0	\$1,082	\$151	\$604	\$686	\$0	\$2,523	\$0	\$2,523
20	22	HUD-CZ5-Elec (FHA)_PNNL	Syracuse, NY	5A	\$0	\$0	\$1,082	\$151	\$604	\$686	\$0	\$2,523	\$0	\$2,523
20	24	HUD-CZ5-Oil_HUD079	Syracuse, NY	5A	\$904	\$0	\$83	\$151	\$604	\$686	\$0	\$2,427	\$0	\$2,427
20	26	HUD-CZ5-Oil_PNNL	Syracuse, NY	5A	\$904	\$0	\$83	\$151	\$604	\$686	\$0	\$2,427	\$0	\$2,427
20	28	HUD-CZ5-Propane_HUD079	Syracuse, NY	5A	\$0	\$1,370	\$75	\$151	\$604	\$686	\$0	\$2,885	\$0	\$2,885
20	30	HUD-CZ5-Propane_PNNL	Syracuse, NY	5A	\$0	\$1,370	\$75	\$151	\$604	\$686	\$0	\$2,885	\$0	\$2,885
20	32	HUD-CZ6-Elec (BB)_HUD079	Watertown, NY	6A	\$0	\$0	\$946	\$113	\$623	\$686	\$0	\$2,368	\$0	\$2,368
20	34	HUD-CZ6-Elec (BB)_PNNL	Watertown, NY	6A	\$0	\$0	\$946	\$113	\$623	\$686	\$0	\$2,368	\$0	\$2,368
20	36	HUD-CZ6-Elec (FHA)_HUD079	Watertown, NY	6A	\$0	\$0	\$1,246	\$113	\$623	\$686	\$0	\$2,668	\$0	\$2,668
20	38	HUD-CZ6-Elec (FHA)_PNNL	Watertown, NY	6A	\$0	\$0	\$1,246	\$113	\$623	\$686	\$0	\$2,668	\$0	\$2,668
20	40	HUD-CZ6-Oil_HUD079	Watertown, NY	6A	\$940	\$0	\$83	\$113	\$623	\$686	\$0	\$2,444	\$0	\$2,444
20	42	HUD-CZ6-Oil_PNNL	Watertown, NY	6A	\$940	\$0	\$83	\$113	\$623	\$686	\$0	\$2,444	\$0	\$2,444
20	44	HUD-CZ6-Propane_HUD079	Watertown, NY	6A	\$0	\$1,423	\$78	\$113	\$623	\$686	\$0	\$2,923	\$0	\$2,923
20	46	HUD-CZ6-Propane_PNNL	Watertown, NY	6A	\$0	\$1,423	\$78	\$113	\$623	\$686	\$0	\$2,923	\$0	\$2,923
20	48	ZEM-CZ4-Elec (HP)	Mineola, NY	4A	\$0	\$0	\$395	\$142	\$192	\$625	\$0	\$1,354	\$0	\$1,354
20	50	ZEM-CZ5-Elec (HP)	Syracuse, NY	5A	\$0	\$0	\$599	\$108	\$207	\$625	\$0	\$1,539	\$0	\$1,539
20	52	ZEM-CZ6-Elec (HP)	Watertown, NY	6A	\$0	\$0	\$735	\$81	\$213	\$625	\$0	\$1,654	\$0	\$1,654

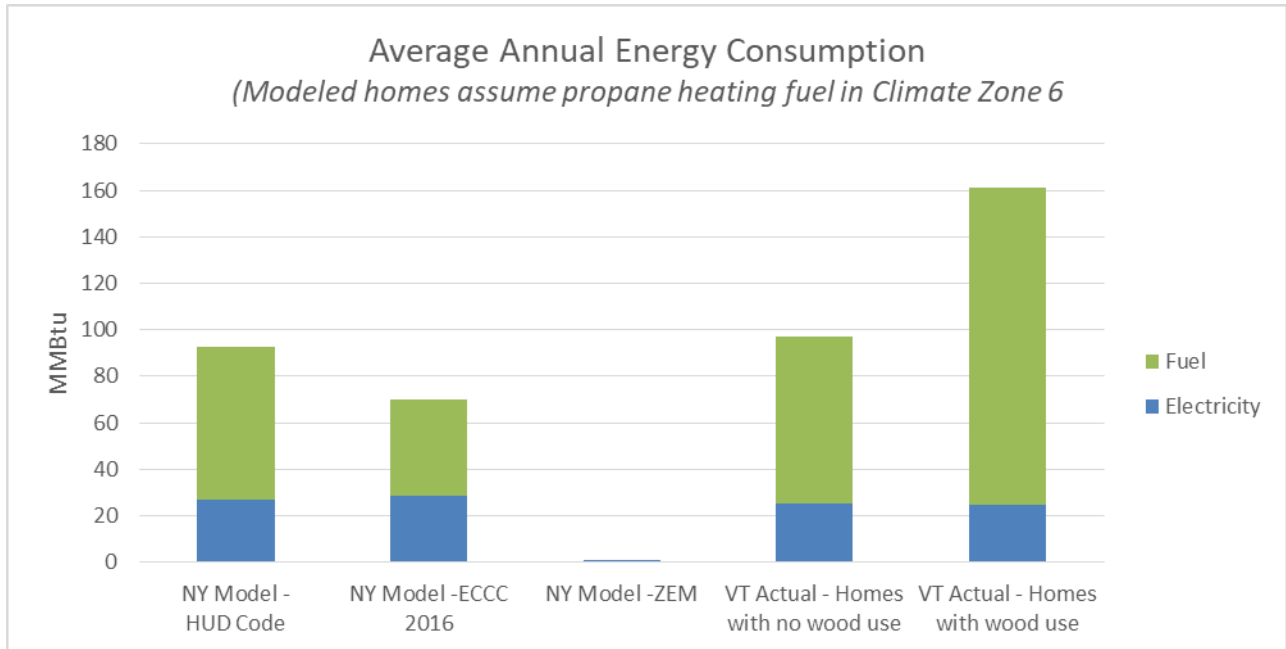


Figure 1. Fuel use comparison between HUD, ECCCNY-2016 and, ZEM modeled homes with Vermont actual average use

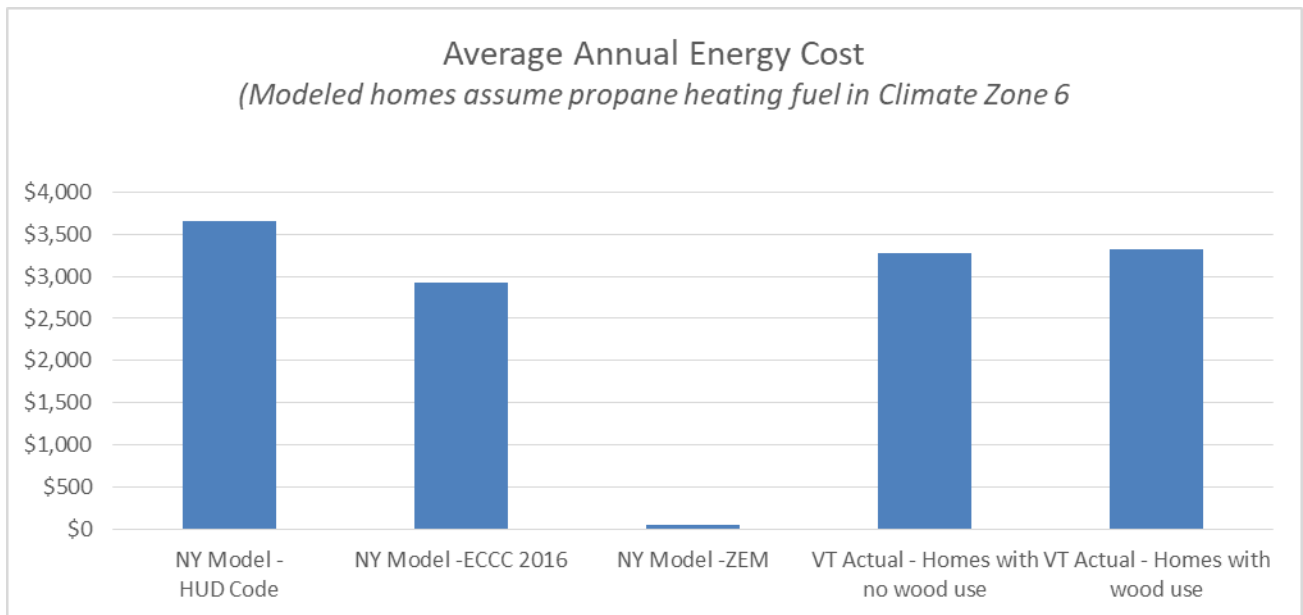


Figure 2. Energy cost comparison between HUD, ECCCNY-2016 and ZEM modeled homes with Vermont actual average use

Appendix 5 - Cash Flow Analysis

Reference file: NY MH Monthly Cash Flow Template_Final Report-NYSERDA_20180918.xlsx

A cash flow analysis was conducted to compare the total annual cost of ownership of a ZEM home with a typical new manufactured home built to HUD standards. For the report a single typical baseline heating fuel/system scenario was selected for comparison to ZEM: propane furnace. Both homes were modeled in IECC Climate Zone 6A. The cash flow scenarios can be run on any baseline heating fuel/system and in all of New York's IECC climate zones. In the table below, cells shaded in yellow are user selected and determine the REM/Rate modeling run used in the comparison. Cells in blue are updated automatically based on the REM model selected.

For the analysis we assumed the ZEM buyer qualifies for SONYMA ENERGY STAR Labeled Homes mortgage. This mortgage provides low interest rates for Energy Star Labeled homes, as well as down payment assistance loan (DPAL) up to \$15,000. The DPAL buys down the first cost of the home. Homebuyers pay a small percent of interest for the DPAL, which is incorporated in the primary mortgage. Homes must be located in SONYMA Target Areas on owned land. The new HUD manufactured home assumes a typical personal property, or chattel loan, commonly used for manufactured home purchases.

Table 10. Monthly Cash Flow Cost Breakdown for ZEM and New HUD Manufactured Home

Monthly Cash Flow Comparison of Zero Energy Modular (ZEM) and New HUD Manufactured Home				
<i>Example home: 2 bedroom/2 bath 14'x70'</i>				
			HUD	ZEM
			Standard Financing (Chattel Loan)	SONYMA ENERGY STAR Loan
			HUD-CZ6- Propane_HUD079	ZEM-CZ6-Elec (HP)
	Model			
Housing Costs				
1	Base Factory Cost		\$72,441	\$150,000
2	Sales Tax		\$1,739	\$3,600
3	Foundation/Site Work		\$10,000	\$10,000
4	Delivery and Set		\$2,000	\$7,000
5	Solar Array		\$0	\$18,750
	Subtotal		\$86,180	\$189,350
Incentives				
6	NYSERDA LR NCP		\$0	(\$4,200)
7	High Performance Products		\$0	\$0
8	Solar Array		\$0	(\$6,000)
	Subtotal		\$0	(\$10,200)
Tax Credits/Other Financial Incentives				
9	Federal tax credit			
10	NYS tax credit			
11	NYS Property Tax abatement			
12	SONYMA homeownership loan			(\$15,000)
Financing				
	Total cost to finance		\$86,180	\$164,150
13	Down payment		\$8,618	\$0
	Closing Costs (out of pocket)		\$0	\$0
	Interest rate		9%	4.75%
	Term (years)		15	30
	Monthly Mortgage Cost		\$787	\$856
Energy Costs				
14	Average monthly energy gross consumption		\$305	\$100
	Average monthly energy gross production		\$0	-\$97
15	Average monthly energy net consumption		\$305	\$4
16	Average monthly service/connection fees		\$30	\$30
	Subtotal		\$335	\$34
Total Cost of Ownership				
	Mortgage payment		\$787	\$856
	Co-op fee		\$0	\$0
	Property taxes (after adjustment)		\$50	\$120
	Insurance		\$30	\$30
	Energy		\$335	\$34
	Total monthly housing cost		\$1,201	\$1,040
	Upfront out of pocket cost		\$8,618	\$0
	Annual Income Required (housing cost as 30% of income)		\$48,052	\$41,602

Table 11. References and Assumptions for Monthly Cash Flow Comparison

Assumptions/References	
1	Base factory costs include full appliance package, stairs, deck and porch and utility hook-up. HUD pricing based on US Census data plus cost of add-ons noted above for direct comparison to ZEM. ZEM pricing based on actual average factory cost from Vermod Homes in Wilder, VT. Updated cost break out for ZEM lean manufacturing approach forthcoming.
2	60% Manufactured/modular homes only pay sales tax on materials. 60% is the portion of material cost based on EVT research and professional judgement 4% State tax rate, does not account for local taxes or tax rate withing the Metropolitan Commuter Transportation District (MCTD) https://www.tax.ny.gov/bus/st/rates.htm
3	Foundation and site work based on Efficiency Vermont research. Assumes frost protected foundation per HUD requirements, helical piers for ZEM.
4	\$2.50 ZEM delivery and set costs include crane.
5	Installed cost per watt based on Efficiency Vermont research 5 kW Solar array size (kW) for Climate Zone 4 (system sized to approximate net zero modeled energy consumption) 6 kW Solar array size (kW) for Climate Zone 5 (system sized to approximate net zero modeled energy consumption) 7.5 kW Solar array size (kW) for Climate Zone 6 (system sized to approximate net zero modeled energy consumption)
6	NYSERDA Low Rise New Construction Program Tier 3 LMI incentive. This incentive only applies to utility customers who pay into the statewide Systems Benefit Charge (SBC) fund.
7	Potential additional rebates and/or midstream incentives to buy down the cost of ZEM products (e.g. ASHP, HPWH, high efficiency lighting and appliances)
8	\$0.80 Based on NY-SUN Residential Rate for New York Upstate Region Block 8. Double incentive amount for LMI customers earning less than 80% of median income in area https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Contractors/Residential-Small-Commercial-MW-Block/Residential-Small-Commercial-Incentive-Structure https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-for-Your-Home/Paying-for-Solar/Incentives-and-Financing
9	30% https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-for-Your-Home/Paying-for-Solar/Tax-Credit
10	25% ibid
11	https://www.tax.ny.gov/research/property/assess/manuals/vol4/pt1/sec4_01/sec487.htm https://www.tax.ny.gov/pdf/current_forms/orpts/rp487_fill_in.pdf
12	This SONYMA mortgage provides low interest rates for Energy Star Labeled homes, as well as down payment assistance loan (DPAL) up to \$15,000.
13	10% Standard downpayment rate for typical HUD home purchase
14	Energy cost per NYSEDA Monthly Average Pricing Report, see 'Assumptions' tab: \$0.18/kWh, \$3.10/gal propane, \$3.22/gal fuel oil
15	Assumes credit for production at same statewide average billing rate of \$0.18/kWh
16	Per NYS net metering laws, credits rollover monthly and apply only to energy consumption not the monthly service fees. https://www.nyserda.ny.gov/Researchers-and-Policymakers/Power-Generation/Net-Metering-Interconnection

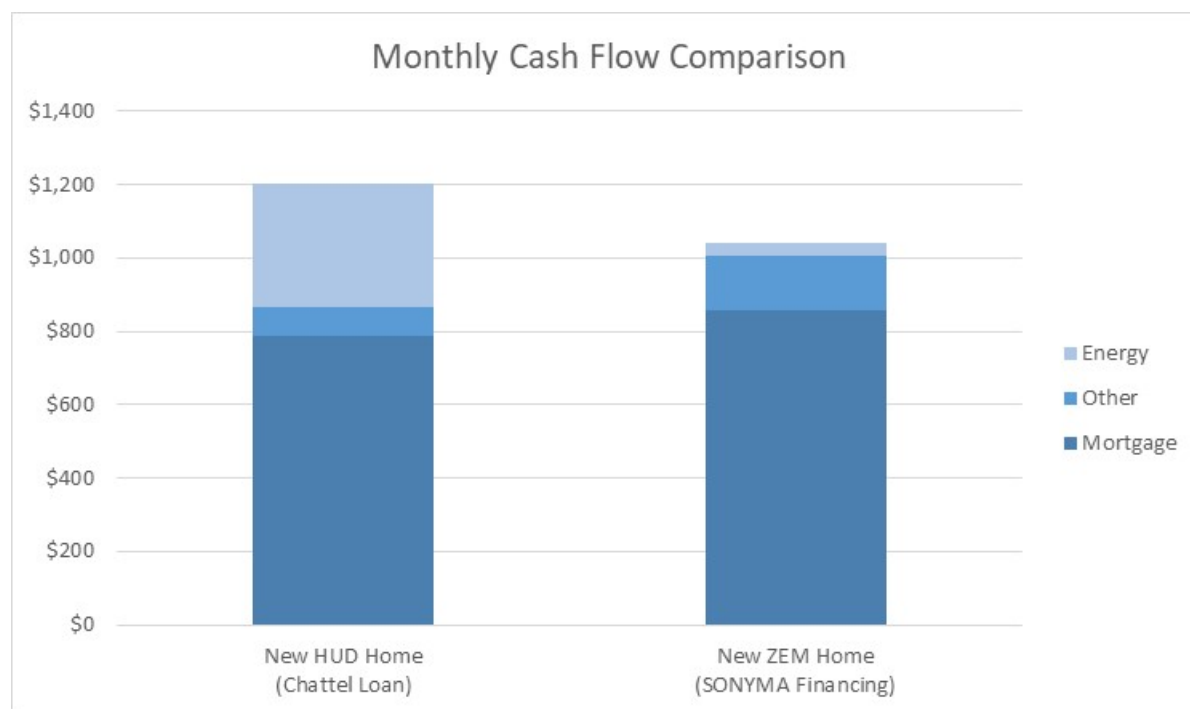


Figure 3. Monthly Cash Flow Comparison for ZEM and New HUD Manufactured Home

Appendix 6 - Estimated Benefits of ZEM

Reference file: Estimated Benefits of ZEM_Final Report-NYSERDA_20180918.xlsx

The tables below summarize the estimated energy, cost and emissions savings from a Zero Energy Modular (ZEM) home over HUD, ECCCNYS-2016 and Vermont actual existing home baselines. The data in these tables have been calculated based on homes modeled in Rem/Rate™ sited in International Energy Conservation Code (IECC) climate zone 6. Additional data on annual, lifetime and cumulative benefits can be found in the attachment referenced at the beginning of this section

Table 12. Annual energy use and cost of a manufactured home built to HUD specifications

Annual Energy Use	HUD CODE - MFR Home (Electric Furnace)	HUD CODE - MFR Home (Propane Furnace)	HUD CODE - MFR Home (Oil Furnace)
Area (square feet)	980	980	980
Heating (kWh)	15,021	759	758
Heating (gallon propane)		718	
Heating (gallon oil)			473
Other Electric (kWh)	7,151	7,151	7,151
PV (kWh)			
Total Annual (kWh)	22,172	7,910	7,910
Total Annual Electric \$	\$ 4,002	\$ 1,428	\$ 1,428
Monthly Electric Utility Bill Charge \$	\$ 12	\$ 12	\$ 12
Total Annual Electric Utility Bill	\$ 4,146	\$ 1,572	\$ 1,572
Total Annual Fuel Bill		\$ 2,228	\$ -
Total Annual Energy Cost	\$ 4,146	\$ 3,799	\$ 1,572

Table 13. Annual energy use and cost of a manufactured home built to ECCCNYS-2016 specifications

Annual Energy Use	ECCCNYS-2016 - New Construction (Electric Furnace)	ECCCNYS-2016 - New Construction (Propane Furnace)	ECCCNYS-2016 - New Construction (Oil Furnace)
Area (square feet)	980	980	980
Heating (kWh)	6,903	434	458
Heating (gallon propane)		459	
Heating (gallon oil)			292
Other Electric (kWh)	7,878	7,878	7,878
PV (kWh)			
Total Annual (kWh)	14,781	8,311	8,336
Total Annual Electric \$	\$ 2,668	\$ 1,500	\$ 1,505
Monthly Electric Utility Bill Charge \$	\$ 12	\$ 12	\$ 12
Total Annual Electric Utility Bill	\$ 2,812	\$ 1,644	\$ 1,649
Total Annual Fuel Bill		\$ 1,423	\$ 940
Total Annual Energy Cost	\$ 2,812	\$ 3,067	\$ 2,588

Table 14. Annual energy use and cost average of pre-weatherized existing manufactured homes in Vermont

Annual Energy Use	Existing MFR Home (Electric Furnace)	Existing MFR Home (Propane Furnace)	Existing MFR Home (Oil Furnace)
Area (square feet)	980	980	980
Heating (kWh)	30,918		
Heating (gallon propane)		760	
Heating (gallon oil)			514
Other Electric (kWh)		6,970	6,447
PV (kWh)			
Total Annual (kWh)	30,918	6,970	6,447
Total Annual Electric \$	\$ 5,581	\$ 1,258	\$ 1,164
Monthly Electric Utility Bill Charge \$	\$ 12	\$ 12	\$ 12
Total Annual Electric Utility Bill	\$ 5,725	\$ 1,402	\$ 1,308
Total Annual Fuel Bill		\$ 2,358	\$ 1,655
Total Annual Energy Cost	\$ 5,725	\$ 3,760	\$ 2,963

Table 15. Annual energy use and cost of a Zero Energy Modular (ZEM) home

Annual Energy Use	ZEM (Electric Heat Pump)
Area (square feet)	980
Heating (kWh)	1,989
Heating (gallon propane)	
Heating (gallon oil)	
Other Electric (kWh)	4,691
PV (kWh)	(6,429)
Total Annual (kWh)	251
Total Annual Electric \$	\$ 45
Monthly Electric Utility Bill Charge \$	\$ 12
Total Annual Electric Utility Bill	\$ 189
Total Annual Fuel Bill	
Total Annual Energy Cost	\$ 189

Table 16. Assumptions used in projected annual savings calculations

Other assumptions			
Number of homes in NY	8,231,687	US Census V2016	
Number of manufactured homes in NY	212,967	Calculated using two Census data sets	US Census 2010
Number of New Homes built in NY (annual)	33711	US Census V2016 (building permits)	
Life (years)	20	estimated	
Electricity \$/kWh	\$ 0.18	NYSERDA historical energy price data	
Propane \$/gallon	\$ 3.10	NYSERDA historical energy price data	
Oil \$/gallon	\$ 3.22	NYSERDA historical energy price data	
Percent propane heat	40%	estimated by NYSERDA	
Percent oil heat	60%	estimated by NYSERDA	
Percent electric heat	0%	estimated by NYSERDA	
Avoided emissions rate (lb./gal oil)	22.4	https://www.eia.gov/environment/emissions/co2_vol_mass.php	
Avoided emissions rate (lb./gal propane)	12.7	https://www.eia.gov/environment/emissions/co2_vol_mass.php	
Avoided emissions rate (lb./kWh)	1.2	US EPA eGRID Data for NPCC Upstate NY Region	

Table 17. Estimated annual and lifetime savings per ZEM home

	Annual Savings per ZEM				Lifetime Savings			
	Energy (kWh)	Propane (gallon)	Oil (Gallon)	Cost (\$)	Energy (kWh)	Propane (gallon)	Oil (Gallon)	Cost (\$)
ZEM replacing new MFR housing (electric)	21,921			\$ 3,957	438,422			\$ 79,135
ZEM replacing new MFR housing (propane)	7,659	718		\$ 3,610	153,177	14,362.75		\$ 72,202
ZEM replacing new MFR housing (oil)	7,659		473	\$ 1,382	153,175		9,468.01	\$ 27,648
ZEM replacing code new construction (electric)	14,530			\$ 2,623	290,593			\$ 52,452
ZEM replacing code new construction (propane)	8,060	459		\$ 2,878	161,202	9,175.66		\$ 57,560
ZEM replacing code new construction (oil)	8,084		292	\$ 2,399	161,690		5,830.02	\$ 47,975
ZEM replacing existing MFR housing (electric)	30,667			\$ 5,535	613,337			\$ 110,707
ZEM replacing existing MFR housing (propane)	6,719	760		\$ 3,570	134,380	15,200.42		\$ 71,407
ZEM replacing existing MFR housing (oil)	6,196		514	\$ 2,774	123,916		10,272.98	\$ 55,477

Table 18. Housing replacement scenario assumptions

Housing Replacement Scenario	
ZEM replacing new MFR housing	15%
ZEM replacing code new construction	15%
ZEM replacing existing MFR housing	70%
Electric	0%
Propane	40%
Oil	60%

Table 19. Summary benefits of ZEM for years 2019-2030

Summary Table - ZEM Benefits 2019-2030	
Number of Years	11
Number of Homes	10000
Electric Savings (kWh)	68,435,697
Oil Savings (gal)	2,845,738
Propane Savings (gal)	2,834,211
Energy Cost Savings	\$ 28,942,986
Avoided Emissions (lbs. CO2 equivalent)	185,107,471

Appendix 7 – ZEM Pricing References

Attached please find the following:

- Vermod 2018 Price Sheet
- ZeMod 2018 Price Sheet



2018 Estimated Pricing

Base Costs *with standard finishes	\$113,000	1 bedroom, 1 bath 14'x40' home
	\$129,000	1 bedroom, 1 bath 14'x56' home
	\$152,000	2 bedroom, 2 bath 14'x72' home
	\$150,000	3 bedroom, 1 bath 14'x72' home
	\$150,000	2 bedroom, 2 bath 28'x36' home
	\$180,000	3 bedroom, 2 bath 28'x42' home
	\$205,000	3 bedroom, 2 bath (2 story) 14'x48' home

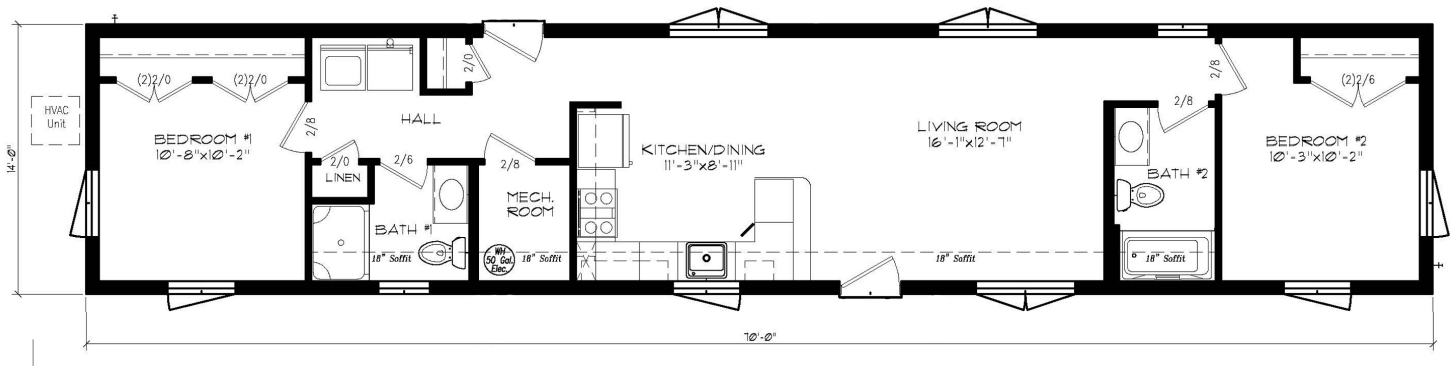
Cost Estimator:

Base Cost		Choose design from above. Varies based on upgrades and level of finishes.
Vermont Sales Tax	Base Cost x .036	Not applicable for out of state purchases.
Frost Protected Foundation	\$10,000- \$30,000	Varies by size of home. Piers, crawl-space, or full basement.
Delivery and Set	\$8,500- \$9,500	Varies by distance from factory in Wilder, VT. Varies by number of boxes and size.
Utility Hook-Ups	\$2,000	Water, Sewer and Electrical utilities connected.
7kW Solar Array	\$18,000	Size of solar array determined by size of home, efficiency of design and number of occupants.
Total Cost of Home:		No Incentives or Subsidies Included
Solar Incentives	-\$7,000	For buyers below 80% median income. Higher income buyers eligible for federal tax credit.
Efficiency VT Incentive	-\$8,500	For buyers below 80% median income. Higher-income buyers eligible for \$3,000 incentive.
CHT Homeownership Loan	-\$35,000	For buyers below 120% median income. Mobile Home Replacement Only.
Final Cost to Finance:		

ZeMod Delaware

Zero Energy Modular Homes

ZEMOD DELAWARE OFFERS HIGH-PERFORMANCE MODULAR HOMES THAT ARE ZERO ENERGY READY FOR THE 21ST CENTURY. YOU DESERVE A BETTER HOME, AND ZEMOD DELAWARE CAN HELP.



SOLSTICE - 2018 ANTICIPATED ZEMOD HOME PRICING

2 bedroom, 2 bath 14'x70' home \$158,172*

**Pricing does not include land & non-home costs (including but not limited to: well, septic, grading, seeding, driveway, permits, etc.). Base price including solar is \$158,172 as shown is \$178,766. Incentives & down payment assistance programs reduce total price for income-qualified buyers.*

Standard Features:

- Solar Electricity
- Super-Insulated 10" Exterior Walls
- Bamboo Floors in Living Space
- High-Performance Doors and Windows
- Fresh Air Ventilation
- Central Heat and Air Conditioning
- ENERGY STAR® Appliances & Lighting

www.ZeModDelaware.com

Email: mmandujano@milfordhousing.com

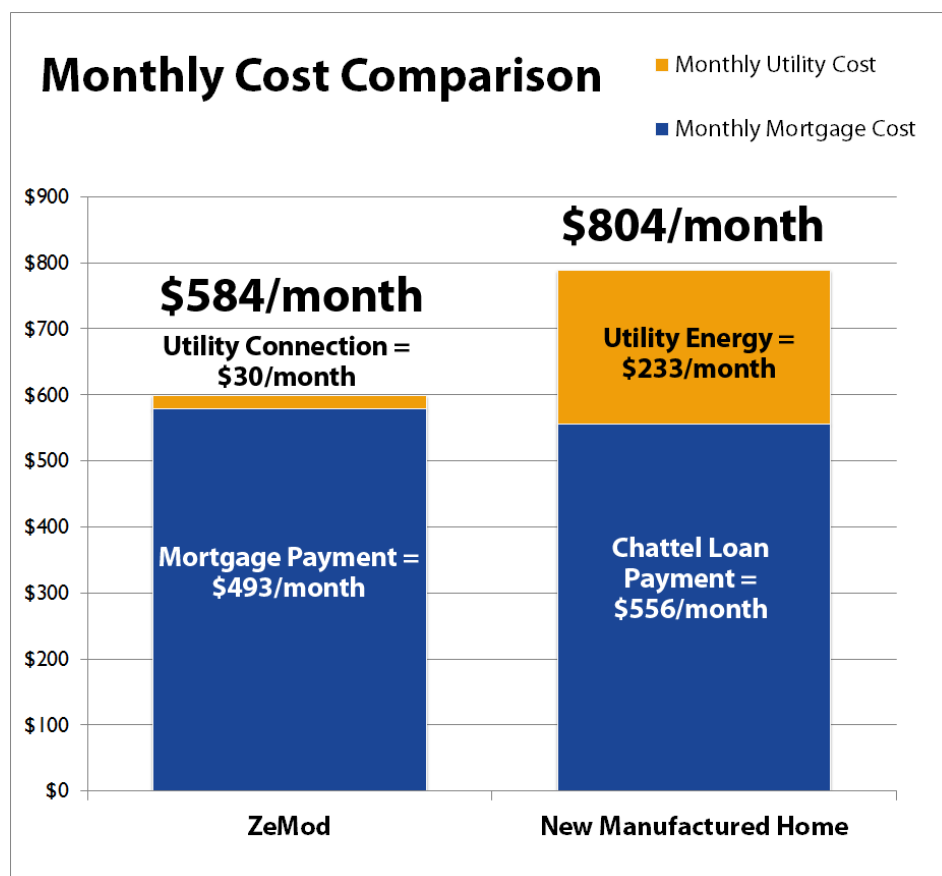
Phone: 302-422-8255

ZeMod Delaware offers both Energy Efficiency Incentives and Down Payment Assistance to ensure the affordability of the homes and help mitigate the of energy efficient features of the units. Both forms of assistance are only be made available for income qualified buyers up to 120% Area Median Income (AMI).

ZeMod Energy Efficiency Incentive - ZeMod Delaware offers homeowners Energy Efficient Incentive funding to buy down incremental cost of energy efficiency features. Incentive amount: \$16,500 per home. Income limit is 120% Area Median Income (AMI).

Down Payment Assistance - Down Payment Assistance is available to eligible households in the amount of up to \$25,000. The amount of assistance will vary per household due to unit cost and income of the buyer. This assistance can be used to cover down payment and is offered at a 0% interest. No monthly payments - loan is repaid upon sale, refinance, or transfer of home.

Call MHDC at 302-422-8255 to speak with a ZeMod Delaware specialist and see if you qualify.



2 bed/2 bath 14' x 70' home	ZeMod	New Manufactured Home
Factory Cost, Foundation & Delivery	\$158,172	\$70,860
ZeMod Incentive	-16,500	\$0
ZeMod Downpayment assistance	-\$25,000	\$0
Total Cost	\$116,672	\$70,860
Down Payment	\$500	\$7,086
Total Cost to Finance	\$116,172	\$63,774
Monthly Mortgage Cost =	\$554	\$556
Interest Rate	4%	6.50%
Term (years)	30	15
Monthly Utility Cost	\$30	\$233
Total Cost Including Utilities =	\$584	\$804

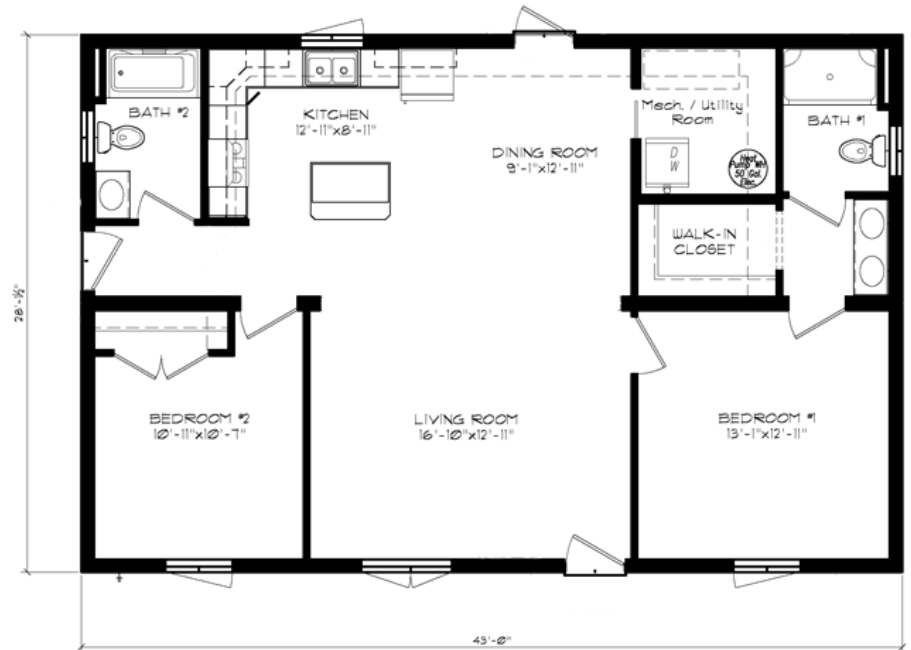
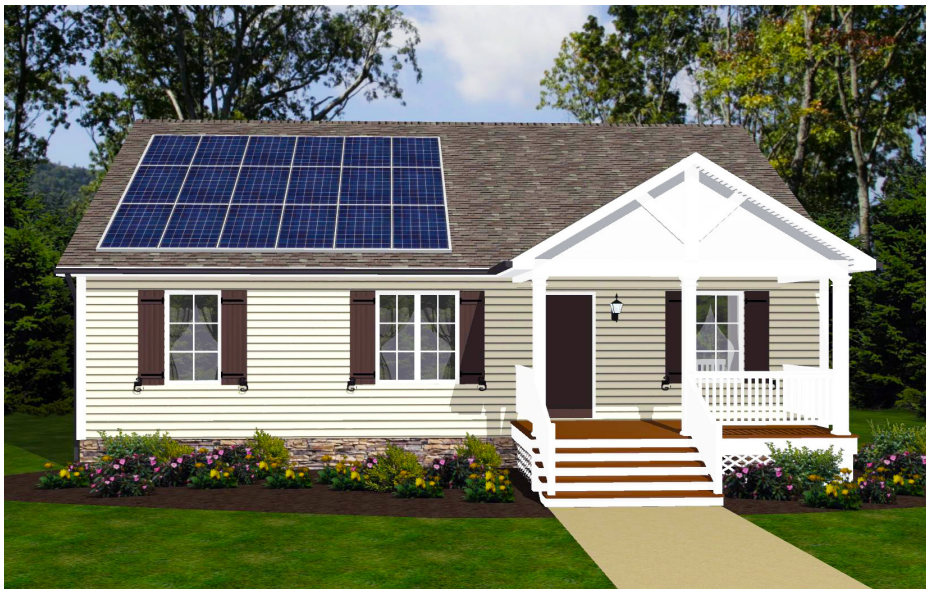
**This comparison is for a 2 bed/2 bath home and assumes buyer is at or below 80% AMI and qualifies for max downpayment assistance*

***Utility costs for manufactured home include utility connection and electricity cost. ZeMod assumes PV generates annual electricity use, net metering and utility connection charge*

ZeMod Delaware

Zero Energy Modular Homes

ZEMOD DELAWARE OFFERS HIGH-PERFORMANCE MODULAR HOMES THAT ARE ZERO ENERGY READY FOR THE 21ST CENTURY. YOU DESERVE A BETTER HOME, AND ZEMOD DELAWARE CAN HELP.



SUNDIAL - 2018 ANTICIPATED ZEMOD HOME PRICING

2 bedroom, 2 bath 28'x43' home \$177,838*

**Pricing does not include land & non-home costs (including but not limited to: well, septic, grading, seeding, driveway, permits, etc.). Base price including solar is \$177,838 as shown is \$191,243. Incentives & down payment assistance programs reduce total price for income-qualified buyers.*

Standard Features:

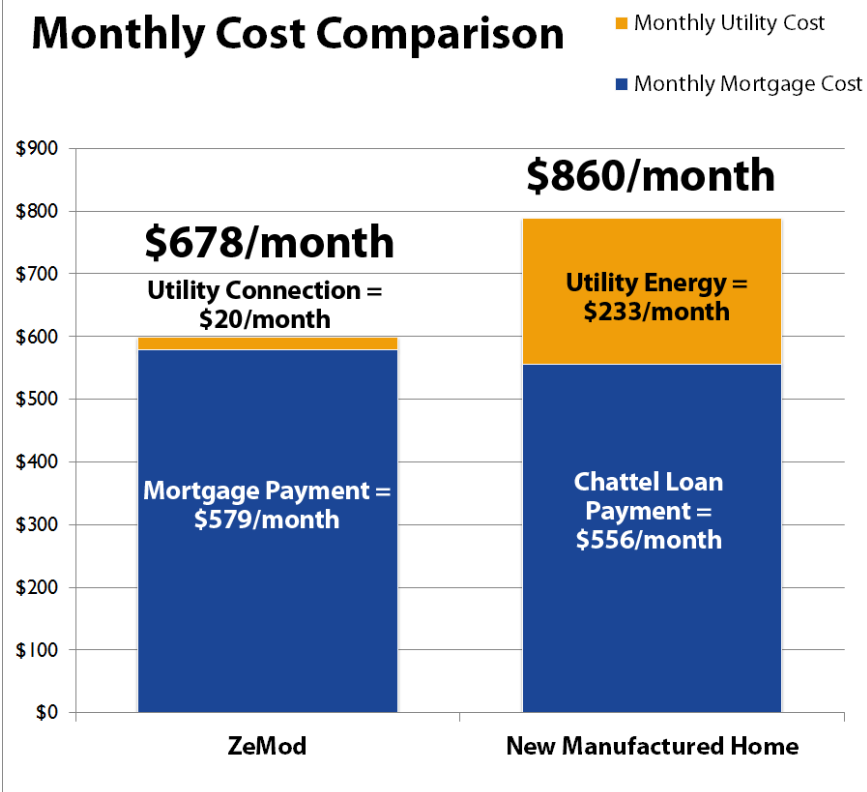
- Solar Electricity
- Super-Insulated 10" Exterior Walls
- Bamboo Floors in Living Space
- High-Performance Doors and Windows
- Fresh Air Ventilation
- Central Heat and Air Conditioning
- ENERGY STAR® Appliances & Lighting

www.ZeModDelaware.com

Email: mmandujano@milfordhousing.com

Phone: 302-422-8255

Monthly Cost Comparison



ZeMod Delaware offers both Energy Efficiency Incentives and Down Payment Assistance to ensure the affordability of the homes and help mitigate the of energy efficient features of the units. Both forms of assistance are only be made available for income qualified buyers up to 120% Area Median Income (AMI).

ZeMod Energy Efficiency Incentive - ZeMod Delaware offers homeowners Energy Efficient Incentive funding to buy down incremental cost of energy efficiency features. Incentive amount: \$16,500 per home. Income limit is 120% Area Median Income (AMI).

Down Payment Assistance - Down Payment Assistance is available to eligible households in the amount of up to \$25,000. The amount of assistance will vary per household due to unit cost and income of the buyer. This assistance can be used to cover down payment and is offered at a 0% interest. No monthly payments - loan is repaid upon sale, refinance, or transfer of home.

Call MHDC at 302-422-8255 to speak with a ZeMod Delaware specialist and see if you qualify.

2 bed/2 bath 28' x 43' home	ZeMod	New Manufactured Home
Factory Cost, Foundation & Delivery	\$177,838	\$80,000
ZeMod Incentive	-16,500	\$0
ZeMod Downpayment assistance	-\$25,000	\$0
Total Cost	\$136,338	\$80,000
Down Payment	\$500	\$8,000
Total Cost to Finance	\$135,838	\$72,000
Monthly Mortgage Cost =	\$649	\$627
Interest Rate	4%	6.50%
Term (years)	30	15
Monthly Utility Cost	\$30	\$233
Total Cost Including Utilities =	\$678	\$860

**This comparison is for a 2 bed/2 bath home and assumes buyer is at or below 80% AMI and qualifies for max downpayment assistance*

***Utility costs for manufactured home include utility connection and electricity cost. ZeMod assumes PV generates annual electricity use, net metering and utility connection charge*

Appendix 8 - REM/Rate Building Summary Reports

Attached please find the following:

- Zero Energy Modular (ZEM), Electric Heat Pump, Climate Zone 6
- New HUD Manufactured Home, Propane Furnace, Climate Zone 6

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather: Watertown, NY HUD-CZ6-Propane_HUD079 NYSERDA MH-Single-HUDcz6-propane_HUD079.blg	Builder	

Property/Builder Information

Building Name	HUD-CZ6-Propane_HUD079
Owner's Name	
Property Address	
City, St, Zip	, NY
Phone Number	
Builder's Name	
Phone Number	
Email Address	
Plan/Model Name	
Community/Development	
Permit Date/Number	

Organization Information

Organization Name	Vermont Energy Investment Corp
Address	128 Lakeside Avenue, Suite 401
City, St, Zip	Burlington, VT 05401
Phone Number	802-658-6060
Website	www.veic.org

Rating/RESNET Information

Provider ID	_____
Sample Set ID	
Registry ID	649319521
Registry Date Registered	
Rater's Name	Li Ling Young (Leslie Badger)
Rater's ID	
Rater's Email	veicinfo@veic.org
Last Field Insp	4/13/2018
Rating Type	Projected Rating
Reason for Rating	Informational
Rating Number	

Building Summary

Property
, NY

Organization
Vermont Energy Investment Corp
802-658-6060
Li Ling Young (Leslie Badger)

HERS
Projected Rating
4/13/2018
Rater ID:

Weather: Watertown, NY
HUD-CZ6-Propane_HUD079
NYSERDA
MH-Single-HUDcz6-propane_HUD079.blg

Builder

General Building Information

Area of Conditioned. Space(sq ft)	980
Volume of Conditioned. Space	7840
Year Built	2015
Housing Type	Mobile home
Level Type(Apartments Only)	None
Floors on or Above-Grade	1
Number of Bedrooms	2
Foundation Type	Open crawl space/raised floor
Enclosed Crawl Space Type	N/A
Number of Stories Including Conditioned Basement	1
Thermal Boundary Location	N/A

Frame Floor Information

Name	Library Entry	Location	Area(sq ft)	Uo Value
all	HUD MH Floor-carpet	Btwn cond & open crwl	980	0.059

Frame Floor Library List

Floor: HUD MH Floor-carpet

Information From Quick Fill Screen

Continous Insulation R-Value	0.0
Cavity Insulation R-Value	22.0
Cavity Insulation Thickness (in.)	6.0
Cavity Insulation Grade	3
Joist Size (w x h, in)	1.5 x 6.0
Joist Spacing (in oc)	16.0
Framing Factor - (default)	0.1300
Floor Covering	CARPET

Note

Above-Grade Wall

Name	Library Entry	Location	Exterior Color	Area(sq ft)	Uo Value
all	HUD MH Wall R19	Cond -> ambient	Light	1274.00	0.074

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather: Watertown, NY HUD-CZ6-Propane_HUD079 NYSERDA MH-Single-HUDcz6-propane_HUD079.blg	Builder	

Above-Grade Wall Library List

Above-Grade Wall: HUD MH Wall R19

Information From Quick Fill Screen

Wall Construction Type	Standard Wood Frame
Continuous Insulation (R-Value)	0.0
Frame Cavity Insulation (R-Value)	19.0
Frame Cavity Insulation Thickness (in)	5.5
Frame Cavity Insulation Grade	3
Stud Size (w x d, in)	1.5 x 5.5
Stud Spacing (in o.c.)	16.0
Framing Factor - (default)	0.2300
Gypsum Thickness (in)	0.5
Note	

Window Information

Name	Wall Assignment	Orient	U-Value	SHGC	Area (sqft)	Overhang			Interior		Adjacent	
						Depth (ft)	To Top (ft)	To Btm (ft)	Winter Shading	Summer Shading	Winter Shading	Summer Shading
front	AGWall 1	Southeast	0.350	0.500	67.60	0.0	0.0	0.0	0.85	0.70	None	None
streetside, right	AGWall 1	Southeast	0.350	0.500	11.70	0.0	0.0	0.0	0.85	0.70	None	None
back	AGWall 1	Northeast	0.350	0.500	72.45	0.0	0.0	0.0	0.85	0.70	None	None
left bedroom	AGWall 1	Southwes	0.350	0.500	18.80	0.0	0.0	0.0	0.85	0.70	None	None

Door Information

Name	Library Entry	Wall Assignment	Opaque Area(sq ft)	Uo Value	R-Value of Opaque Area	Storm Door
Front	Steel/FG Entry Door	AGWall 1	21.0	0.144	6.0	No
Back	Steel/FG Entry Door	AGWall 1	21.0	0.144	6.0	No

Roof Information

Name	Library Entry	Ceiling Area(sq ft)	Roof Area(sq ft)	Exterior Color	Radiant Barrier	Type	Uo Value	Cement or Clay Tiles	Roof Tile Ventilation
cathedral ALL	HUD MH Ceiling	995.00	995.00	Dark	No	Vaulted	0.054	No	No

Building Summary

Property
, NY

Weather: Watertown, NY
HUD-CZ6-Propane_HUD079
NYSERDA
MH-Single-HUDcz6-propane_HUD079.blg

Organization
Vermont Energy Investment Corp
802-658-6060
Li Ling Young (Leslie Badger)

Builder

HERS
Projected Rating
4/13/2018
Rater ID:

Roof Library List

Ceiling: HUD MH Ceiling

Information From Quick Fill Screen

Continous Insulation (R-Value)	0.0
Cavity Insulation (R-Value)	30.0
Cavity Insulation Thickness (in)	9.3
Cavity Insulation Grade	3
Gypsum Thickness (in)	0.500
Insulated Framing Size(w x h, in)	1.5 x 9.3
Insulated Framing Spacing (in o.c.)	16.0
Framing Factor - (default)	0.1412
Ceiling Type	Vaulted
Note	

Building Summary

Property
, NY

Weather: Watertown, NY
HUD-CZ6-Propane_HUD079
NYSERDA
MH-Single-HUDcz6-propane_HUD079.blg

Organization
Vermont Energy Investment Corp
802-658-6060
Li Ling Young (Leslie Badger)

Builder

HERS
Projected Rating
4/13/2018
Rater ID:

Mechanical Equipment

Number of Mechanical Systems	3
Heating SetPoint(F)	68.0
Heating Setback Thermostat	Present
Cooling SetPoint(F)	78.0
Cooling Setup Thermostat	Present
DHW SetPoint(F)	125.0

Heat: HUD Furnace-Prop75

SystemType	Fuel-fired air distribution
Fuel Type	Propane
Rated Output Capacity (kBtuh)	100.0
Seasonal Equipment Efficiency	75.0 AFUE
Auxiliary Electric	1223 Eae
Note	
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100
Percent Load Served	100

DHW: 50 gal. 0.92EF Elec

Water Heater Type	Conventional
Fuel Type	Electric
Energy Factor	0.92
Recovery Efficiency	0.98
Water Tank Size (gallons)	50
Extra Tank Insulation (R-Value)	0.0
Note	Fed Std
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100
Percent Load Served	100

Cool: 13SEER A/C 2 ton

Building Summary

Property
, NY

Weather: Watertown, NY
HUD-CZ6-Propane_HUD079
NYSERDA
MH-Single-HUDcz6-propane_HUD079.blg

Organization
Vermont Energy Investment Corp
802-658-6060
Li Ling Young (Leslie Badger)

Builder

HERS
Projected Rating
4/13/2018
Rater ID:

Mechanical Equipment

System Type	Air conditioner
Fuel Type	Electric
Rated Output Capacity (kBtuh)	24.0
Seasonal Equipment Efficiency	13.0 SEER
Sensible Heat Fraction (SHF)	0.70
Note	
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100
Percent Load Served	100

DHW Efficiencies

All bath faucets & showers <= 2gpm	false
All DHW pipes fully insulated >= R-3	false
Recirculation type	None (standard system)
Farthest fixture to DHW heater	30
TOTAL Pipelength for longest DHW run	40
DWHR unit present?	false

DHW Diagnostics	
dhwGpd	35.06
peRatio	0.55
dishwasherGpd	2.04
clothesWasherHotWaterGPD	1.60
EDef	0.93
ewaste	21.22
tmains	52.30
dwhrWhInletTempAdj	0.00
pumpConsKwh	0.00
pumpConsMmbtu	0.00

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather:Watertown, NY HUD-CZ6-Propane_HUD079 NYSERDA MH-Single-HUDcz6-propane_HUD079.blg	Builder	

Duct Systems

Name	MH Ducts
Conditioned Floor Area(sq ft)	980.0
# of Returns	1
Heating System	HUD Furnace-Prop75
Cooling System	13SEER A/C 2 ton
Supply Duct Surface Area(sq ft)	264.6
Return Duct Surface Area(sq ft)	49.0
Duct Leakage	
Qualitative Assessment	Not Applicable
Duct Leakage to Outside	
Supply+Return	0.120 CFM25 / CFA
Supply Only	Not Applicable
Return Only	Not Applicable
Total Duct Leakage	0.120 CFM25 / CFA
Duct Tightness Test	Postconstruction Test
Test Exemptions	
IECC	FALSE
RESNET LtO	FALSE
ENERGY STAR LtO	FALSE

Type	Location	Percent Location	R-Value
Supply	Mobile home belly	90.0	22.0
	Mobile home belly	10.0	8.0
Return	Mobile home belly	100.0	0.0

Building Summary

Property
, NY

Weather: Watertown, NY
HUD-CZ6-Propane_HUD079
NYSERDA
MH-Single-HUDcz6-propane_HUD079.blg

Organization
Vermont Energy Investment Corp
802-658-6060
Li Ling Young (Leslie Badger)

Builder

HERS
Projected Rating
4/13/2018
Rater ID:

Infiltration and Mechanical Ventilation

Whole Dwelling Infiltration

Input Type	Blower door
Heating Season Infiltration Value	8.00 ACH @ 50 Pascals
Cooling Season Infiltration Value	8.00 ACH @ 50 Pascals
Shelter Class	4
Code Verification	Tested

Mechanical Ventilation for IAQ

Type	Exhaust Only
Rate(cfm)	50
Sensible Recovery Efficiency(%)	0.00
Total Recovery Efficiency(%)	0.00
Hours per Day	12.1
Fan Power (watts)	50.00
ECM Fan Motor	false

Ventilation Strategy for Cooling

Cooling Season Ventilation	Natural Ventilation
----------------------------	---------------------

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather:Watertown, NY HUD-CZ6-Propane_HUD079 NYSERDA MH-Single-HUDcz6-propane_HUD079.blg	Builder	

Lights and Appliances

Rating/RESNET audit

Ceiling Fan CFM / Watt	0.00
Refrigerator kWh/yr	413
Refrigerator Location	Conditioned
Range/Oven Fuel Type	Electric
Induction Range	No
Convection Oven	No

Dishwasher

Energy Factor	0.00
Dishwasher kWh/yr	307
Place Setting Capacity	12

Clothes Dryer

Fuel Type	Electric
Location	Conditioned
Moisture Sensing	Yes
CEF	3.11

Clothes Washer

Location	Conditioned
LER (kWh/yr)	487
IMEF	0.807
Capacity (CU.Ft)	3.200
Electricity Rate	0.08
Gas Rate	0.69
Annual Gas Cost	23.00

Qualifying Light Fixtures

Interior CFLs %	34.0
Interior Fluorescent %	0.0
Exterior Lights %	0.0
Garage Lights %	0.0

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather:Watertown, NY HUD-CZ6-Propane_HUD079 NYSERDA MH-Single-HUDcz6-propane_HUD079.blg	Builder	

Mandatory Requirements

IECC Requirements

Verified IECC 04	false
Verified IECC 06	false
Verified IECC 09	false
Verified IECC 12	false
Verified IECC 15	false
Verified IECC 18	false
Verified NY-ECCC 2016	false
Verified IECC MI	false

EPA Requirements

Rater certifies that the home complies with the following requirements for:

None

- Rater Design Review Checklist(National)
- Rater Field Checklist(National)
- HVAC Design Report
- HVAC Commissioning Checklist (optional)

ENERGY STAR Version 3 Appliances

Amount

Refrigerators	0
Ceiling Fans	0
Exhaust Fans	0
Dishwashers	0

ENERGY STAR Version 3 Basements

Basement Wall Area 50% Below Grad:	false
Basement Floor Area	0.00
2009 IECC Prescriptive Requirements for ENERGY STAR v3.0	false
Slab Insulation Exemption:	false

Indoor airPlus Verification Checklist false

EPA Field App ID

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather:Watertown, NY HUD-CZ6-Propane_HUD079 NYSERDA MH-Single-HUDcz6-propane_HUD079.blg	Builder	

DOE Zero Energy Ready Home

Home Builder ID Number

Mandatory Requirements

Verified Fenestration	false
Verified Insulation	false
Verified Duct Location	false
Verified Appliance	false
Verified Lighting	false
Verified Fan Efficiency	false
Verified Water Efficiency	false
Verified EPA Indoor airPLUS	false
Verified Renewable Energy Ready Solar Electric	false

Optional Home Builder Commitments for Recognition

Certified under the EPA WaterSense for New Homes Program	No
Certified under the IBHS fortified for Safer Living Program	No
Followed the DOE Zero Energy Ready Home Quality Management Guidelines	No
The buyer of this home signed a waiver giving DOE Zero Energy Ready Home access to utility bill data for one year.	No

Active Solar

System Type	None
Collector Loop Type	None
Collector Type	None
Collector Orientation	None
Area(sq ft)	0.0
Tilt(degrees)	0.0
Volume(cu ft/gal)	0.0

Building Summary

Property

, NY

Weather: Watertown, NY
HUD-CZ6-Propane_HUD079
NYSERDA
MH-Single-HUDcz6-propane_HUD079.blg

Organization

Vermont Energy Investment Corp
802-658-6060
Li Ling Young (Leslie Badger)

Builder

HERS

Projected Rating
4/13/2018
Rater ID:

Notes

EVT 70' 2 bed
crawl space
2X10 floor - dpfg
DSW10" wall - dpfg
half light doors
.21 windows
SIP
FH09
CERV w Prioair6, COP 2.3
heat pump clothes dryer CEF 4.5

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather: Watertown, NY ZEM-CZ6-Elec (HP) NYSERDA MH-Single-ZEM-cz6-electricHP-PV _v4.blg	Builder	

Property/Builder Information

Building Name	ZEM-CZ6-Elec (HP)
Owner's Name	
Property Address	
City, St, Zip	, NY
Phone Number	
Builder's Name	
Phone Number	
Email Address	
Plan/Model Name	
Community/Development	
Permit Date/Number	

Organization Information

Organization Name	Vermont Energy Investment Corp
Address	128 Lakeside Avenue, Suite 401
City, St, Zip	Burlington, VT 05401
Phone Number	802-658-6060
Website	www.veic.org

Rating/RESNET Information

Provider ID	_____
Sample Set ID	
Registry ID	649319521
Registry Date Registered	
Rater's Name	Li Ling Young (Leslie Badger)
Rater's ID	
Rater's Email	veicinfo@veic.org
Last Field Insp	4/13/2018
Rating Type	Projected Rating
Reason for Rating	Informational
Rating Number	

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather:Watertown, NY ZEM-CZ6-Elec (HP) NYSERDA MH-Single-ZEM-cz6-electricHP-PV _v4.blg	Builder	

General Building Information

Area of Conditioned. Space(sq ft)	980
Volume of Conditioned. Space	7840
Year Built	2015
Housing Type	Mobile home
Level Type(Apartments Only)	None
Floors on or Above-Grade	1
Number of Bedrooms	2
Foundation Type	Open crawl space/raised floor
Enclosed Crawl Space Type	N/A
Number of Stories Including Conditioned Basement	1
Thermal Boundary Location	N/A

Frame Floor Information

Name	Library Entry	Location	Area(sq ft)	Uo Value
all	Hardwood 0-40.8 1.5x9.25@16**0	Btwn cond & open crwl	980	0.029

Frame Floor Library List

Floor: Hardwood 0-40.8 1.5x9.25@16**0

Information From Quick Fill Screen

Continous Insulation R-Value	0.0
Cavity Insulation R-Value	40.8
Cavity Insulation Thickness (in.)	9.3
Cavity Insulation Grade	1
Joist Size (w x h, in)	1.5 x 9.3
Joist Spacing (in oc)	16.0
Framing Factor - (default)	0.1300
Floor Covering	HARDWOOD
Note	

Above-Grade Wall

Name	Library Entry	Location	Exterior Color	Area(sq ft)	Uo Value
all	DSWF 012.930.1 3.*****	Cond -> ambient	Light	1274.00	0.024

REM/Rate - Residential Energy Analysis and Rating Software v15.6.1

This information does not constitute any warranty of energy costs or savings.

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Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather: Watertown, NY ZEM-CZ6-Elec (HP) NYSERDA MH-Single-ZEM-cz6-electricHP-PV _v4.blg	Builder	

Above-Grade Wall Library List

Above-Grade Wall: DSWF 012.930.1 3.*****

Information From Quick Fill Screen

Wall Construction Type	Double Stud Wood Frame
Continuous Insulation (R-Value)	12.9
Frame Cavity Insulation (R-Value)	30.1
Frame Cavity Insulation Thickness (in)	7.0
Frame Cavity Insulation Grade	1
Stud Size (w x d, in)	1.5 x 7.0
Stud Spacing (in o.c.)	24.0
Framing Factor - (default)	0.1988
Gypsum Thickness (in)	0.5

Note

Window Information

Name	Wall Assignment	Orient	U-Value	SHGC	Area (sqft)	Overhang			Interior		Adjacent	
						Depth (ft)	To Top (ft)	To Btm (ft)	Winter Shading	Summer Shading	Winter Shading	Summer Shading
fron door	AGWall 1	Southeast	0.220	0.110	21.00	8.0	1.0	4.5	0.85	0.70	None	None
back door	AGWall 1	Northwes	0.260	0.130	21.00	4.0	1.0	7.0	0.85	0.70	None	None
front	AGWall 1	Southeast	0.210	0.270	67.60	0.0	0.0	0.0	0.85	0.70	None	None
streetside, right	AGWall 1	Southeast	0.210	0.270	11.70	0.0	0.0	0.0	0.85	0.70	None	None
back	AGWall 1	Northeast	0.210	0.270	72.45	0.0	0.0	0.0	0.85	0.70	None	None
left bedroom	AGWall 1	Southwes	0.210	0.270	18.80	0.0	0.0	0.0	0.85	0.70	None	None

Roof Information

Name	Library Entry	Ceiling Area(sq ft)	Roof Area(sq ft)	Exterior Color	Radiant Barrier	Type	Uo Value	Cement or Clay Tiles	Roof Tile Ventilation
cathedral ALL	Neopor SIPs 12	995.00	995.00	Dark	No	Vaulted	0.016	No	No

Roof Library List

Ceiling: Neopor SIPs 12

Information From Quick Fill Screen

Building Summary

Property

, NY
Weather: Watertown, NY
ZEM-CZ6-Elec (HP)
NYSERDA
MH-Single-ZEM-cz6-electricHP-PV
_v4.blg

Organization

Vermont Energy Investment Corp
802-658-6060
Li Ling Young (Leslie Badger)

HERS

Projected Rating
4/13/2018
Rater ID:

Builder

Roof Library List

Continous Insulation (R-Value)	50.0
Cavity Insulation (R-Value)	10.0
Cavity Insulation Thickness (in)	2.8
Cavity Insulation Grade	1
Gypsum Thickness (in)	0.625
Insulated Framing Size(w x h, in)	3.5 x 2.8
Insulated Framing Spacing (in o.c.)	24.0
Framing Factor - (default)	0.1933
Ceiling Type	Vaulted
Note	

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather: Watertown, NY ZEM-CZ6-Elec (HP) NYSERDA MH-Single-ZEM-cz6-electricHP-PV _v4.blg	Builder	

Mechanical Equipment

Number of Mechanical Systems	5
Heating SetPoint(F)	68.0
Heating Setback Thermostat	Present
Cooling SetPoint(F)	78.0
Cooling Setup Thermostat	Present
DHW SetPoint(F)	125.0

Heat: MSZ-FH09NA and MUZFH09NAO****

SystemType	Air-source heat pump
Fuel Type	Electric
Rated Output Capacity 47 (kBtuh)	10.9
Rated Output Capacity 17 (kBtuh)	6.7
Seasonal Equipment Efficiency	13.5 HSPF
Backup Resistance kW	0
Pump Energy	0 kWh/yr
Desuperheater	No
Note	
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100
Percent Load Served	90

DHW: SPX50DHPT 100***

Water Heater Type	Heat pump
Fuel Type	Electric
Energy Factor	2.75
Recovery Efficiency	0.00
Water Tank Size (gallons)	50
Extra Tank Insulation (R-Value)	0.0
Note	
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather: Watertown, NY ZEM-CZ6-Elec (HP) NYSERDA MH-Single-ZEM-cz6-electricHP-PV _v4.blg	Builder	

Mechanical Equipment

Percent Load Served	100
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Cool: MSZ-FH09NA:MUZFH09NA*

System Type	Air-source heat pump
Fuel Type	Electric
Rated Output Capacity (kBtuh)	9.0
Seasonal Equipment Efficiency	30.5 SEER
Sensible Heat Fraction (SHF)	0.70
Fan Power (Watts)	0
Pump Energy	0 kWh/yr
Desuperheater	No
Note	
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100
Percent Load Served	50

Cool: CERV Cool - Prioair6

System Type	Air-source heat pump
Fuel Type	Electric
Rated Output Capacity (kBtuh)	2.4
Seasonal Equipment Efficiency	2.3 COP
Sensible Heat Fraction (SHF)	0.70
Fan Power (Watts)	62
Pump Energy	0 Watts
Desuperheater	No
Note	Prioair6 fan set - 62W fan total on Ventilation page
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100
Percent Load Served	50

Heat: CERV Heat - PrioAir60

Building Summary

Property , NY	Organization Vermont Energy Investment Corp 802-658-6060 Li Ling Young (Leslie Badger)	HERS Projected Rating 4/13/2018 Rater ID:
Weather: Watertown, NY ZEM-CZ6-Elec (HP) NYSERDA MH-Single-ZEM-cz6-electricHP-PV _v4.blg	Builder	

Mechanical Equipment

SystemType	Air-source heat pump
Fuel Type	Electric
Rated Output Capacity 47 (kBtuh)	5.6
Rated Output Capacity 17 (kBtuh)	2.0
Seasonal Equipment Efficiency	2.3 COP
Backup Resistance kW	0
Pump Energy	62 Watts
Desuperheater	No
Note	PrioAir6 fan set - 62W fan total on Ventilation page
Number Of Units	1
Location	Conditioned area
Performance Adjustment	100
Percent Load Served	10

DHW Efficiencies

All bath faucets & showers <= 2gpm	true
All DHW pipes fully insulated >= R-3	false
Recirculation type	None (standard system)
Farthest fixture to DHW heater	30
TOTAL Pipelength for longest DHW run	40
DWHR unit present?	false
DHW Diagnostics	
dhwGpd	31.48
peRatio	0.55
dishwasherGpd	1.69
clothesWasherHotWaterGPD	-0.06
EDef	0.93
ewaste	21.22
tmains	52.30
dwhrWhInletTempAdj	0.00
pumpConsKwh	0.00
pumpConsMmbtu	0.00

Building Summary

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Infiltration and Mechanical Ventilation

Whole Dwelling Infiltration

Input Type	Blower door
Heating Season Infiltration Value	79 CFM @ 50 Pascals
Cooling Season Infiltration Value	79 CFM @ 50 Pascals
Shelter Class	4
Code Verification	Tested

Mechanical Ventilation for IAQ

Type	Balanced
Rate(cfm)	50
Sensible Recovery Efficiency(%)	100.00
Total Recovery Efficiency(%)	100.00
Hours per Day	24.0
Fan Power (watts)	62.00
ECM Fan Motor	true

Ventilation Strategy for Cooling

Cooling Season Ventilation	Natural Ventilation
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Building Summary

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Lights and Appliances

Rating/RESNET audit

Ceiling Fan CFM / Watt	0.00
Refrigerator kWh/yr	371
Refrigerator Location	Conditioned
Range/Oven Fuel Type	Electric
Induction Range	No
Convection Oven	No

Dishwasher

Energy Factor	0.00
Dishwasher kWh/yr	270
Place Setting Capacity	12

Clothes Dryer

Fuel Type	Electric
Location	Conditioned
Moisture Sensing	Yes
CEF	4.50

Clothes Washer

Location	Conditioned
LER (kWh/yr)	96
IMEF	3.060
Capacity (CU.Ft)	3.810
Electricity Rate	0.11
Gas Rate	1.22
Annual Gas Cost	11.00

Qualifying Light Fixtures

Interior CFLs %	100.0
Interior Fluorescent %	0.0
Exterior Lights %	100.0
Garage Lights %	0.0

Building Summary

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Mandatory Requirements

IECC Requirements

Verified IECC 04	false
Verified IECC 06	false
Verified IECC 09	true
Verified IECC 12	false
Verified IECC 15	false
Verified IECC 18	false
Verified NY-ECCC 2016	false
Verified IECC MI	false

EPA Requirements

Rater certifies that the home complies with the following requirements for:

None

- Rater Design Review Checklist(National)
- Rater Field Checklist(National)
- HVAC Design Report
- HVAC Commissioning Checklist (optional)

ENERGY STAR Version 3 Appliances

Amount

Refrigerators	0
Ceiling Fans	0
Exhaust Fans	0
Dishwashers	0

ENERGY STAR Version 3 Basements

Basement Wall Area 50% Below Grad:	false
Basement Floor Area	0.00
2009 IECC Prescriptive Requirements for ENERGY STAR v3.0	false
Slab Insulation Exemption:	false

Indoor airPlus Verification Checklist

false

EPA Field App ID

Building Summary

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DOE Zero Energy Ready Home

Home Builder ID Number

Mandatory Requirements

Verified Fenestration	false
Verified Insulation	false
Verified Duct Location	false
Verified Appliance	false
Verified Lighting	false
Verified Fan Efficiency	false
Verified Water Efficiency	false
Verified EPA Indoor airPLUS	false
Verified Renewable Energy Ready Solar Electric	false

Optional Home Builder Commitments for Recognition

Certified under the EPA WaterSense for New Homes Program	No
Certified under the IBHS fortified for Safer Living Program	No
Followed the DOE Zero Energy Ready Home Quality Management Guidelines	No
The buyer of this home signed a waiver giving DOE Zero Energy Ready Home access to utility bill data for one year.	No

Active Solar

System Type	None
Collector Loop Type	None
Collector Type	None
Collector Orientation	None
Area(sq ft)	0.0
Tilt(degrees)	0.0
Volume(cu ft/gal)	0.0

Photovoltaics

Name	Collector Orientation	Collector Area(sq ft)	PV Panel Peak Power(Watts)	Collector Tilt(degrees)	Inverter Efficiency(%)
ZEM PV	South	386.0	7500.0	4.0	96.0

REM/Rate - Residential Energy Analysis and Rating Software v15.6.1

This information does not constitute any warranty of energy costs or savings.

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Building Summary

Property

, NY

Weather: Watertown, NY

ZEM-CZ6-Elec (HP)

NYSERDA

MH-Single-ZEM-cz6-electricHP-PV

_v4.blg

Organization

Vermont Energy Investment Corp

802-658-6060

Li Ling Young (Leslie Badger)

Builder

HERS

Projected Rating

4/13/2018

Rater ID:

Notes

EVT 70' 2 bed

crawlspace

2X10 floor - dpfg

DSW10" wall - dpfg

half light doors

.21 windows

SIP

FH09

CERV w Prioair6, COP 2.3

heat pump clothes dryer CEF 4.5

Appendix 9 - Zero Energy Modular Factory Initiative

Scope of Work funded by The New York Community Trust

Inventory of Factory Resources and Constraints –VEIC will inventory existing New York modular housing factories and their interest in building ZEM. We are currently not aware of any New York factories that are building homes to the level of efficiency or durability of ZEM, and this task will be focused on discovering whether any such capacity currently exists and to what extent new capacity needs to be developed. Therefore, we will:

- Identify and contact by phone, all known modular factories that are located in New York. Identify and contact at least three modular factories in states contiguous to New York. For identified factories attempt to gather operational data points such as:
 - Location
 - Annual housing production for the past three years
 - Maximum annual housing production based on factory size and configuration
 - Delivery radius
 - Estimated transportation costs
 - Energy efficiency and renewable energy features typically included in their construction
 - Willingness to complete homes turnkey (e.g. HVAC and finishes)

Development of Factory Specifications - To support faster development of modular building capacity, VEIC will develop tools and resources for potential ZEM builders to understand how to most efficiently and effectively set up and operate a modular factory which can build homes according to the ZEM home specifications. Activities supporting this task will include:

- A literature review of publically available resources on modular factory specifications such as typical factory configurations, building process, tooling requirements, labor requirements, production capacity strategies, material ordering, and transport and installation requirements for select local jurisdictions;⁴
- Integration of data gathered as a result of the NYSERDA market assessment in order to develop scenarios for ZEM annual housing demand;
- Technical specifications of the equipment needed for a ZEM factory and best practices in value stream mapping and lean manufacturing principles of modular factories;
- Development of factory templates based on the expected production capacity necessary to serve the New York regional markets. Scenarios will identify a geographic area so material and labor costs can be calibrated to local conditions. These factory templates will include:
 - Sketches of plant configuration, physical requirements, and equipment needs
 - Floor plan layout for construction, storage, and staff
 - Construction tasks and process flows including build times and risks

⁴ We have already identified resources that are likely to be extremely valuable for this effort and have secured the commitment of key partners and advisers, such as the Healthy Building Network, Vermont Manufacturing Extension Center, and Isabelina Nahmens, Professor at Louisiana State University and factory- built housing expert.

- Strategy for quality assurance programs (LEAN) and healthy indoor air quality for workers
- Considerations for permitting for housing construction and unit delivery

Development of a ZEM Business Planning Toolkit - VEIC will develop a business planning toolkit which incorporates the ZEM factory specifications outlined above, and also includes a framework for estimating costs and timelines for launching and operating a ZEM factory which can be used by builders, social entrepreneurs, and others. Activities will include:

- Collaboration with LSU to develop estimates of the startup costs for materials, equipment, staffing, and production ramp up periods
- Assessment of the supply chain for building materials, identifying where any gaps may exist and ways to overcome gaps
- Descriptions of potential factory ownership structures such as sole proprietor, public-private partnership, or a cooperative business structure where the employees own the business
- Discussion of growth scenarios and needed systems to manage and maintain high quality business practices

Dissemination of ZEM Tools and Resources - Core to this entire work plan is connecting the work products with local stakeholders that will use them to start building ZEMs. We expect key stakeholders to include:

- Builders, such as modular home builders, Passive House builders and other “green” builders
- Economic and work force development agencies
- Low-moderate income affordable housing initiatives / programs
- Representatives of Native American tribes in New York⁵

Development of ZEM Technical Specifications – VEIC feels strongly that any home built by a ZEM factory needs to be built to a stringent Zero Energy standard using nontoxic and healthy materials. ZEM homes will be designed using Passive House principles and certified to national energy efficiency standard like DOE Zero Energy Ready Homes, and careful attention will be paid to meeting local program requirements, if any, to qualify for energy efficiency and renewable energy incentives. The home specifications will be developed in a way that could be applied to homes in any configuration, but for this work, the home used to illustrate compliance with ZEM specifications will be sized to fit lots typically found in manufactured home communities (i.e., standard single-wide and double-wide manufactured home configurations). For this task we will:

- Starting with Vermont ZEM technical specifications, modify as appropriate the insulation values, mechanical specifications, design elements, and relevant energy efficiency certifications, to meet NYSERDA requirements, including eligibility for energy efficiency and renewable energy incentives through NYSERDA or other incentive programs in the Northeast region;

⁵ Native American tribes are included here due to the high demand for both affordable housing and economic development on reservations; VEIC believes that ZEM factories are a very good fit for these communities and we have existing relationships to draw upon if we are awarded this grant.

- Review of materials for opportunities to increase local, recycled and reduced life-cycle impacts and reduce the use of toxic materials in building products specified in ZEM homes; and
- Document assumptions and estimate construction costs of ZEM home in final report.