

Delaware Zero Net Energy Modular Home Phase 2 Final Report & Pilot Program Design

**PREPARED FOR
DELAWARE SUSTAINABLE ENERGY UTILITY**

**PREPARED BY
VERMONT ENERGY INVESTMENT CORPORATION**

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Table of Contents

Executive Summary	5
Project Purpose	8
Delaware ZNE Modular Home Pilot Program.....	9
Goals	9
Pilot Program Administration.....	10
Timeline	11
DESEU Scope of Work	12
Preprogram Launch.....	12
Program Operation.....	12
Post Occupancy.....	13
Program Annual Planning.....	13
Milford Housing Scope of Work	13
Preprogram Launch.....	13
Program Operation.....	14
Post Occupancy Services	15
Program Annual Planning.....	15
Vermont Energy Investment Corporation Scope of Work	16
Preprogram Launch.....	16
Program Operation.....	17
Post Occupancy Services	17
Program Annual Planning.....	17
Steering Committee Scope of Work	18
Beracah Homes Scope of Work	18
Pilot Program Partners	19
Delaware Zero Net Energy Modular Homes	20
DESEU Incentives	20
Funding and Financial Assistance	21
Number and Location of Modular Homes	25
Target Occupant Demographics	25
Pilot Eligibility.....	27
Income qualification	27
Ownership.....	27
Residency.....	28
Financing for Affordability.....	28
Scenario for Low-Income Households	28
Scenario for Moderate-Income Households	29
Scenario Using Stretch Underwriting Criteria.....	30
Scenario for Market-Rate Buyers	31
Program Evaluation	32
Budget.....	33
Zero Net Energy Unit.....	35
Technical Specification.....	35

Local Manufactured and Modular Home Builders	35
Cost-Benefit Analysis	37
Analysis Method	37
Inputs and Assumptions	38
Building Characteristics	38
Construction Costs	40
Energy Benefits	41
Equipment Replacement Schedule	42
Results	44
Financing and Assistance Packages	44
Scenario 1 – No incentives	44
Scenario 2 - \$15,000 incentive	45
Scenario 3 - \$15,000 incentive plus down-payment assistance through DESEU financing	46
Conclusion	48
Appendix A: The VerMod:	49
Vermont’s High-Performance Modular Home	49
Background	49
Key Accomplishments	50
Lessons Learned	51
Key Stakeholders	52
Key Supporters	53
Appendix B: Stakeholder Engagement	54
Engagement Strategy	54
Appendix C: Letters of Support	58

Table of Tables

Table 1: 120% of Area Median Income, Delaware Counties	27
Table 2: Affordable Buyer at 51% - 93% AMI	29
Table 3: Affordable to Buyer at 51% - 93% AMI	30
Table 4: Stretch Underwriting Criteria	31
Table 5: Stretch Underwriting Criteria	32
Table 6: Delaware Zero Net Energy Modular Home Prescriptive Requirements	40
Table 7: Construction Costs, HUD Compliant vs. ZNE Modular Home	41
Table 8: Estimated Annual Energy Consumption, HUD Compliant vs. ZNE Modular Home	42
Table 9: HUD-Compliant Manufactured Home Replacement Schedule*	43
Table 10: Delaware ZNE Modular Home Replacement Schedule*	43
Table 11: Financing and Assistance Package Scenario 1	45
Table 12: Financing and Assistance Package Scenario 2	46
Table 13: Financing and Assistance Packages Scenario 3.....	47

Table of Figures

Figure 1. PPMT hierarchy.....	11
Figure 2: Cost-Burdened Households in Delaware, 2007-2011	26
Figure 3: DE SEU ZNE MH Pilot Program Three Year Budget.....	34
Figure 4: Cost-Benefit Analysis Steps.....	38
Figure 5: High performance Modular Home vs. Typical Northeast Manufactured Home.....	50

Executive Summary

In 2014, the Delaware Sustainable Energy Utility (DESEU) approached Vermont Energy Investment Corporation (VEIC) about a new zero net energy modular home that was just beginning to move into the market. This home, known as the “VerMod”, was developed in response to the significant damage experienced by owners of manufactured homes as a result of Hurricane Irene and is designed to be so energy efficient that its annual energy consumption could be offset by rooftop solar panels. This design of the home and the programs implemented to bring it to Vermonters also addresses a number of other current problems associated with ownership of manufactured homes - including building durability, health and safety, and affordable financing. The history of the Vermont modular home, the VerMod, is contained in Appendix A.

DESEU saw the potential of the VerMod model to dramatically reduce energy use and costs for Delawareans who reside in mobile or manufactured homes. Residents of mobile and manufactured homes generally face significantly higher per square foot energy costs than residents of site-built homes, and are more likely to be in low- or moderate-income households. The potential for energy savings, improved home construction and health and safety features, as well as creative and effective partnering with affordable housing providers, could help some of Delaware’s more vulnerable residents afford high quality, efficient, durable homes which were previously unavailable to them.

A first phase market study was completed by VEIC in 2014 to determine the market potential for a Zero Net Energy (ZNE) modular home.¹ That analysis concluded that there is sufficient market to create a ZNE modular pilot program in Delaware. The designated target market for a pilot program would be purchasers of new homes on land that is owned by the homebuyer or is owned by a nonprofit that can provide a very long-term leasehold.

In this report, VEIC recommends that the DESEU move into the next stage of pilot program implementation. Key program functions and roles for the pilot program are described below:

- DESEU will be the fiscal sponsor of the program. Decision making authority of the pilot program will reside ultimately with the DESEU. The DESEU will use the Energy Programs Committee (EPC), which is an existing committee comprised of DESEU Board members, as an ad hoc Steering Committee, which will review goals and progress reporting and advise on programmatic issues during the course of the pilot. The EPC, which is chaired by the DNREC Secretary, assists the Board in its oversight of legislatively mandated programs, activities, and policies and procedures. The committee works closely with the Board’s Finance & Audit Committee in developing and assessing the organization’s effectiveness and efficiency in compliance with accepted industry standards. In addition, the committee reviews proposed programs, RFP’s and contracts prior to submission to the Board for approval.

¹ <https://www.veic.org/documents/default-source/resources/reports/veic-market-analysis-for-net-zero-manufactured-home-replacements-delaware.pdf?sfvrsn=2>

- VEIC will provide implementation and technical support, advising DESEU and Milford Housing on program implementation and advising Beracah on technical specifications for modular home unit.
- Milford Housing will be the Pilot Program Manager (PPM), responsible for day to day operations, interactions with pilot program partners, and recruiting homeowners to the pilot program.
- Beracah Homes will be the factory builder, responsible for producing the ZNE Modular homes and certifying the units to Department of Energy Zero Energy Ready Homes Standard (DOE ZERH).

The DESEU will contract directly with VEIC, Milford Housing and Beracah to provide these products and services. Pilot program partners will be existing organizations, such as homebuyer counseling agencies, which will agree to promote the pilot program, refer eligible homebuyers, and leverage their existing public and private mortgage services to purchase a ZNE modular home.

The pilot program design calls for taking full advantage of existing resources in the community to leverage DESEU programming to the best effect. There is no need to recreate the successful and effective organizations that have shown their commitment to working collaboratively on the implementation of this program. Appendix B provides letters of support from some of those willing partners.

The pilot program design calls for placement of 25 ZNE modular homes in Delaware on land that is fully owned by the homeowner or is leased from a nonprofit with a leasehold of at least 30 years. This will support mortgage financing rather than chattel² financing of the home, which provides significant savings for the homeowner.

The number of homes recommended allows the real underlying cost structure of ongoing manufacturing to be determined. The cost of the first instance of nearly anything is higher, often by far, than the cost of later iterations. Assessing the success of the pilot based only on a few homes would unnecessarily skew the results against full-scale roll-out. By the time two dozen of these have rolled off the production line onto house sites, the real cost of both production and siting will be known.

Energy savings of the ZNE modular home are modeled so that the DESEU can determine whether the energy savings support the recommended incentives. The DESEU incentive is only one piece of a funding and financing package to catalyze the market. Other funding sources, including down-payment assistance for low-income homeowners, are also included to reduce the amount to be

² When a manufactured home is titled as personal property, it generally must be financed through a personal property loan, also known as a chattel loan. A chattel mortgage is a term used to describe a loan arrangement in which an item of movable personal property is used as security for the loan. A chattel mortgage is a loan that is secured by chattel rather than by real property.

financed by the homeowner. Lower first-cost financing means that homes can be made affordable to more households that are at lower levels of income.

The pilot program has been designed to be affordable to households at or below 120% of Area Median Income (AMI), with a strong focus on those who are at or below 80% of AMI, the standard definition of low-income.³ There is no reason that households above that income level cannot also be served. Often a strong catalyst for market activity is to have higher-income households showing demand for the homes. In that way, the homes are not perceived as solely “down-market” and only for low-income people. While incentives may be reduced for those at higher income levels, the ability of those households to build attraction to the homes is an important aspect of the market transformation that is central to this effort.

A key element of a pilot program of this scope is to be opportunistic. During the research and development process, a potential application of the ZNE modular home for private rental housing was uncovered. Such opportunities can be strong market initiators. The pilot program should be open to such opportunities, as long as they are in line with DESEU program goals of energy savings and service to low-income Delawareans.

VEIC is encouraged by the strong show of support for the ZNE modular home in Delaware. It is that support that will move this pilot program forward, with the long-term goal of full-scale commercialization and a fundamental transformation of the energy use and financing of manufactured housing.

³ Used by the U.S. Department of Housing and Urban Development, Area Median Income (AMI) provides a measure of income status that allows for regional variation. In Delaware, three regions are defined, tied to county boundaries.

Project Purpose

The DESEU commissioned VEIC to assess the feasibility of developing Zero Net Energy modular homes to replace mobile and manufactured homes in Delaware. The assessment was structured in two phases.

Phase 1 evaluated the market potential for a program to replace mobile and manufactured homes with ZNE modulars in Delaware. The study, *Market Analysis for Zero Net Energy Manufactured Home Replacements in Delaware* (January 2015), determined that there is sufficient market to create a ZNE modular pilot program, and sufficient market in the long-term to justify the costs of a pilot program. Based on the results of that analysis, the DESEU decided to proceed with the design of a pilot in order to further assess viability.

The purpose of Phase 2 was to accomplish the following tasks and provide the basis for a decision on whether to implement a DESEU ZNE modular pilot program:

- Establish a working group to provide information on program design; working group will include designated DESEU Energy Program Committee members and external stakeholders
- Work with regional modular home manufacturers to revise the Vermod open-source ZNE modular plans for Delaware's climate
- Estimate the cost of a ZNE modular home, based on Delaware's climate, production costs, and siting costs
- Define potential ownership models for the ZNE modular home, such as homeowners on leased versus owned land, and possible rental applications
- Investigate funding and financing sources for a pilot project, with the objective of identifying sustainable funding and financing options to support long-term market development
- Compare the costs and benefits of ZNE modular to those of site-built and manufactured homes
- Develop recommendations on the pilot design, including number and location of homes, program partners, incentives and financing, program budget, performance metrics and savings verification

Delaware ZNE Modular Home Pilot Program

This section outlines the key elements of a ZNE modular home pilot program for Delaware. Understanding that the pilot should be established and run in a way that is responsive to what is learned about the product and the market in real time is foundational. New information should be integrated as appropriate to inform mid-course corrections to the program design. The purpose of the pilot is to gain deeper information about the market, which can then lead to a robust plan for full-scale commercialization should the pilot prove successful.

The pilot program should be opportunistic in its approach, seizing on prospects that may not have been foreseen but are beneficial to advancing the goals of affordable and sustainable housing. An example of this was presented during the research and development phase when one modular home manufacturer introduced the idea of using these homes for rental housing because one of its current customers was interested in more efficient housing for that purpose. While the initial approach targeted homeowners, this unforeseen opportunity may meet the goals of the program and should therefore be considered.

The pilot program should also be responsive to the needs of the people it is aiming to serve. As an example, if a homeowner has just received a lump-sum of money from a one-time source, perhaps through an inheritance, such a one-time transfer should not preclude them from receiving the ongoing benefits of a low-energy-cost home.

Goals

The Delaware Zero Net Energy Modular Home Pilot is designed to replace mobile and manufactured homes with a modular home that fits a traditional manufactured home footprint, but is more affordable and durable than a traditional manufactured home.

Pilot program goals are to:

- Partner with HUD-approved housing counseling agencies to identify and educate potential ZNE modular home purchasers
- Work with a local modular manufacturer, Beracah Homes, to design and build homes which meet DOE's Zero Energy Ready Home specification
- Site the first 25 homes, providing appropriate site-specific and occupant-specific support
- Collaborate with affordable housing developers to leverage existing funding and financing, using existing and new sources wherever available and appropriate
- Develop funding and financing packages, including DESEU incentives and financing, that are responsive to the needs of identified homebuyers and are replicable over time and at scale

- Catalyze a market for ZNE modular homes by manufacturing and siting the first 25 homes in locations and with owners that are conducive to open houses for future potential buyers
- Initiate training of residential appraisers to ensure that asset value (including energy features) is fully assessed and documented for real estate transaction purposes
- Determine actual energy savings and solar PV generation in sited ZNE modular homes

The pilot program is the first catalytic stage of a longer transformation of the market to increase demand for modular homes as replacements for mobile and manufactured homes. Therefore, the long-term goals are to:

- Reduce the energy burden for low-income Delawareans
- Increase the number of housing units in Delaware that are affordable, durable, healthy, and efficient
- Replace homes that are depreciating assets with homes that appreciate in value, helping low-income Delawareans to build and maintain wealth
- Replace homes that are considered personal property financed with chattel loans with homes that are real property financed with mortgage loans, reducing the financing costs paid by residents who are already overburdened with energy and housing costs
- Leverage available resources from the U.S. and Delaware governments to provide technical assistance and offset the higher costs of ZNE modular homes
- Leverage available public and private capital to reduce the cost of ZNE modular home ownership
- Utilize available capabilities within Delaware's affordable housing community to market and develop ZNE modular homes
- Increase capabilities and interest of modular home builders to build to ZNE standards
- Improve energy ratings and home appraisals to appropriately assess the value of ZNE modular homes
- Provide an affordable, durable, healthy, and efficient option for low- and moderate income homeowners looking for green and sustainable alternatives to manufactured homes

Pilot Program Administration

This section describes the roles of the three primary organizations that will implement the ZNE modular home pilot over a three year period. The DESEU will be the Fiscal Sponsor of the program. Decision making authority of the pilot program will reside ultimately with the DESEU. The DESEU will use the Energy Program Committee as an ad hoc steering committee, which will review goals and progress reporting, and advise the DESEU on programmatic issues. VEIC will

provide implementation and technical support, advising DESEU and Milford Housing on program design and implementation and advising Beracah on technical specifications for the modular home unit. Milford Housing will be the Pilot Program Manager (PPM), responsible for day-to-day operations, interactions with pilot program partners and recruiting homeowners to the pilot program. This team is referred to as the Pilot Program Management Team (PPMT).

Beracah Homes will be the factory builder, responsible for producing the ZNE modular homes and certifying the units to Department of Energy Zero Energy Ready Homes Standard (DOE ZERH). VEIC, Milford Housing and Beracah will contract directly with the DESEU. Pilot program partners will be existing organizations, such as homebuyer counseling agencies, which will agree to promote the pilot program, refer eligible homebuyers, and leverage their existing public and private mortgage services to purchase a ZNE modular home.

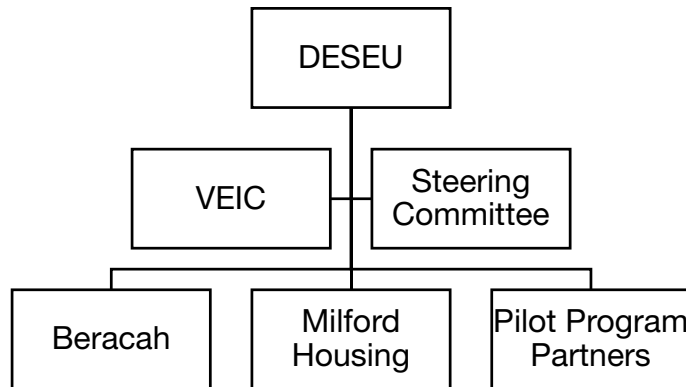


Figure 1. PPMT hierarchy.

Timeline

The timeline of tasks will be broken into four distinct phases: Preprogram launch, program operation, post occupancy services, and program annual planning.

Preprogram Launch (June 2016 – September 2016) - Preprogram launch will run from June 2016 through September 2016. During this period, the steering committee will be engaged, goals and milestones will be approved, energy savings estimates developed, marketing documents drafted, program processes (e.g. invoicing, application documents) finalized, and program partners recruited. During this period, up to two model homes will be purchased by the DESEU.

Program Operation (October 2016 – June 2019) – Day-to-day program operation will include normal operations to recruit homebuyers to program, facilitating the rebate and financing processes to enable purchases, and placing homebuyers in homes.

Post Occupancy Services (estimated May 2017 – June 2019) - Post occupancy services will occur once the homebuyer is residing in the home and will include monitoring and feedback for

items such as comfort, performance, energy savings and energy generation for units with solar photovoltaics (PV).

Program Annual Planning (Annual cycle starting September 2017) - Each year, the pilot program will formally assess progress against milestones. Program implementation will be evaluated to improve processes, such as recruitment, homeowner experience and progress towards goals. Technical aspects of units will also be evaluated to optimize cost and performance.

DESEU Scope of Work

As stated above, the DESEU is the Fiscal Sponsor and has ultimate decision-making authority and responsibility for oversight of the ZNE Modular Home pilot program. The DESEU will set goals, review progress reports, allocate incentives, provide financial assistance to homeowners, and ensure contractors are delivering services appropriately. Like any pilot program, this pilot will need to be flexible and seize opportunities that were not planned for but would benefit the program. The DESEU will be the organization to approve course corrections if it determines that program modifications are beneficial.

Preprogram Launch

The DESEU will collaborate with VEIC and the PPM to finalize the pilot program implementation plan before launch. The DESEU will:

- Form a Steering Committee, including defining roles, establishing a decision making process, and setting a meeting schedule
- Approve three year goals and quarterly reporting parameters proposed by VEIC and developed in collaboration with Milford Housing
- Finalize monthly invoicing procedures for subcontractor labor and home owner incentives
- Approve final incentive levels for ZNE modular units proposed by VEIC and developed in collaboration with Milford Housing
- Approve loan terms proposed by VEIC and developed in collaboration with Milford Housing, including down-payment assistance and the loan agreement with the financial institution program partner
- Finalize marketing and homebuyer recruitment plans proposed by VEIC and developed in collaboration with Milford Housing
- Purchase one or two ZNE modular home(s) to be used as model home(s) to demonstrate technology and recruit homebuyers

Program Operation

Throughout the term of this pilot program, the PPM will manage program implementation and budgeting. The role of the DESEU will be to:

- Convene and participate in Steering Committee meetings to review progress toward goals and milestones
- Pay incentives and distribute down-payment assistance to Milford Housing
- Pay pilot program contractors, such as VEIC and Milford Housing, according to invoicing and contract agreements

- Pay other items, such as referral fees, to pilot program partners as appropriate
- Approve pilot program modifications as appropriate

Post Occupancy

The pilot program will monitor the occupied homes for several parameters, such as indoor air quality, energy use, and equipment efficiency. The DESEU will:

- Review data and results of reporting to understand if ZNE modular unit is performing as expected
- If ZNE modular units are not performing as expected, review and approve PPM and VEIC recommendations to remedy issues

Program Annual Planning

As noted above, the pilot program is expected to run for three years starting in 2016. Each year, VEIC will lead a program planning exercise in collaboration with Milford Housing, appropriate program partners and the DESEU to prepare for the next fiscal year cycle. In support of this activity, the DESEU will:

- Participate in program planning meetings
- Review and approve recommendations developed by VEIC in collaboration with Milford Housing
- Review and approve fiscal year budgets

Milford Housing Scope of Work

As pilot program manager (PPM), Milford Housing is responsible for the day-to-day implementation of the pilot program. This role is needed in order to create and uphold a seamless experience for the customer by coordinating the various program processes and ensuring they are integrated and effective. Project team communication will occur mainly through regular check-ins among the PPM, VEIC, and the DESEU. These meetings are expected to be weekly or biweekly at the start of the pilot, and will be adjusted as needed as the pilot matures.

Preprogram Launch

The PPM will be expected to collaborate with the DESEU and VEIC to finalize the program implementation plan prior to launch. VEIC will lead this effort and Milford Housing will support, and the final draft of the program implementation plan will be presented to the DESEU for review and approval prior to implementation. In order to accomplish this, the PPM will collaborate on the following services:

- Set up and document the pilot program process
- Support development of clearly-stated three year goals and milestones for approval by the DESEU
- Support development of a marketing plan and supporting activities including:
 - Developing marketing materials and program referral partnerships
 - Identifying strategies to promote model home as marketing tool
 - Determining location(s) to site ZNE modular home(s) to be used as model homes

- Support recruitment of pilot program partners for homebuyer enrollment, marketing, affordable housing development, external incentives and financing
- Support the development and execution of MOUs describing the roles for pilot program partners, as well as training and support materials available to partners
- Collaborate with VEIC and Beracah to finalize unit, foundation and installation specifications, as well as unit layout and appearance choices (such as 2-3 bedroom, exterior siding and colors)
- Support the ongoing assessment of the Delaware market and ensure that market mechanisms are in place to enable a successful pilot program. Items include:
 - Working with Delaware appraisers to determine if there is a need to conduct Green Appraiser training
 - Identifying market-based raters to certify ZNE modular homes
 - Identifying mechanical contractors able to service high efficiency equipment
- Establish the reporting and data management processes necessary to evaluate program effectiveness
 - For this item, Milford will lead and be responsible for:
 - Developing reporting capabilities in response to goals and milestones established, and
 - Developing invoicing processes that meet DESEU needs

Program Operation

During program operation, Milford Housing will lead the following efforts, with collaboration and support from VEIC:

- Manage program implementation and budgets set by the DESEU
- Provide monthly invoices to the DESEU
- Provide information necessary for all progress reporting, including annual reporting to DESEU and board
- Implement the marketing plan approved by the DESEU
- Oversee and manage pilot program partners, including providing training on their roles and pilot program eligibility
- Flag market barriers that may prevent achieving pilot program goals or milestones
- Host bi-weekly meetings with the DESEU and VEIC—frequency can be adjusted as program matures
- Monitor builder activities to ensure the builder is certifying units to DOE ZERH standard and installing homes as specified
- Update the DESEU and VEIC on progress towards established goals

For the homebuyer, the PPM will:

- Present options for layout and appearance of ZNE modular homes
- Coordinate with utilities on modular home installations, including ensuring grid interconnection for solar when installed
- Facilitate the incorporation of available incentives or financing resources for the homebuyer (such as down-payment assistance loans and efficiency incentives from the

DESEU)—homeowners will not be expected to gather materials and submit paperwork themselves

- Act as the primary point of contact for builders and homebuyers (e.g., notify builders when the lot is secured and the homebuyer is qualified)
- Act as primary point of contact for the DESEU and the homebuyers on coordination of incentives payments and down payment assistance loans
- Assist homeowners in setting up internet accounts for post-occupancy home monitoring equipment
- Provide homeowner assistance from the beginning to the end of the home-buying process, including overseeing unit certification, delivery, installation, inspection, punch-list, occupancy, and post-occupancy testing.

In some cases, the PPM may work with affordable housing developers, such as Habitat for Humanity, or act as a housing developer in order to advance the goals of the program. In this regard, tasks that may be required include:

- Locate and purchase sites for modular homes or work with lots already owned by homeowners
- Gather all permitting and infrastructure requirements, such as water, sewer and energy utilities, and coordinate with the utility on solar PV connection to the grid
- Coordinate home delivery and placement with builder
- Contract for foundation construction for home
- Explore purchase of land for a ZNE modular home park, potentially via purchase of an existing manufactured home community

Post Occupancy Services

In addition to the PPM's role in maintaining a seamless customer experience as described above, the PPM will continue to engage with the homeowner through at least the first 24 months following occupancy. Milford Housing will:

- Help the homeowner understand warranty terms and conditions from the factory builder
- Provide homeowner education and post occupancy assistance to ensure units are functioning as designed with respect to energy use and comfort
- If requested by VEIC, troubleshoot internet connectivity issues related to monitoring equipment
- If requested by VEIC, conduct post occupancy visits and provide results to VEIC for analysis

Program Annual Planning

The pilot program is expected to run for three years starting in 2016. Each year, VEIC will lead a program planning exercise in collaboration with Milford Housing and the DESEU to prepare for the next fiscal year cycle. In support of this activity, Milford Housing will:

- Participate in program planning meetings

- Collaborate with VEIC on recommendations for program modifications, including program budgets, marketing, homeowner recruitment, incentive levels and program partners.
- Develop and propose fiscal year budgets for Milford Housing activity

Vermont Energy Investment Corporation Scope of Work

The Vermont Energy Investment Corporation (VEIC) will provide technical and implementation support during the term of this pilot. In the role of implementation support, VEIC will be working closely with both the DESEU and the PPM to ensure the program is executed in an efficient, cost effective fashion. In the role of technical support, VEIC will review ZNE modular home performance with respect to parameters such as energy consumption, equipment performance and indoor air quality.

Preprogram Launch

During the preprogram launch period, VEIC will lead the program implementation plan development effort in close collaboration with Milford Housing as the PPM. VEIC will present the final program implementation plan to the DESEU to approve prior to program launch. In support of this effort, VEIC will provide the following services:

- Define and document pilot program processes
- Lead development of clearly-stated three year goals and milestones for approval by the DESEU
- Lead development of the marketing plan and supporting activities including:
 - Developing marketing materials and program referral partnerships
 - Identifying strategies to promote model home as marketing tool.
 - Determining location(s) to site ZNE modular home(s) to be used a model homes
- Lead the recruitment of pilot program partners for homebuyer enrollment, marketing, affordable housing development, external incentives and financing
- Lead the development and execution of MOUs describing roles for pilot program partners, as well as training and support materials available to partners
- Lead effort to work with Beracah to finalize unit, foundation and installation specifications, as well as unit layout and appearance choices (such as 2-3 bedroom, exterior siding and colors)
 - For this item, VEIC will be responsible for:
 - Providing specifications which optimize units for lowest cost while meeting performance criteria
 - Oversee the certification of units to ZERH using market-based raters
 - Document unit design options, procedures and equipment specifications
- Lead the ongoing assessment of the Delaware market and ensure that market mechanisms are in place to enable a successful pilot program. Items include:
 - Working with Delaware appraisers to determine if there is a need to conduct Green Appraiser training
 - Identifying market-based raters to certify ZNE modular homes
 - Identifying mechanical contractors able to service high efficiency equipment

- Establish the reporting and data management processes necessary to evaluate program effectiveness
 - For this item, VEIC will be responsible for:
 - Determining how energy and emission savings will be measured and reported
 - Developing post occupancy monitoring and data collection templates and processes, including reporting frequency

Program Operation

During program operation, VEIC will work with the DESEU and Milford Housing on the following items:

- Participate in bi-weekly conference calls with the PPM to review and discuss pilot program activities, flagging areas for improvement or modification, and collaborating with Milford to propose program improvements
- Provide quarterly progress reports to the DESEU
- Actively assess program processes as designed and modify over time to meet market conditions
- Use monitoring data to inform specification changes which optimize cost and performance of ZNE modular homes
- Serve as the technical support lead on unit siting and commissioning

Post Occupancy Services

VEIC will analyze data collected by the PPM and produce a report with program recommendations. To produce this report, VEIC will:

- Gather and analyze data on energy performance (use and production), indoor air quality, and other attributes of sited ZNE modular homes
- Conduct post occupancy customer satisfaction surveys and utilize feedback to inform program recommendations
- Analyze metered data on energy use and solar PV production, comparing actual energy use to what was predicted through modeling.

Program Annual Planning

The pilot program is expected to run for three years, starting in 2016. Each year VEIC will lead a program planning exercise in collaboration with Milford Housing and the DESEU to prepare for and the next fiscal year cycle. In support of this activity, VEIC will:

- Schedule and lead program annual planning meetings
- Collaborate with Milford Housing to develop recommendations for program modifications, including the necessary budgets, marketing, homeowner recruitment, incentive levels, and program partners necessary to carry out proposed modifications
- Develop and propose fiscal year budgets for VEIC activity

Steering Committee Scope of Work

The DESEU Energy Program Committee will serve as the Steering Committee, and will have the responsibility to review, monitor and ensure the PPM is achieving program goals. The steering committee will advise the DESEU Board and the Executive Director on the following aspects of the program, including:

- Appropriateness of annual budgets, including sources and uses of funds
- Effectiveness of implementation meeting established goals
- Review of program evaluations and recommendations
- Review of annual fiscal year budgets and proposed program modifications
- Opportunities for program expansion, as appropriate

Beracah Homes Scope of Work

Beracah Homes will be the factory builder, responsible for producing the ZNE modular homes and certifying that the units meet the DOE ZERH Program. For the term of this pilot, Beracah Homes will do the following:

- Act as the factory builder, responsible for manufacturing the ZNE modular homes, installing solar electric and energy monitoring systems, delivering, setting and completing homes on site
- Coordinate with the land development partner on foundation and site work necessary to place the homes
- Collaborate with PPMT to develop cost-optimized building efficiency specifications, internal layout, and interior and exterior aesthetics design options
- Retain a RESNET Energy Rater to provide consultation and compliance services for the DOE ZERH program
- Ensure that design and construction of all homes within the pilot meet the design specifications of the pilot and earn DOE ZERH certification
- Provide DOE ZERH certification documentation to both the homebuyer and to the PPMT
- Communicate to the PPMT any challenges executing the designs as specified by the pilot program or DOE ZERH
- Secure approval from the PPMT before making any changes to the home design or materials specifications
- Agree to build 25 ZNE modular homes over three years if demand from the program exists
- In collaboration with VEIC, train internal staff on installation and setup of SiteSage in Homes monitoring systems in each home
- Work with the PPMT to identify North American Board of Certified Energy Practitioners (NABCEP) certified solar installers, applicable solar rebates or other incentives, and negotiate best price for quality equipment and installation

- Agree to display a model home at the Beracah facility at **9590 Nanticoke Business Park Dr. Greenwood, DE** in a prominent location until final location of unit is determined
- Stage the model unit with furnishings, maintain the cleanliness of the unit, and secure appropriate insurance against loss or damage
- Work with the PPMT to establish a process for providing access to the unit to show to prospective buyers
- Participate in progress meetings on a regular basis to discuss obstacles, innovations and progress toward program goals

Pilot Program Partners

In addition to the PPMT, a number of key partners are needed for the Delaware ZNE modular home pilot to succeed. A primary focus of the stakeholder engagement process has been to gain better understanding of the key players in the Delaware market in order to define a partnership structure and make recommendations about potential partners which would be most advantageous for the success of the pilot.

The stakeholder engagement process identified the following types of recommended partners:

- **Affordable Housing Developers:** The target for this program is low- and moderate-income homeowners and homes will be financed in a manner similar to other affordable housing projects. Therefore, VEIC recommends that the DESEU initially launch the pilot program by working with Milford Housing Development Corporation and recruit additional developers, such as Sussex County Habitat for Humanity, and Diamond State Community Land Trust, as the pilot advances. Each of these organizations has the necessary expertise for deploying the ZNE modular home program, as well as the interest in serving the affordable housing needs identified. See letters of support from each organization.
- **Solar Contractors:** There exist well-established business models and companies which provide turnkey installation, maintenance, and financing for solar PV systems. There is no need to duplicate the existing infrastructure in this area. Rather, the pilot program will draw on these solar providers, who are well-versed on federal and local regulations, including net metering. The market for solar PV is well developed in Delaware due to the work of the DESEU.
- **Housing Counseling Agencies:** The DESEU will need a network of recruitment partners to build the initial and ongoing pipeline of low- and moderate-income customers for the ZNE modular home. Delaware has nine HUD-approved Housing Counseling Agencies that understand the needs of low-income homeowners, and are committed to educating homeowners for successful tenure. These agencies are well suited to serving as recruitment partners. These agencies can also play a valuable role in ongoing engagement with

homeowners to ensure that any issues are addressed at the earliest possible point in time. VEIC recommends initial partnerships with First State Community Action, with additional partners added as the program grows.

Delaware Zero Net Energy Modular Homes

Delaware Zero Net Energy Modular Homes will meet or exceed all state and local codes. Detailed technical specifications for the homes can be found below in “Delaware Zero Net Energy Modular Home Technical Specification.” The homes will meet all specifications in the manual and be certified to the U.S. Department of Energy Zero Energy Ready Home standards by a Home Energy Rating System (HERS) Rater and HVAC specialist.

Homes will be sized to meet site, production and transportation requirements, typically having a width that is less than 16 feet and a length that is 72 feet or less. Single- or double-wide units will qualify, though the primary focus will be single-wide units designed to fit on the footprint of a typical manufactured (a.k.a., “mobile”) home. Most units will be under 1000 square feet.

While units may be placed with or without solar PV, all units should be constructed to be solar PV-ready, unless the site is overshadowed by permanent structures or other obstructions that would prevent solar production permanently.

Homes will be placed either on an owned lot or on a lot with a leasehold interest that can be extended to a term sufficient to obtain mortgage financing. Short-term lot leases will disqualify an application since there is no security of tenure provided to the homeowner and the DESEU investment is unprotected from the property being converted to another use.

The Delaware ZNE modular home pilot program leverages:

- DOE’s Zero-Energy Ready Home (ZERH) Standard
- Market-based home energy raters

DESEU Incentives

It is recommended that the pilot program offer a \$15,000 incentive for Delaware ZNE modular homes that meet technical requirements and are owned by or rented to qualified low- or moderate income households. A lower incentive is recommended for market-rate units (households with incomes above the moderate-income level. The market rate units will fall under the DESEU incentive program for single family new construction.

The incentive is designed to offset much of the incremental cost of the Delaware ZNE modular home, compared to homes built to minimum standards of local energy code. This incentive will be part of the purchase price, and will be paid by DESEU to the manufacturer to reduce the upfront cost to the buyer.

During the pilot phase, production cost data will be required from Beracah Homes, so that incremental costs of production can be monitored. Adjustments to incentives during the pilot program or later full-scale implementation would be based on the assessment of incremental costs and market uptake.

The DESEU will also provide available renewable energy incentives for those units that include solar PV. The program will leverage all existing incentives for efficiency and renewable energy, including the Green Grant for Delmarva Customers.⁴ In addition to DESEU incentives for efficiency upgrades, the program will coordinate with the Green Energy Rebate program. Current rebate levels are \$0.55 per watt up to 5000 watts installed with \$0.20 per watt installed for systems up to 50,000 watts. The maximum grant is \$3,500.⁵

The DESEU pilot program will also pay for home energy rater services, estimated at \$750-\$1000 per unit.

VEIC recommends that incentives cover a large portion of incremental costs during initial launch and potentially during the first stages of full program implementation. The incentive can be reduced as the market begins to value the features of the home, demand increases, and competition creates pressure for greater production efficiency and cost containment.

Funding and Financial Assistance

The estimated price of the Delaware ZNE modular is approximately twice the price of a conventional manufactured home built to the HUD code, though significantly less than the average new site-built home.⁶ In order to make the modular home affordable to low- and moderate-income buyers, the pilot program will work with partners to offer both funding and financing that effectively lowers the cost of the home.

Recommended Approaches

The pilot will leverage DESEU funds by drawing on private and public financing products. The following financial products and approaches are recommended to supplement existing capital sources for qualified low- or moderate-income buyers:

Down payment assistance loan. Assistance is provided in the form of a loan to help with down payment and closing costs for qualified low- or moderate income buyers. Down payment assistance loans are designed to be deferred second mortgages. First mortgage holders will be

⁴ The program is currently oversubscribed and undergoing a review of program process and funding (December 2015). <http://greengrantdelaware.com/green-grant-delmarva-residential/>

⁵ <http://greengrantdelaware.com/new-incentive-levels-for-the-green-energy-fund/>

⁶ The median price of a newly constructed home in Delaware in 2014 was \$152,017 (http://eyeonhousing.org/wp-content/uploads/2014/07/state_price14.pdf), the least expensive in the country.

fully informed of the existence of a deferred second mortgage. The loans are offered at 0.00% interest, and all principal payments are deferred until the property is sold, transferred, or refinanced. While these loans provided by public sources are often assumable by subsequent income-eligible buyers, VEIC recommends a case-by-case review of each borrower at the time of sale, transfer, or refinancing. Milford Housing administers a similar program for the City of Dover, so they are a logical choice to serve as administrator of a down payment loan program in support of the DESEU ZNE modular home pilot.

Down-payment assistance loans provide many advantages, including:

- They reduce the amount of the first mortgage, which makes monthly payments more affordable and provides an added level of security to first mortgage lenders
- They are flexible in closing the affordability gap, with the size of the down payment assistance loan tied directly to income level of the household
- DESEU will never have to foreclose on a low-income Delawarean - a critical feature for a public organization like the DESEU, which should never be in the position of putting low-income people out of their homes in order to reduce energy use
- DESEU financing leverages first mortgage investments since senior lenders finance the vast majority of the purchase price. This targets SEU funds where it's most needed to make a zero energy home affordable to low-income households
- The down payment allows private lenders to make loans to customers that would otherwise not qualify
- DESEU recaptures money from the borrower at a time when capital is available (time of sale), as opposed to increasing the monthly housing costs for homeowners by collecting repayment over the loan term

Milford Housing has agreed to serve as administrator of a down payment assistance loan program.

Nonprofit Zero Net Energy Park Financing – It is recommended that DESEU solicit proposals from nonprofit affordable housing organizations to purchase an existing mobile home park or undeveloped land to develop as a ZNE modular home community. As a tool to spur the market adoption of the ZNE modular home, this offering should be limited in scope to one such project with one or two dozen homes. Financing could be offered at 3% for a term of ten years to allow DESEU to recapture the funds for later use. If this concept is adopted by DESEU, it would be prudent to utilize the skills and expertise of the DSHA to administer this offering.

Approaches Not Recommended

The following financial products and approaches were reviewed, but are not recommended for the Delaware ZNE modular home pilot.

Interest rate buy-down (IRB). While the DESEU could explore an interest rate buy-down in order to make mortgage payments more affordable to eligible buyers, VEIC's analysis indicates this would not be the best use of funds. An interest rate buy-down requires payment of the net present value (NPV) of the future stream of interest payments at the time of loan closing. If the DESEU wishes to work with multiple financing products, the cost of the IRB will vary depending on the interest rates being offered and the target interest rate (e.g., 0%, 1%, 2%) for the term of the loan. While IRBs can attract interest by consumers, they are an expensive option for programs, and often accrue unearned benefit to the financial institution because many borrowers pay off loans early. While IRBs would leverage DESEU's funds over a larger number of homeowners by only requiring funding of interest rather than the full mortgage amount, the cost is relatively high: The IRB from 5.5% interest to 3.0% interest on a loan of \$100,000 over 25 years would lower the customer's monthly payment from \$614 to \$474 at a cost of over \$26,000 to the DESEU. VEIC does not recommend IRB as a primary strategy for the pilot program.

Direct Mortgage Financing – Consideration was given to the DESEU serving as the financier of the first mortgage, but the advantages of serving as the silent second outweighed the advantages of offering direct first mortgage financing. DESEU capital can play a valuable initial market-enabling role in making loan payments affordable. While some level of direct mortgage-backed financing might be used to help with early sales, it is not recommended that the DESEU provide the full financed amount for this program. Ultimately, the DESEU is not in the housing finance business, but rather should work to provide financing tools which catalyze rather than replace private and public capital. The risk of having to foreclose on low-income Delawareans is also a strong argument against the provision of direct DESEU mortgage financing.

The following financial products and services are available to qualified residents from the DSHA or the U.S. Department of Agriculture (USDA) Rural Development Program. Leveraging these financing products will extend the reach of DESEU resources. The inventory below includes financial products that are available to Delawareans if they meet the specific terms of each program. These are also subject to availability as the funding sources are generally limited.

- **DSHA Advantage 4** provides down payment and closing costs assistance in the form of a grant equal to four percent (4%) of the first mortgage loan amount.⁷
- **DSHA Second Mortgage Assistance Loan (SMAL)** assists income qualified borrowers in the purchase of their own home by providing down payment and closing cost assistance

⁷ http://www.destatehousing.com/HomeOwnership/hb_advantage3.php

in the form of second mortgages. SMAL must be used in conjunction with DSHA's Homeownership Loan.⁸

- **DSHA First-Time Homebuyer Tax Credit.** The Delaware First-Time Homebuyer Tax Credit is an income tax credit designed to help make homeownership more affordable to qualified homebuyers. Homebuyers who elect to use the federal tax credit are eligible to claim a portion of the annual interest paid on their mortgage as a special tax credit. The tax credit can be used in conjunction with DSHA's other products.⁹
- **DSHA Homeownership Loan** offers first mortgage financing at below-market interest rates to qualified Delaware homebuyers. These loans are originated by DSHA participating lenders.¹⁰
- **USDA Section 502 Loans** - USDA Rural Development offers program for eligible rural areas (communities with populations under 35,000).¹¹ For Delaware, all of the communities south of Delaware City and outside of the Dover metro area are eligible for USDA loans. Current USDA policy limits these programs to homes located on owned land (not yet available in Delaware on leased land). For single family home-buyers, there are two types of USDA loan programs:
 1. **Direct Government Loans** -characteristics of these loans include:
 - Fixed rate – as low as 1% for eligible borrowers
 - Monthly payment assistance for eligible borrowers
 - No down payment – can finance 103% of property value.
 - 30-year term
 - Program adjusted household income must fall below 80% of median county or area income
 - USDA field staff process and approve these loans
 2. **Guaranteed Private Loans** - characteristics of these loans include:
 - Loan processing and approval by banks, credit unions or mortgage companies which must request a “Loan Guarantee” from the USDA
 - No down payment required
 - 30-year term
 - Fixed interest rate
 - DSHA rates and terms are eligible
 - No monthly payment assistance is offered
 - Available to families with household income up to 115% of area or county income

⁸ http://www.destatehousing.com/HomeOwnership/hb_smal.php

⁹ http://www.destatehousing.com/HomeOwnership/hb_fthb.php

¹⁰ http://www.destatehousing.com/HomeOwnership/hb_sfmrb.php

¹¹ <http://www.rd.usda.gov/programs-services/single-family-housing-direct-home-loans>

See the section below on **DESEU Financing for Affordability** for specific incentive and financing scenarios and analyses of their affordability for low- and moderate-income Delaware households.

Number and Location of Modular Homes

The pilot program should include a sufficient number of occupied homes to enable long-term program decisions. While it is always important to define critical go / no-go decision points, once the decision to move forward with the pilot is made, it is important to maintain pilot program operations through the end of the pilot period in order to obtain any potential cost efficiencies. The first iteration of nearly anything is the most expensive, with subsequent units generally coming down in cost. For the ZNE modular home, the first design, construction, installation, sale, financing, contract, and testing will involve refining the program design and processes in order to optimize cost and performance. Therefore, each iteration should improve program results.

The pilot program will work to site at least 25 ZNE modular homes, which will allow sufficient experience in each of the components of the process to be vetted and refined. By the time that the homes are sited, data on costs and benefits will be sufficiently normative so that it can be used for decisions about longer term roll-out and full-scale commercialization.

The ZNE modular pilot will not place units in typical mobile home parks where the land lease is short term (e.g. 1 year), nor in communities with uncertain longevity or compromised infrastructure. The pilot program will focus on owned land or land leased through a land trust with sufficiently long tenure to allow for mortgage-backed financing. The location of the units must have:

- Long-term lease or land ownership
- Modern infrastructure and utilities
- Considerations of locational efficiency (e.g., proximity to services, public transportation)
- Orientation flexibility to maximize solar production

Target Occupant Demographics

The most important determinant of the target demographics is the necessity to define a situation for which long-term mortgage-backed financing can be brought to the project. The only alternative to developing projects that can be financed as real property is to bring large amounts of direct funding to the project, and that is not a sustainable strategy.

One good reason to focus on owner-occupied homes is the level of housing burden currently maintained by Delaware homeowners. While in many states, higher housing burden numbers are typically seen among renters, in Delaware, more homeowners are extremely housing-burdened

than are renters.¹² It is these overburdened homeowners who should be the first target of opportunity for the DESEU ZNE modular home pilot.

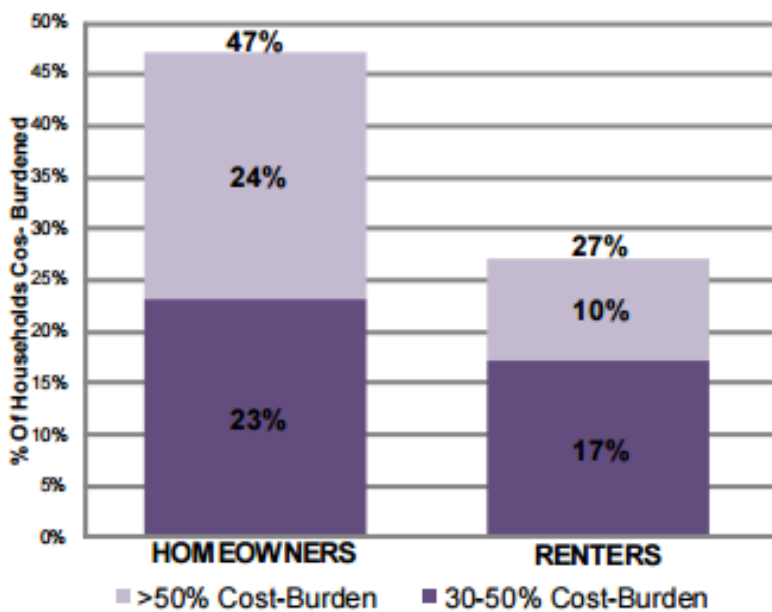


Figure 2: Cost-Burdened Households in Delaware, 2007-2011

The land underneath the home will need to be owned or leased on a very long-term basis. Normal leasing terms in mobile and manufactured home parks in Delaware are one year, which will preclude using the property as security on a longer-term loan. The 99-year lease provided as part of the community land trust model, such as is offered by the Diamond State Community Land Trust, is one avenue worth exploring as a potential partnering model for both pilot program purposes as well as full-scale commercialization. In addition, any park owned by a nonprofit organization or by the residents in the form a cooperative will enable homebuyers to use both public and private financing.

While the pilot program will focus on housing units that are individually owned by residents or have other ownership characteristics that allow low-cost mortgage financing, it should remain flexible to other models that support ZNE modular home deployment. Individual ownership may be the most common model, but other models are possible as in, for example, a land trust or affordable housing provider developing ZNE modular homes as rental units.

¹² http://www.destatehousing.com/FormsAndInformation/datastatmedia/ds_delaware_fs.pdf.

Pilot Eligibility

Income qualification

The purpose of the pilot is to define and test program parameters for low- and moderate-income Delawareans. The target group of homeowners is low- and moderate income households (i.e., below 120% of Area Median Income) which are able to meet standard underwriting guidelines. The table below shows the 120% of Area Median Income guidelines for Delaware counties in 2016. These income guidelines are updated annually, typically in March, and the pilot should update its income guidelines accordingly.

Table 1: 120% of Area Median Income, Delaware Counties
HUD Income Limits (Effective 3/28/16)

County	Household Size			
	1	2	3	4
New Castle	\$ 67,560	\$ 77,160	\$ 86,760	\$ 96,360
Kent	\$ 52,920	\$ 60,480	\$ 68,040	\$ 75,480
Sussex	\$ 51,960	\$ 59,400	\$ 66,840	\$ 74,160

Source: http://www.destatehousing.com/Renters/rentersmedia/hud_incomelimits.pdf

While households meeting the income criteria above should receive additional incentives and other financial support, income qualification should not be required to purchase a ZNE modular home and obtain energy-related incentives. There are two reasons for this:

- ZNE modular home purchases by middle- and upper-income individuals can help to promote market acceptability.
- All ZNE modular home purchases help to solidify the business line for the ZNE modular home manufacturer and others in the supply chain.

The use of a down-payment assistance loan was described in the “Funding and Financial Assistance” section of this report, and it will be a critical component of making the Delaware ZNE modular home affordable to low-income households. For those households in the 50-80% of AMI range, these deferred, second mortgage loans, which require no interest or principal payment until the property is sold, allow a greatly reduced first mortgage loan, and result in affordable payments for the household.

Ownership

As has been emphasized throughout this report, the need for long-term real-property financing dictates that the pilot program focus on homes that are on owned land or on land owned by a nonprofit/co-op that can provide a lease of sufficiently long term and secure tenure that a financial

institution will be satisfied. It is expected that low to moderate income homebuyers will be the primary market for the pilot. However, there may be opportunities to partner with affordable housing developers to make these homes available to income-qualified renters, and those should also be explored as part of this pilot.

Residency

The pilot program will serve Delaware residents who occupy their homes year-round. The requirement for year-round occupancy is necessary because part of the financing and funding package is dependent on projected energy savings, and those savings will be calculated on a year-round basis.

This requirement for year-round residency may be re-examined as part of a broader program rollout. Should, for example, summer peak electricity costs increase dramatically such that they offset the loss of winter savings, then this requirement might be loosened or eliminated. Alternatively, extremely high summer peak load costs could also free additional resources so that higher overall levels of incentives could be made available. That could reduce the amount that needs to be financed, and potentially allow expansion of the program to people who were previously not credit-worthy. Consideration of the balance of costs and benefits and fine-tuning of the program offering each year becomes an important task of the program administrator should this program be expanded beyond the pilot term.

Financing for Affordability

The incentive and financing structure outlined above was intentionally designed to make the Delaware ZNE modular home affordable for low- and moderate income people. In this section, we present examples of what that affordability looks like in four scenarios: low-income households, moderate-income households, incorporation of stretch underwriting criteria, and market rate buyers. The affordability parameters used below are the inputs to the lifecycle cost modeling done in the Cost-Benefit Analysis section below.

In each case below, a purchase price of \$128,000 is used. For low- and moderate-income purchasers, a DESEU High-Performance Incentive of \$15,000, plus a \$2,500 down-payment from the buyer are included.

Scenario for Low-Income Households

The table below shows the affordability of the modular home to low-income households. Affordability is enhanced through the use of a deferred second loan to provide down-payment assistance. The first mortgage amount was tested for affordability and the resulting value of the deferred second varies depending on the needed offset to ensure affordability. In this case, if a deferred second of \$28,100 is provided, the first mortgage principal value is reduced to \$82,400, with payments that are affordable, using standard underwriting criteria, to households at or above 51-93% of AMI. The range reflects different AMIs for households of different sizes in different counties.

Table 2: Affordable Buyer at 51% - 93% AMI

Purchase Price	\$128,000
Appraised Value	\$128,000
High Performance Incentive	\$15,000
Buyer Down Payment	\$2,500
First Mortgage	\$82,500
Deferred Second	\$28,100
First Mortgage Rate	4.375%
First Mortgage Term	360
Monthly Mortgage Payment	\$411
Lot Rent / Land Mortgage	\$350
Taxes and Insurance	\$200
Total Monthly Housing Payments	\$961
Necessary Monthly Income	\$3,434
Housing: Income at 28%	\$961
Debt: Income at 43%	\$1,476
Non-Housing Monthly Debt	\$515

Scenario for Moderate-Income Households

The table below uses nearly all of the same parameters as the low-income household scenario above, with the exception that the first mortgage is calculated at 80% of the home’s appraised value. The buyer/borrower should be able to qualify for that level of financing, though there is still a small gap to reach the full purchase price. That gap is made up via a significantly smaller deferred second loan (\$8,100 versus \$28,100). This demonstrates the ability of the deferred second loan to be responsive to the borrower’s income.

Table 3: Affordable to Buyer at 51% - 93% AMI

Purchase Price	\$128,000
Appraised Value	\$128,000
High Performance Incentive	\$15,000
Buyer Down Payment	\$2,500
First Mortgage	\$102,400
Deferred Second	\$8,100
First Mortgage Rate	4.375%
First Mortgage Term	360
Monthly Mortgage Payment	\$511
Lot Rent / Land Mortgage	\$350
Taxes and Insurance	\$200
Total Monthly Housing Payments	\$1061
Necessary Monthly Income	\$3,790
Housing: Income at 28%	\$1,061
Debt: Income at 43%	\$1,630
Non-Housing Monthly Debt	\$569

Scenario Using Stretch Underwriting Criteria

In this scenario, instead of using a deferred second to support the buyer, stretch underwriting criteria are used, with the buyer borrowing in excess of the standard 80% maximum of the home’s assessed value. In addition, the maximum housing debt-to-income ratio is increased from the standard 28% to the stretch level of 35%. Since the ZNE modular home will cost less to operate, it leaves more room in the household budget to make larger monthly mortgage, tax, and insurance payments. In this case, a higher interest rate of 5.0 percent is warranted because of the lack of 20% down payment. The payments are still affordable, with very little left over for other debt, to households at levels ranging from 48% to 88% of AMI, depending on the size of the household and location. The amount used for taxes and insurance is increased by \$75 per month to account for the addition of private mortgage insurance (PMI), which is required when there is not a 20% down payment.

This scenario is presented as an option to the provision of a deferred second mortgage loan. VEIC considers this option less preferential, and recommends the DESEU utilize deferred second financing if possible.

Table 4: Stretch Underwriting Criteria

Purchase Price	\$128,000
Appraised Value	\$128,000
High Performance Incentive	\$15,000
Buyer Down Payment	\$2,500
First Mortgage	\$110,500
Deferred Second	-
First Mortgage Rate	5.000%
First Mortgage Term	360
Monthly Mortgage Payment	\$593
Lot Rent / Land Mortgage	\$350
Taxes and Insurance	\$275
Total Monthly Housing Payments	\$1,218
Necessary Monthly Income	\$3,481
Housing: Income at 28%	\$1,218
Debt: Income at 43%	\$1,497
Non-Housing Monthly Debt	\$278

Scenario for Market-Rate Buyers

In this last example, a market-rate buyer receives a smaller DESEU incentive and there is no need for a deferred second loan. The DESEU incentive is used to reduce the down payment, but the buyer then remits a sufficient down payment to bring the principal amount of the mortgage to a standard 80% loan-to-value ratio. First mortgage financing is obtained using standard underwriting criteria.

Table 5: Stretch Underwriting Criteria

Purchase Price	\$128,000
Appraised Value	\$128,000
High Performance Incentive	\$5,000
Buyer Down Payment	\$20,600
First Mortgage	\$102,400
Deferred Second	-
First Mortgage Rate	4.375%
First Mortgage Term	360
Monthly Mortgage Payment	\$511
Lot Rent / Land Mortgage	\$350
Taxes and Insurance	\$200
Total Monthly Housing Payments	\$1,061
Necessary Monthly Income	\$3,790
Housing: Income at 28%	\$1,061
Debt: Income at 43%	\$1,630
Non-Housing Monthly Debt	\$569

Program Evaluation

The pilot program should be evaluated along a variety of important metrics related to the goals of the program, including:

- Number of homes built and installed
- Energy savings realized
- Solar capacity installed
- Incremental costs of the ZNE modular home compared to a standard manufactured home
- Affordability of ZNE modular homes
- Demographics of owners / residents

- Appraised value of ZNE modular homes built and sited
- Customer satisfaction
- Manufacturing capacity developed
- Market feedback
- Program cost-effectiveness

The on-going assessment and evaluation of these metrics during the pilot can and should result in prompt changes to pilot program design and procedures in order to optimize the program's performance in meeting its goals.

Budget

The full budget for the three-year pilot program is presented here. The Year 1 budget is firm and the budgets for years 2 and 3 are estimates. Final budgets for years 2 and 3 will be developed as part of the annual planning process described above. Final budgets for years 2 and 3 must be approved within 90 days of the beginning of the new budget cycle to allow for any adjustments to staffing and other resources to be made prior to the start of the plan year.

Category	Pilot program element	Funding for	Description	Unit Cost	Total 3	Year 1	Year 2	Year 3	
Number of units						25	5	10	10
Pilot program management									
	Pilot Program Manager	Millford Housing as Pilot Program Manager	Millford staffing for program administration. Full time Program Coordinator plus leadership, construction and administrative support from other Millford staff.		\$ 365,000	\$ 125,000	\$ 120,000	\$ 120,000	
	Marketing	Millford Housing as Pilot Program Manager	Millford will manage marketing and budget			\$ 20,000	\$ 5,000	\$ 5,000	
	Referral Fee	Homebuyer Counseling	Referral fee for homebuyer counseling (HBC) or affordable developer that brings a home buyer to the program. Paid by DE SEU directly to partner. Request made to DE SEU by Millford.	\$ 500	\$ 12,500	\$ 2,500	\$ 5,000	\$ 5,000	
	Program development consulting	VEIC	Consulting/program set up assistance to pilot program manager, reporting, marketing, outreach, coordination with program partners, rater verification, coordinate factory technical assistance		\$ 385,000	\$ 175,000	\$ 122,500	\$ 87,500	
Incentives									
	DE SEU Incentives	Homeowner Incentive	Incentive to buy down incremental cost of energy efficiency features. Paid by DE SEU, to homebuyer at closing. Request made to DE SEU by Millford.	\$ 15,000	\$ 375,000	\$ 75,000	\$ 150,000	\$ 150,000	
Financing incentives									
	Down payment assistance	Homeowner Incentive	Money could come back to DE SEU at sale or stay with home to maintain affordability. Average home sale is 7 years so beyond pilot horizon	\$ 25,000	\$ 625,000	\$ 125,000	\$ 250,000	\$ 250,000	
	Fiscal Management	Fiscal agent	Fee to lending organization or DE SEU Bank to administer down payment assistance and other financing. To be set up during pre launch	1%	\$ 6,250	\$ 1,250	\$ 2,500	\$ 2,500	
Builder Technical Training									
	Technical Assistance	Subcontractor	If needed, additional technical assistant will be provided to Beracah to meet construction	\$ 4,950	\$ 23,700	\$ 14,850	\$ 14,850		
	Appraisal Training	Subcontractor	Training for Green Appraisers to value ZNE MH, if needed	\$ 1,000	\$ 15,000	\$ 5,000	\$ 5,000	\$ 5,000	
	DOE ZERH seminar	Subcontractor	Venue and refreshments during DOE ZERH	\$ 500	\$ 1,500	\$ 1,000	\$ 500		
Unit siting and commissioning									
	Foundation and Siting technical	VEIC	Each lot will have unique siting considerations.	\$ 2,500	\$ 62,500	\$ 12,500	\$ 25,000	\$ 25,000	
	Post occupancy commissioning	VEIC	VEIC will lead program manager team, to verify systems are operating as expect when the home is occupied.	\$ 1,500	\$ 37,500	\$ 7,500	\$ 15,000	\$ 15,000	
	Post occupancy trouble shooting	VEIC	If systems are not operating as expected, VEIC will lead program manager team to determine fixes and lessons learned for future models.	\$ 2,500	\$ 62,500	\$ 12,500	\$ 25,000	\$ 25,000	
Model home and expenses									
	Model home	Model home	Cost of model home and delivery, set up. Pilot goal is to sell units so money comes back the DE SEU	2		\$ 300,000			
	Minquadale	Minquadale lot rent	Model home lot rent plus electric utility			\$ 4,140	\$ 4,140	\$ 4,140	
		Insurance	Liability insurance for model home	2		\$ 1,500	\$ 1,500	\$ 1,500	
Post occupancy data monitoring									
	Equipment cost	VEIC to choose equipment and order	e-Monitor, installed by Beracah	\$ 2,000	\$ 50,000	\$ 10,000	\$ 20,000	\$ 20,000	
	Internet contract for homeowner	Millford Housing	Internet connection fee	\$ 600	\$ 15,000	\$ 3,000	\$ 6,000	\$ 6,000	
	Data storage	VEIC	Annual fee for data storage, VEIC to manage	\$ 150	\$ 3,750	\$ 750	\$ 1,500	\$ 1,500	
	Ongoing data analysis	VEIC	Data review for program evaluation		\$ 150,000	\$ 30,000	\$ 45,000	\$ 75,000	
Total						\$ 2,196,200	\$ 926,490	\$ 818,490	\$ 798,140

Figure 3: DE SEU ZNE MH Pilot Program Three Year Budget

Zero Net Energy Unit

Technical Specification

Included in the pilot design is a complete Delaware ZNE Modular Home Technical Specification, which details each component of the Delaware ZNE Modular Home. This is a living document, which will evolve as results are gathered from installation of units and as alternative options are made available in the Delaware market.

As part of the pilot process, these homes will be designed to qualify for specific national building certifications. Certifying these homes provides several advantages:

- Quality assurance that these homes will perform to the highest standard possible
- Marketing recognition and support
- Technical assistance and support

The certification process typically begins with a home energy model, which will in turn provide a Home Energy Rating System (HERS) Index. An energy model takes the home technical specifications, dimensions, and climate zone, and generates an estimate of annual energy consumption. The results of the model are converted to a score, or index. The lower the index, the less energy a home is expected to consume compared to a similar home built to the minimum energy code. A home with a HERS Index of zero will generate as much energy as it consumes on an annual basis – also known as Zero Net Energy. More information on specific building certifications for the Delaware ZNE Modular Home can be found in the Delaware ZNE Modular Technical Specification Manual document.

Local Manufactured and Modular Home Builders

As a key part of stakeholder engagement, outreach was done to local modular home manufacturers. VEIC and DESEU reached out to Beracah Homes, which is a family-owned business based in Delaware with a strong record of incorporating energy efficiency in its construction practices. Additional outreach was done to bring Champion Homes into discussions, which is located nearby in Pennsylvania. Both of these local builders expressed interest in working with the DESEU on a pilot program.

VEIC's recommendation is to launch the pilot program with one builder. The construction phase is an iterative one, requiring continual back-and-forth between the design team and the construction team. Simplifying the process by limiting the pilot to one builder, at least during the pilot's initial phases, will keep it more streamlined and cost-effective. Additionally, we expect there to be changes in manufacturing processes involved in the production of ZNE modular homes. Limiting the pilot to one manufacturer allows them to spread those production-change costs over more units, providing a better assessment of modular home production costs at scale. Were we

designing for a pilot program involving a couple of hundred units, it would make sense to engage with two production facilities. That makes much less sense for a pilot program that will bring 25 homes to market. Ultimately, the goal of the pilot is to create a specification that can be shared and used by several modular builders in the Delaware market, and to create demand to go to the next stage of commercialization, which would require multiple manufacturers.

Quality Assurance / Quality Control

Quality assurance is a critical part of the certification process for national programs, such as ENERGY STAR and Zero Energy Ready Homes. This includes development and utilization of builder checklists that are assessed both in the factory and in the field. Each ZNE modular home installed will have a minimum of two inspections - the first occurring before the drywall is installed in the factory, so that air sealing and framing details can be viewed without obstruction. The second inspection occurs in the field, and it confirms that the home is constructed and placed as designed. Additionally, the home will have diagnostic testing performed to verify that the unit is airtight and that ductwork is properly sealed. These additional inspection points help to assure both the homeowner and the program administrator that the home will perform as designed.

Cost-Benefit Analysis

Lifecycle costs and customer economics are an important consideration for the DESEU. A core goal of the pilot program is to promote affordable housing that saves energy and money for homeowners, and produces cost-effective energy savings for the DESEU. Comparing the costs and benefits of a Delaware ZNE modular home with those of a traditional manufactured home tells a story that reaches beyond energy benefits. While first costs for a Delaware ZNE modular home are higher, the benefits of lower energy costs, improved durability, better indoor air quality, and access to traditional low interest, long term mortgage products help to reduce overall monthly housing costs and provide long term value for the homeowner.

Analysis Method

To analyze lifecycle costs and develop financing and incentive packages appropriate for the pilot program, VEIC used the Building Life Cycle Cost (BLCC)¹³ tool developed by the National Institute of Standards and Technology (NIST). This tool was chosen for its ability to compare the relative cost-effectiveness of alternative building designs that have different upfront construction, energy, and operating and maintenance costs. The tool also can account for differences in financing terms, the long-term value of building, and equipment life and costs in order to determine which option has the lowest lifecycle cost over the analysis period from the perspective of the homeowner. This tool does not provide a cradle-to-grave analysis of materials used during construction to build the units.

A Delaware ZNE modular home provides a variety of benefits, some of which can be monetized, and others that cannot. The analysis is unable to quantify the benefits of:

- Increased resilience of housing and communities
- Increased energy independence - personally for the homeowner and nationally
- Reduced greenhouse gas emissions from lower energy use
- Improved occupant health as a result of better indoor air quality

Each of these benefits is critically important, but indoor air quality is of significant concern - to homeowners and, increasingly, to rental property owners. Studies continue to show strong interest in the health benefits that a high-quality home offers. Americans spend, on average, approximately 90 percent of their time indoors¹⁴, making indoor air quality an important consideration for overall health. Although the quantification and monetization of health benefits has begun, there is still a

¹³ <http://energy.gov/eere/femp/building-life-cycle-cost-programs>

¹⁴ <http://www.nature.com/jes/journal/v11/n3/full/7500165a.html>

long way to go for the research to provide figures that can be calculated and put into working cost-benefit models.

If ZNE modular homes were manufactured by a factory in Delaware, the following additional non-energy benefits would pertain:

- Job creation in local manufacturing – supporting one of the key goals of the SEU
- Additional tax revenues from manufacturers and building contractors working at the sites
- Economic multiplier effects of income produced and kept in-state

This cost-benefit framework uses the best available assumptions and modeling methodologies. The pilot program will gather actual data from manufacturers to continue to test and refine the model. The analysis steps are summarized below:

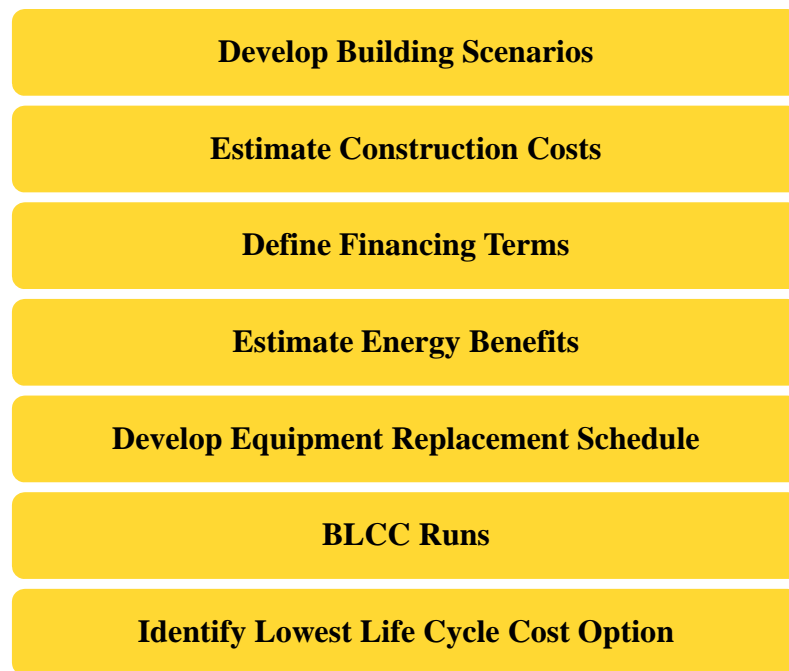


Figure 4: Cost-Benefit Analysis Steps

Inputs and Assumptions

Building Characteristics

The premise of the pilot program is to target homeowners who would typically be shopping for new manufactured homes and provide them with a better alternative that meets their needs financially - the Delaware ZNE modular home. This target market was determined to have the highest benefit and highest likelihood for success in a pilot program.

The baseline building characteristic is therefore determined to be a HUD-compliant manufactured home. HUD’s manufactured housing building standard covers safety, transportability, size, foundation as well as thermal envelope.¹⁵ The assumptions used to model energy use for a HUD-compliant manufactured home are found in the table below. The table also includes assumptions based on the Delaware ZNE modular home building standards. All of these assumptions were used to model energy use of a HUD-compliant manufactured home with a ZNE modular home with and without a solar PV array sized to meet the annual electric energy use for the unit.

The HUD-compliant manufactured home building envelope components were defined by the Pacific Northwest National Laboratory (PNNL), a member of the DOE Manufactured Home Working Group. Where requirements are not specified by HUD, PNNL made assumptions.

The Delaware ZNE Modular is fully defined in “Delaware Zero Net Energy Modular Home Technical Specifications.” The core technical requirement is that it meets the DOE ZERH standard. Additional prescriptive requirements are specified for appliances, heat recovery, lighting and windows, as described in detail in the technical specification manual and summarized below.

¹⁵ <http://www.ecfr.gov/cgi-bin/text-idx?SID=a2c5655a37054c584f7dd6a0ed240fb8&node=pt24.5.3280&rgn=div5>

Table 6: Delaware Zero Net Energy Modular Home Prescriptive Requirements

	HUD Compliant	ZNE Modular
Wall Insulation R-value (hr-ft ² -F/Btu)	13	43
Ceiling Insulation R-value (hr-ft ² -F/Btu)	30	60
Floor Insulation R-value (hr-ft ² -F/Btu)	22	50
Window U-factor (Btu/hr-ft ² -F)	0.52	0.19
Window SHGC	0.5	0.22
Envelope Leakage Limit (ACH50)	NR (8)	5
Duct Leakage Limit (CFM25/100 ft ² CFA)	NR (12)	N/A
Heating	Electric Resistance	Ductless Mini Split
Cooling	Window AC	Ductless Mini Split
Hot Water	Electric Resistance	Heat Pump
Mechanical Ventilation	NA	Conditioned Energy Recovery Ventilator (CERV)
High-efficacy Lighting Percentage (%)	RESNET Default	100%
Refrigerator	Federal min. standard	ENERGY STAR
Washer	Federal min. standard	ENERGY STAR
Dryer	Federal min. standard	ENERGY STAR
Dishwasher	Federal min. standard	ENERGY STAR

Construction Costs

The Delaware ZNE modular home cost is estimated to be \$95 per square foot.¹⁶ The costs included in this estimate are unit construction, foundation installation, and home delivery and installation. Home delivery assumes that a crane is used for placement on the site. The foundation walls are assumed to be constructed of poured, reinforced concrete, similar to a site-built home with concrete crawlspace walls. The crawlspace will be unvented and will have a ground moisture barrier (as opposed to a poured slab floor) to mitigate any moisture-related issues.

The HUD-compliant manufactured home cost is estimated to be \$44,275. This value was calculated by using the national average unit cost divided by the average square footage of a single-

¹⁶ Beracah estimated construction costs for the ZNE modular home to be \$90 per square foot. VEIC used \$95 per square foot as a conservative estimate to take into account unanticipated additional costs. These estimates will be updated once construction begins and actual data can be incorporated into the modeling.

wide manufactured home ¹⁷ in order to determine the average cost per square foot. That average cost per square foot was then multiplied by 975 square feet (the standard size of the ZNE modular home). The HUD-compliant manufactured home is assumed to be on concrete piers raised off the ground, with skirting added for aesthetics and to keep unwanted animals from living below the unit.

Table 7: Construction Costs, HUD Compliant vs. ZNE Modular Home

	HUD Compliant	ZNE Modular
Factory home purchase price	\$ 44,275	\$ 92,625
Foundation & Site work	\$ 7,000	\$ 12,375
Delivery and set-up	\$ 4,000	\$ 7,000
Solar installation (4 kW PV)		\$ 16,000
Total First Cost	\$ 55,275	\$ 128,000

Energy Benefits

The energy benefits of ZNE modular home include reduced energy use through efficiency measures such as building envelope upgrades and installation of efficient lighting, HVAC, and appliances. The modular home is designed to be all-electric, with electricity generation through an onsite grid-connected solar PV system sized to offset the annual energy consumption of the home.

Energy use in the three different scenarios (HUD-compliant manufactured home, and ZNE modular home with and without solar PV) was estimated using the REMRate modeling tool, which is an industry-recognized software used by ENERGY STAR programs, including Home Performance with ENERGY STAR and ENERGY STAR New Homes. The home’s orientation, size, window to wall ratio, and occupancy schedule were all held constant across the three scenarios, while envelope, mechanical, appliance and lighting inputs were modified to match each scenario’s building characteristics.

Electricity generation through a solar PV system was estimated using PVWatts, which is an online tool developed by the National Renewable Energy Laboratory (NREL) that estimates electric production based on location using TYM2 data, panel efficiency, array tilt, system losses and inverter efficiency.¹⁸ Using PVWatts, a 4kW solar PV system is predicted to generate 5,340 kWh per year and a 5kW system generates 6,675 kWh per year. A 4kW system was chosen since Delaware’s net metering rules allow limited credits for over-production.

¹⁷ <https://www.census.gov/construction/mhs/pdf/sitebuiltvsmh.pdf>

¹⁸ <http://pvwatts.nrel.gov/>

Both the REMRate and PVWatts tools require extensive inputs, which are included in Appendix D.

The estimated annual energy consumption for the HUD-compliant manufactured home and the ZNE modular home by end use is summarized in the table below:

Table 8: Estimated Annual Energy Consumption, HUD Compliant vs. ZNE Modular Home

	HUD Compliant	ZNE Modular
Heating (kWh)	7,296	965
Cooling (kWh)	1,198	323
Water Heating (kWh)	3,298	914
Interior Lights (kWh)	1,239	516
Exterior Lights (kWh)	149	37
Refrigerator (kWh)	673	386
Dishwasher (kWh)	140	106
Oven/range (kWh)	409	409
Clothes washer (kWh)	63	63
Clothes dryer (kWh)	830	281
Mechanical ventilation (kWh)	391	391
Plug loads (kWh)	1,443	1,443
PV (kWh)		(5,342)
Total Annual (kWh)	17,128	492
Electricity \$	\$0.13	\$0.13
Total Annual Electric \$	\$2,226.68	\$63.92

Equipment Replacement Schedule

HVAC systems and appliances are different between the HUD-compliant manufactured home and the Delaware ZNE modular home. Therefore, relevant equipment lives, costs, and maintenance schedules were factored into the BLCC analysis. The input assumptions are listed in the table below. The values come from a variety of sources and include assumptions on equipment and labor costs. Appendix E includes the details and sources of values used in this analysis.

Table 9: HUD-Compliant Manufactured Home Replacement Schedule*

	Description	Expected Life	Cost
Heating System	electric resistance	30 yrs	\$1,341
Water Heater	electric resistance	10 yrs	\$885
Washer	top load	10 yrs	\$399
Dryer	electric resistance	10 yrs	\$330
Refrigerator	federal requirement	10 yrs	\$450
Annual HVAC Tune up	n/a		

*The HUD scenario above assumes the residual value of the unit is 10% after 25 years. According to a 2015 study referenced in the Seattle Times, the annual depreciation for Clayton-brand homes is 4% based on a survey of "average quality" Clayton-branded homes and their average annual blue-book value between 2006 and 2015, using prices from [NADAguides](#). The model doesn't account for expenses that aren't financed in the loan, including land preparation, installation, home moving and real-estate agent fees.

Table 10: Delaware ZNE Modular Home Replacement Schedule*

	Description	Expected Life	Cost
Heating System	Mini Split	15 yrs	\$3,300
HRV	CERV	15 yrs	\$5,300
Water Heater	Heat Pump	10 yrs	\$1,300
Washer	CEE Tier 3	10 yrs	\$550
Dryer	Heat Pump	10 yrs	\$1,200
Refrigerator	CEE Tier 3	10 yrs	\$650
Annual HVAC Tune up	Yes	1 yrs	\$350
PV	4 kW	20 yrs	\$16,000
Inverter		10 yrs	\$3643

*The Delaware ZNE modular home scenarios assume the residual value of the unit is 50% after 25 years based on standard depreciation schedules from the home building industry.

Results

To understand if the Delaware ZNE modular home has a lower lifecycle cost than the HUD-compliant manufactured home, the construction costs, financing terms, and energy benefits were entered into the BLCC tool. The BLCC tool allows the user to analyze a time horizon of up to 25 years and includes the residual value of the unit. These results are illustrated in the summary tables for each scenario below.

Financing and Assistance Packages

The financing terms are the only inputs that are varied in the scenario analyses below. These terms were varied in order to test the effect of different financial incentive types and amounts. Building characteristics, construction costs, energy benefits equipment replacement and residual value are all held constant.

The following items are assumed:

- Market-rate first mortgages are obtained
- Pilot homeowners are low- to moderate-income
- Financing and assistance packages need to ensure units are affordable to residents in all three counties with incomes in the 80 - 120% AMI range

To test the appropriate level of DESEU assistance, multiple scenarios were run, holding all input variables the same except the financing and incentive packages outlined in this section.

Scenario 1 – No incentives

Scenario 1 assumes no financial incentives from DESEU or other sources. The results of this scenario shows that the HUD-compliant home is the lowest cost option over the course of 25 years by approximately \$13,000.

Table 11: Financing and Assistance Package Scenario 1

	HUD Standards	DE ZNE MH
Total Cost of unit	\$54,275	\$128,000
Homeowner down payment	\$10,855	\$25,600
Down payment assistance	n/a	n/a
DESEU Incentive	n/a	n/a
Amount financed	\$43,420	\$102,400
Rate	9%	4.375%
Term	15	30
Annual debt payment (principal and interest)	\$5,285	\$6,135

	Initial Cost (NPV)	Life Cycle Cost
HUD Unit	\$10,855	\$113,947***
DE ZNE	\$25,600	\$127,320

***indicates the lowest life cycle cost

Scenario 2 - \$15,000 incentive

Scenario 2 assumes a DESEU incentive of \$15,000. With a \$15,000 incentive applied to the ZNE modular home, the 25-year lifecycle costs of the two units are approximately the same.

Table 12: Financing and Assistance Package Scenario 2

	HUD Standards	DE ZNE MH
Total Cost of unit	\$54,275	\$128,000
Homeowner down payment	\$10,855	\$22,600
Down payment assistance	n/a	n/a
DESEU Incentive	n/a	\$15,000
Amount financed	\$43,420	\$90,400
Rate	9%	4.375%
Term	15	30
Annual debt payment (principal and interest)	\$5,285	\$5,416

	Initial Cost (NPV)	Life Cycle Cost
HUD Unit	\$10,855	\$113,947***
DE ZNE	\$22,600	\$115,435

***indicates the lowest life cycle cost

Scenario 3 - \$15,000 incentive plus down-payment assistance through DESEU financing

Scenario 3 assumes DESEU provision of a \$15,000 cash incentive, plus down-payment assistance financing of \$23,100 to ensure affordability to a low-income household. With a \$15,000 incentive and \$23,100 in down payment assistance, the lifecycle cost of ZNE modular home is less than the HUD-compliant manufactured home and is also affordable to low income Delaware residents.

Table 13: Financing and Assistance Packages Scenario 3

	HUD Standards	DE ZNE MH
Total Cost of unit	\$54,275	\$128,000
Homeowner down payment	\$10,855	\$22,600
Down payment assistance	n/a	n/a
DESEU Incentive	n/a	\$15,000
Amount financed	\$43,420	\$90,400
Rate	9%	4.375%
Term	15	30
Annual debt payment (principal and interest)	\$5,285	\$5,416

	Initial Cost (NPV)	Life Cycle Cost
HUD Unit	\$10,855	\$113,947
DE ZNE	\$2,500	\$97,624***

***indicates the lowest life cycle cost

Conclusion

VEIC recommends that the DESEU move into the next stage of pilot program implementation. The pilot program design calls for taking full advantage of existing resources in the community to leverage DESEU programming to the best effect.

The pilot program design calls for placement of 25 ZNE modular homes in Delaware on land that is fully owned by the homeowner or is leased from a land trust with a leasehold of at least 30 years. This will support mortgage financing rather than chattel financing of the home, which provides significant savings to the homebuyer in the form of lower interest rates and spreading out payments over a longer loan term.

The DESEU is uniquely positioned to oversee this program in Delaware, and there are a number of potential partners ready to support the DESEU in implementing the program. There is widespread agreement on the need for affordable housing in Delaware and that ZNE modular home construction is an avenue that can help to affordable housing increase production in the state.

ZNE modular home costs can be offset by the DESEU providing an incentive to offset the incremental costs of home construction. Furthermore, affordability of the unit for low-income Delaware residents can be assured through DESEU down payment assistance loans that reduce the first mortgage amount and payments. The pilot program presented in this report has been designed to be affordable to households at or below 120% of AMI, with a strong focus on those who are at or below 80% of AMI.

There is no reason that households above that income level cannot also be served by this pilot, and a financial incentive with no down-payment assistance is recommended for market-rate purchases. This option could provide catalyst for increased market activity by showing demand for the homes from households across a broad income spectrum.

VEIC is highly encouraged by the strong show of support for the ZNE modular home in Delaware. It is that support that will move this pilot program forward, with the long-term goal of full-scale commercialization and a fundamental transformation of the efficiency and financing of manufactured housing.

Appendix A: The VerMod: Vermont's High-Performance Modular Home

Background

- In 2011, Tropical Storm Irene devastated 15 percent of Vermont's mobile homes. This pivotal climate event showed how tenuous these homes are. Efficiency Vermont (EVT) partnered with affordable housing providers in the state to design, build, and properly site a new kind of modular home in the footprint of a mobile home.
- Built to the highest construction standards and sited on foundations, these homes have higher upfront purchase costs but significantly lower operating and lifetime costs when financed as real property.
- Pulling together a diverse set of stakeholders, EVT leveraged human and financial resources to bring this idea from concept to market.
- EVT launched the project with funding from
 - Vermont Housing and Conservation Board (VHCB), a quasi-state agency that funds affordable housing and land conservation projects
 - High Meadows Fund (HMF), a Vermont-based foundation that “promotes vibrant communities and a healthy natural environment while encouraging long term economic vitality in Vermont”
 - Efficiency Vermont (EVT), Vermont's energy-efficiency utility operated by VEIC
- The Manufactured Home Innovation Project served as the working group to guide and inform a pilot project focused on developing a new approach to replacing manufactured homes for low-income Vermont homeowners. This group consisted of the players listed in the **Key Stakeholders** section below.
- A builder was recruited from among the ranks of Vermont's pool of high-performance home contractors to create the high-performance modular home (HPMH) and develop the production processes to build such a home. EVT has provided ongoing support to refine and adjust the construction materials and techniques to create the highest efficiency home for the Vermont climate.
- The program targeted homes that were in parks rather than those on owned land, partnering with the Addison County Community Trust (ACCT) to install the first HPMH in a park owned by ACCT.

- Vermont Housing Finance Agency (VHFA) does not provide mortgage financing to homes on leased land because of restrictions on the sale of such mortgages in the secondary market.
- VHFA allocates a portion of the Vermont Affordable Housing Tax Credit to a pool of funds used to make 0%, deferred down-payment loans on new manufactured and modular homes located in parks. For income-eligible buyer, \$25,000 is available for new manufactured homes. An additional \$10,000 is made available for high-performance homes, so HPMH-buyers are eligible for \$35,000 down-payment loans. The loans are repaid when the home is sold to the next buyer, or loans may be assumed by the next buyer if they are income-eligible and meet underwriting criteria.
- Efficiency Vermont provides an incentive of \$8,500 for HPMH-buyers with incomes below 80% AMI or \$2,000 for buyers above this income level.

Key Accomplishments

- We have learned how to build and deliver a high-quality, high-performance, reasonably priced durable home. The sited homes are net zero when a solar photovoltaic array is added. Without solar, utility costs are one-third of those for an Energy Star manufactured home. See below for energy consumption data on five VerMod units, with comparison to energy consumption of a typical new manufactured home.

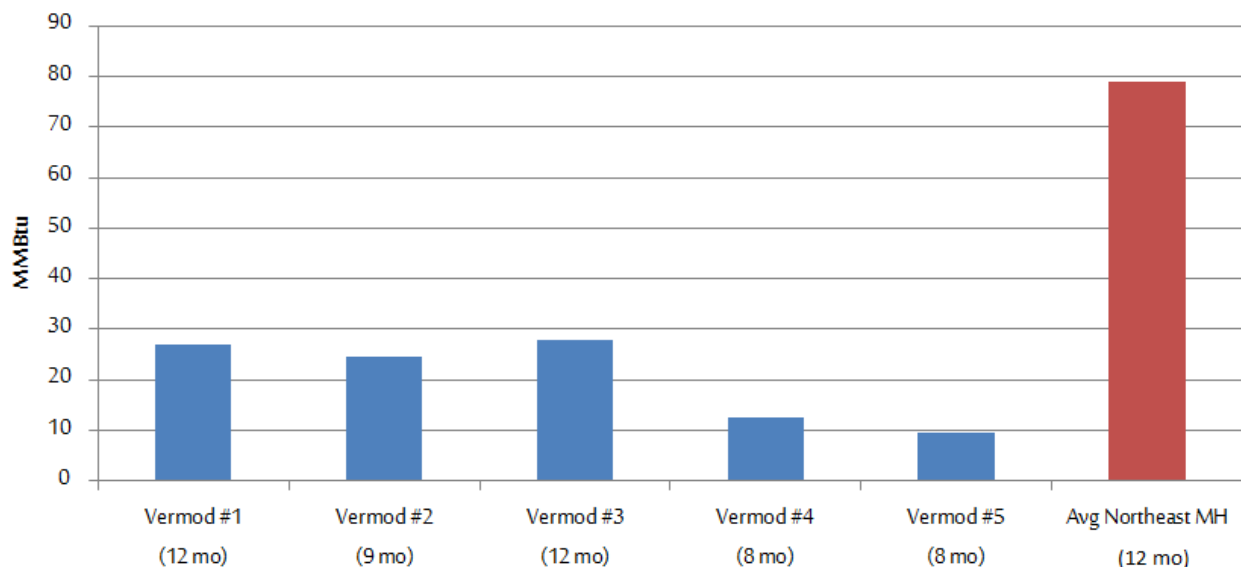


Figure 5: High performance Modular Home vs. Typical Northeast Manufactured Home

Comparison of actual energy usage from occupied VerMods and the average energy usage based on EIA data of new manufactured homes

(<http://www.eia.gov/consumption/residential/data/2009/index.cfm?view=consumption#end-use>).

- As of fall 2015, twenty-six HPMHs have been sited in 16 different communities across Vermont and one in New Hampshire. Eight are on owned land and 18 of the homes are in parks on leased land, with 16 located in nonprofit-owned parks.
- Creditworthy customers (based on standard underwriting criteria) have been able to qualify for reasonable financing terms from local financial institutions. A statewide credit union is currently in development to offer conventional financing for VerMods. Buyers have received rates and terms as favorable as 4.875% (fixed) on a 25-year loan, compared to 20-year financing at 8.25% for HUD Energy Star homes, with some interest rates as high as 12.5%.
- In June 2015, the U.S. Department of Agriculture (USDA) announced a pilot program to allow buyers of HPMHs to access long-term, fixed-rate mortgage financing in Vermont and New Hampshire. Under the USDA Energy Efficiency Manufactured Home Pilot Program, a low-income homebuyer purchasing a HPMH and placing it in a mobile home park would be eligible for a 30-year mortgage at a 3.25%. Very low-income home buyers may be eligible for an interest subsidy down to 1 percent.
- The gap between the cost to build and site the HPMH and the fair market appraised value has decreased with recently placed homes appraising for \$120,000 and higher. To ensure that HPMHs are valued accurately, EVT works with the Vermont Chapter of the Appraisal Institute both to expand the number of certified green appraisers and to educate the local appraisal community on the values of this new durably-constructed home. EVT has provided incentives for appraisers to complete the courses required to earn placement on the Appraisal Institute's *Valuation of Sustainable Buildings Professional Registries*.

Lessons Learned

- Without public subsidy, the HPMH is not affordable to the originally targeted market of very-low and low-income buyers. Affordable mortgage financing is the key to making HPMHs economically feasible on leased land. Since most lenders do not offer long-term, fixed-rate financing for homes on leased land (regardless of the energy performance), most low-income buyers would not qualify for a mortgage without the \$35,000 down-payment loan and the \$8,500 EVT incentive. Appropriate mortgage financing that utilizes the substantial energy savings can result in monthly housing costs similar to what a buyer of a new, conventional manufactured home would pay.

- Find a building partner that is committed to high performance and high quality. VerMod’s commitment to building only this level of performance has helped maintain focus and has given the project the ability to work through the design issues endemic to this type of construction. A builder that will not cut corners and that is committed to construction quality will provide benefits throughout the life of the program.
- Know the market. Understand the economic and demographic profile of potential buyers, including location and design preferences and concerns. Vermont is still working on this. Expect the product to evolve, and include time in the program development schedule to make design adjustments.
- Educate the real estate community about this new housing type. A key element to appraising high performance buildings is ensuring appraisers are provided with all relevant information relating to energy efficient features of a property, so they can more thoroughly analyze and make appropriate judgments for building energy performance and help lenders understand their collateral risk. Moreover, high performance buildings require enhanced competency and the services of highly qualified appraisers.
- Be honest about the key barriers, including high first-cost and confidence in energy savings. Again, Vermont is still working on this. We have discovered that one of the best approaches is to shift the buyers’ reference point to focus on the losses they will incur if they do not purchase a HPMH. Lack of understanding or belief in the ability to achieve net zero at a reasonable price requires additional education. Promote the full range of benefits. Position these as losses that will accrue if a conventional manufactured home is purchased. Benefits include comfort, quiet, air quality, construction quality, asset appreciation, etc.
- Put a team together that has the breadth of knowledge to deal with full range of tasks and issues that will arise as part of a pilot program: design (architectural, structural, mechanical, site-work, etc.), permitting and zoning, financing options and appraisals, and partner relations and agreements.
- Develop soft funding sources to help subsidize pilot program sales. Pair with the best possible hard financing options to show “operating cost equivalence” to prospective buyers.

Key Stakeholders

- VEIC
- Vermont Housing and Conservation Board
- High Meadows Fund

- Champlain Valley Office of Economic Opportunity – Mobile Home Project
- University of Vermont Community Development and Applied Economics Department
- Vermont Housing Finance Agency
- Twin Pines Housing Trust
- Upper Valley Housing Coalition
- Addison County Community Trust
- Cathedral Square Corporation

Key Supporters

A critical step in the process of developing a statewide program like this is bringing together diverse organizations and people who share common goals: to increase the quality of low-income housing and decrease energy costs for residents. These groups are:

- Electric utilities
- Electric efficiency providers
- Energy service providers
- Modular home manufacturers
- Mobile home park owners and residents
- Affordable housing providers
- Low-income service providers and advocates
- Financial institutions

Appendix B: Stakeholder Engagement

Engagement Strategy

The primary goal of stakeholder engagement in the ZNE modular home pilot program is to gather critical knowledge of the local market and insights on the opportunities and barriers. Successful stakeholder engagement has provided information critical for a go / no-go decision on moving forward with pilot program implementation and has set the stage for a successful ZNE modular home pilot program.

VEIC worked collaboratively with the DESEU and appropriate stakeholders to identify the right organizations to inform the market assessment and subsequent program design, and engaged those groups appropriately to obtain maximum benefit of their expertise.

Stakeholder engagement strengthened our shared knowledge in several key ways:

- Provided the foundation for broad-based support
- Obtained valuable insight with local context for program design elements
- Helped to prioritize recommendations and next steps for the pilot program design
- Identified the most-influential potential supporters or detractors early in the process
- Identified potential pilot partners

We identified three primary ways to engage stakeholders to gather the right information from each type of stakeholder as effectively as possible - phone calls, one-on-one meetings, and group meetings. Large group meetings took place in both Delaware and Vermont for different audiences and purposes.

Throughout the summer and fall of 2015, VEIC had many individual telephone conversations with stakeholders to describe the project and solicit early input. These conversations provided information to help recruit and select stakeholders to participate in a charrette. The charrette was held on Friday, October 16, 2015.

In addition to the VEIC research team and DESEU staff, the following people participated in the charrette, in whole or in part:

- Jen Allen, First State Manufactured Housing Association
- Jami Berardi, Redman Homes
- David Bonar, Public Advocate and DESEU Advisory Board
- Phil Cherry, Delaware Weatherization Assistance Program

- Roger Collison, Beracah Homes
- Bernice Edwards, First State Community Action
- Ed Flinton, Redman Homes
- Marlena Gibson, Delaware State Housing Authority
- Kevin Gilmore, Sussex County Habitat for Humanity
- Patricia Kelleher, Delaware Housing Coalition
- Bill McGowen, U.S. Department of Agriculture Delaware Office
- John Meredith, Beracah Homes
- David Moore, Milford Housing Development Corporation
- Joe Nebbia, Newport Partners (DOE Zero Net Energy consultant)
- Rich Schroeder, Champion Homes
- Stacy Slacum, U.S. Department of Agriculture Rural Development Office
- Ken Smith, Diamond State Community Land Trust
- Bahareh Van Boekhold, Delaware Division of Energy and Climate Change

The group was facilitated through a series of small- and full-group exercises, with the goal of identifying opportunities and barriers for a ZNE modular home program in Delaware. Some of the key findings included:

- DESEU has the financial resources and oversight capabilities for a viable ZNE modular home program
- Participant stakeholders are key to the program's success
- Milford Housing Development Corp. (MHDC) completes 150-200 mobile home repair projects per year
- MHDC is exploring purchasing a mobile home park which could serve as a site for ZNE modular homes
- Delaware Weatherization Assistance Program defers approximately half of the mobile home-dwelling applicants who apply due to need for home repairs
- Habitat for Humanity affiliates have very limited funds for mobile home repairs
- Minquadale project provides a unique opportunity for the ZNE modular home pilot as the only mobile home cooperative in the state
- Bay Wood in Sussex County is another opportunity for ZNE modular home installations, with higher-end homes, and owners who have traditional mortgages
- Well and septic systems are failing in some parks, creating a potential housing crisis for residents of these parks
- Most parks are on leased land, so there is a need to find or create parks that can offer very long-term leases
- Coverdale provides an opportunity for the ZNE modular home as need is very high and land is owned or leased long-term
- Rent justification has caused some owners to put manufactured home parks on the market

- There is a shortage of capital to manufactured home park purchases

DESEU Delegation Trip to Vermont

VEIC hosted a delegation of the Advisory Board and the Executive Director of the DESEU at its Burlington, VT offices in October 2015. The purpose of this trip was to meet with key stakeholders involved in the development of the VerMod, and to see firsthand the VerMod manufacturing facility and an occupied VerMod home.

Additional Individual Stakeholder Meetings

In November 2015, two members of the VEIC research team went to Delaware for individual meetings with stakeholders. Those meetings and some of the important findings from each included:

David Moore, Milford Housing, and Matthew Park, Discover Bank

- There is unmet demand for affordable housing
- There are resources for development
- Modular housing could be an important part of meeting demand
- Milford Housing could be an important partner, with potential interest not only in development, but also in manufacturing as part of its social enterprise mission
- High potential for development partnership due to capabilities in construction management, site work, funding and financing
- Potential interest in the concept of a full-ZNE modular home park

Marlena Gibson, Matthew Heckles, and Susan Eliason, Delaware State Housing Authority

- Many of DSHA's existing financing products could be made available to individual ZNE modular home buyers
- Existing products are often in short supply compared to demand
- High potential for partnership to act as financial agent using expertise in housing finance
- Potential for financing nonprofit acquisition of a land to serve as a modular home park
- Recently completed a statewide housing needs assessment, which pointed to the issue of mobile home residents living in deteriorating homes

Phil Cherry, Delaware Weatherization Assistance Program (WAP)

- Can serve as a strong advocate for a ZNE modular home program
- Can provide referrals of clients into the program
- They manage the Green Energy Program
- Could provide energy audits and other technical expertise

- Could provide data on pre- and post- weatherization energy use for homes they have served, with specific break-outs of manufactured and mobile homes
- High percentage of weatherization jobs in mobile and manufactured homes are deferred due to poor home conditions

Roger Collison, Beracah Homes

- High quality production of energy efficient homes
- Experience working with Habitat for Humanity
- Experience with Passive House standards, having just completed townhouse units to that standard in Maryland
- Introduction to one customer, Mr. Schiff, who has expressed interest in energy efficient homes as rental units

Kevin Gilmore, Sussex County Habitat for Humanity

- Interested in modular homes to increase production capacity
- Need for additional financing
- Habitat is constrained by money, time, and applicants
- Potential to modify process to accommodate modular home construction

Appendix C: Letters of Support

Partner	Pledge of support
Milford Housing Dev. Corp	develop homes and home-buyer education, site work
DE Division of Energy & Climate	WAP referrals and data-sharing
Diamond State CLT	develop homes, provide pool of qualified buyers

977 East Masten Circle
Milford, DE 19963



302-422-8255 *phone*
302-422-8260 *fax*
www.milfordhousing.com

December 28, 2015

Mr. Tony DiPrima
Delaware Sustainable Energy Utility
Suite 400
500 West Loockerman Street
Dover, DE 19901

Dear Mr. ^{Tony}DiPrima:

We write to express the support of Milford Housing Development Corporation (MHDC) for implementation of the Zero Net Energy Modular Home (ZNE MH) Pilot Program by the Delaware Sustainable Energy Utility (DESEU). MHDC has been involved with the research and development of this Pilot, and this letter serves as our commitment to work in partnership with DESEU.

MHDC is a nonprofit housing developer and we have served over 3000 families since 1998 many of who leave manufactured homes to participate in our program. Residents of manufactured homes spend, on average, nearly twice as much on energy per square foot of living space than do residents of site-built homes. Monthly utility bills of \$500 or more during summer and winter utility peak periods are common, placing a significant energy cost burden on many low- income families.

If a ZNE MH pilot is authorized by DE SEU, MHDC would be willing to explore several roles as we are uniquely positioned to make this pilot program a success. MHDC is a full service affordable housing developer that runs first time home buyer seminars and operates Mission Builders, a construction division which regularly builds to the ENERGY STAR New Homes Standard. MHDC's affiliate Ground Control which is a contractor that specializes in site development affords us a one-stop approach to developing affordable housing. With this skill set, MHDC could help recruit homeowners, build ZNE MH units as well as develop a small community with all ZNE MH if support was available from DE SEU.

This pilot program has the potential to catalyze the transformation of Delaware's manufactured housing market with ZNE MH that achieve reduced energy use, offer healthy indoor environment, are affordable to purchase and operate. We are very happy to support and be part of this exciting work.

Sincerely,

A handwritten signature in blue ink that reads 'David Moore'. The signature is written in a cursive style with a large 'D' and 'M'.

David Moore
President/CEO



STATE OF DELAWARE
DIVISION OF ENERGY & CLIMATE
100 W. WATER STREET
SUITE 5A
DOVER, DELAWARE 19904

Department of Natural Resources
and Environmental Control

Phone: (302) 735-3480
www.dnrec.delaware.gov/energy

January 4, 2016

Mr. Tony DePrima
Delaware Sustainable Energy Utility
Suite 400
500 West Loockerman Street
Dover, DE 19904

Dear Tony:

I write to express the support of Delaware Division of Energy and Climate (DEC) for implementation of the Zero Net Energy Modular Home (ZNE MH) Pilot Program by the Delaware Sustainable Energy Utility (DESEU). This letter serves as our commitment to work in partnership with the DESEU and other organizations that are interested in housing affordability, energy efficiency, and renewable energy in Delaware.

More than 38,000 families live in manufactured homes in our State, accounting for nearly 10% of our housing stock. Residents of manufactured homes spend, on average, nearly twice as much on energy per square foot of living space than do residents of site-built homes. Monthly utility bills of \$500 or more during summer and winter utility peak periods are common, placing a significant energy cost burden on many low-income families. According to the U.S. Census, 36 percent of manufactured homes in Delaware were built and sited before 1979, housing more than 13,600 families.

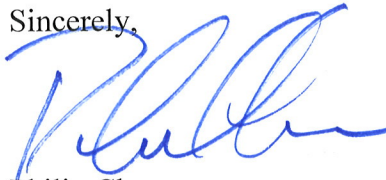
There is a clear and compelling case for addressing the unique needs of these families with a new type of high efficiency modular home which is being proposed by the DESEU. DEC has been involved since the beginning with the research and development of this concept in Delaware, and we are committed to making it successful. DEC manages the Weatherization Assistance Program (WAP) and the Green Energy Program – two programs that might interface well with the new ZNE MH Pilot program.

Delaware's Good Nature depends on you!

If a ZNE MH pilot is authorized by DESEU, DEC would be willing to refer WAP customers to the pilot program and promote the benefits of ZNE MHs. As funding allows, the Green Energy Program can also supply rebates to homeowners who purchase solar panels for their new modular unit.

This pilot program has the potential to catalyze the transformation of Delaware's manufactured housing market with ZNE MH's that achieve reduced energy use, offer a healthy indoor environment, are affordable to purchase and operate and are readily available from local builders. We are very happy to support and be part of this exciting work.

Sincerely,



Philip Cherry

Director, Division of Energy & Climate



Diamond State Community Land Trust

*Our mission is to strengthen Delaware communities
by creating and stewarding forever affordable housing
while promoting the sustainable use of the land.*

January 13, 2016

Mr. Tony DiPrima
Delaware Sustainable Energy Utility
500 West Loockerman Street
Suite 400
Dover, Delaware 19904

Dear Tony:

I am writing to express the support of Diamond State Community Land Trust for the Zero Net Energy Modular Home (ZNE MH) Pilot Program by the Delaware Sustainable Energy Utility (DESEU). This letter serves as our commitment to work in partnership with the DESEU and other organizations that are interested in housing affordability, energy efficiency, and renewable energy in Delaware.

As you may know, Diamond State Community Land Trust was formed in 2006 as the nation's first statewide community land trust. Our mission is to strengthen Delaware communities by creating an inventory of permanently affordable homes. We make use of the leasehold form of home ownership to provide homes that are secure and inheritable, as well as affordable upon resale to the next home-buying family. A member of the National Community Land Trust Network, DSCLT uses permanently affordable homeownership as a platform to nurture and sustain healthy and economically diverse communities. A collaboration with DESEU promises to extend the impact of our respective organizations to more low and moderate-income Delawareans.

CLT mortgages products – home loans that would accommodate the shared-equity, community land trust form – were a major preoccupation as Diamond State began its strategic planning process in 2012. Credit was tight, banks were under scrutiny, and public opinion was no longer favoring home ownership for low-income buyers. Since then, things have improved for our home buyers. Each of the improvements outlined here may prove to accelerate the DESEU ZNE MH pilot program:

- Fannie Mae has included the community land trust homeownership procedure in its new, automated desktop underwriting software, making for easier execution by loan originators.
- The Veterans Administration granted approval for Diamond State home buyers to be eligible for VA mortgages.
- Diamond State CLT home buyers in rural areas are now eligible to access the USDA/Rural Development 502 Direct and Guaranteed mortgage products. This comes at an opportune time for the organization, as it begins development of its first rural homes in the Ellendale area.
- We are in discussions with local banks interested in creating a CLT loan product which would be kept on the books of those banks and not resold. All these developments increase our ability to continue to build the inventory of permanently affordable homes in Delaware.

The proposed DESEU Zero Net Energy Modular Home fits well with our strategic planning goals for 2014-2017. Specifically, this effort ties in with our goal “to take a more engaged role in coordinating the development of quality, affordably priced homes that will become a part of our portfolio, to be kept

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www.DiamondStateCLT.org

permanently affordable.” Our housing production goals include: 1) increasing CLT homes in Rodney Village to 10; 2) creating CLT home ownership opportunities in Sussex; 3) increasing Kent County CLT homes by 23 over five years to a total of 47; and 4) creating 16 Sussex County CLT homes.

There is a clear and compelling case for addressing the unique needs of these families with the new type of high efficiency modular home which is being proposed by the DE SEU. According to the Delaware Housing Coalition, Delaware homeowners face staggering affordability gaps: \$69,125 in New Castle County; \$87,175 in Kent and \$168,2450 in Sussex. The target sale price with the proposed incentives and down-payment assistance will reach families with incomes as low as 50% of HUD Area Median Income. This level of affordability will enable DSCLT to serve more households with fewer scarce public subsidies.

DSCLT has been involved with the feasibility assessment phase of this concept in Delaware, and we are committed to participating in the pilot program. We are a statewide housing development organization with a unique focus on promoting permanently affordable home ownership. Together, we can bring the benefits of Zero Energy Homes to low-income Delawareans – a benefit that is often only available to middle and upper income families.

We believe that this pilot program has the potential to begin the transformation of Delaware’s manufactured housing market with a ZNE MH that achieves reduced energy use, offers healthy indoor environment, are affordable to purchase and operate and are readily available from local builders. We pledge our support and are excited to be part of this creative project.

Kind regards,

A handwritten signature in black ink that reads "Ken Smith". The signature is written in a cursive, slightly slanted style.

Ken Smith

Executive Director

kensmith@diamondstateclt.org