Energy and Environmental Analysis of Propane Energy Pod Homes

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Prepared for the
Propane Education & Research Council
by Newport Partners LLC

About the Authors

This research project was conducted by Newport Partners LLC of Davidsonville, MD. Newport Partners performs technical, regulatory, and market research and analysis related to the built environment, with a specific focus on the energy performance of buildings and building systems.

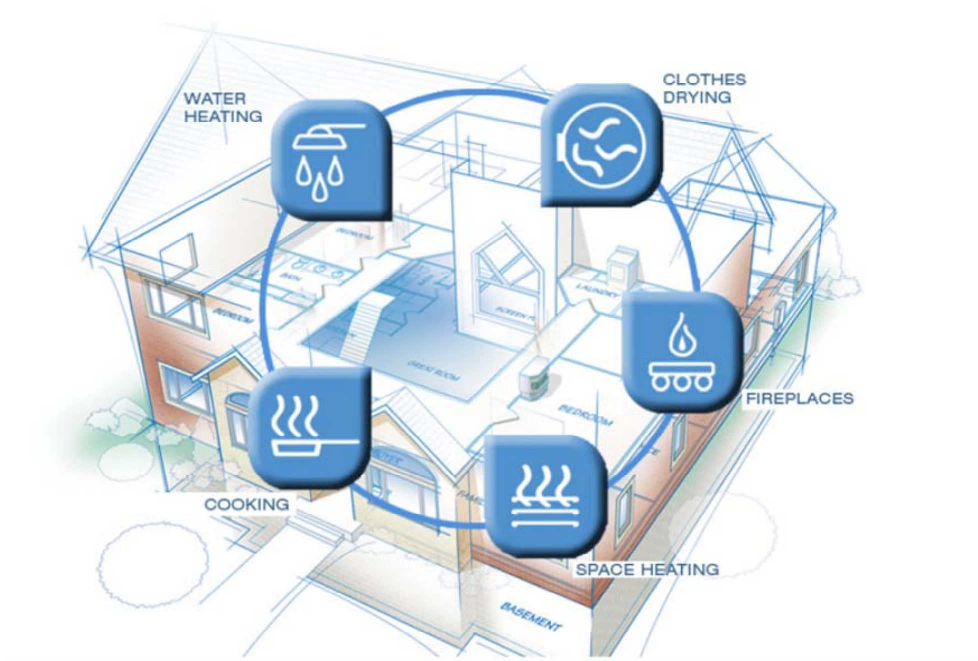
Executive Summary

Bundles or collections of building systems in homes can form the basis of an energy package or "pod." These can be the foundation for homes delivering energy and CO2 emissions savings that outperform typical new homes in the marketplace. In this project, Newport Partners researchers used building energy analysis to evaluate the energy and environmental performance of a series of Propane Energy Pod prototype homes at two sizes, across different climate zones. These results were compared with standard homes with typical technology packages.

Each Propane Energy Pod home comprised five residential energy-use loads, as shown in the illustration. These loads represent five prominent energy end uses in a home. Optimizing their performance can have a significant impact on energy costs and CO2 emissions.

<u>Methodology</u>

The specifications for the technologies within each Propane Energy Pod home were based on current product offerings as well as the climate. For example, in the Cold Climate Propane Energy Pod home, the specified heating system was a 95 AFUE forced-air furnace, while in the Moderate Climate Propane Energy Pod home (where heating demand is not as high), a dual-fuel system using a high-efficiency heat pump with a high-efficiency propane furnace back-up was specified. The specifications for cooking, fireplaces, and clothes drying were based on data from DOE analyses and market data for both the propane systems and the standard (electric) systems. In the standard homes, electric systems were specified for space



Source: Hanley Wood

heating (air-source heat pump) and water heating (electric storage tank water heater) as well as for cooking, fireplaces, and clothes drying. One exception was analysis locations in the Northeast, where the space heating system was a heating oil-fired furnace. In all cases, space and water heating systems in the standard homes were set at current federal standards.

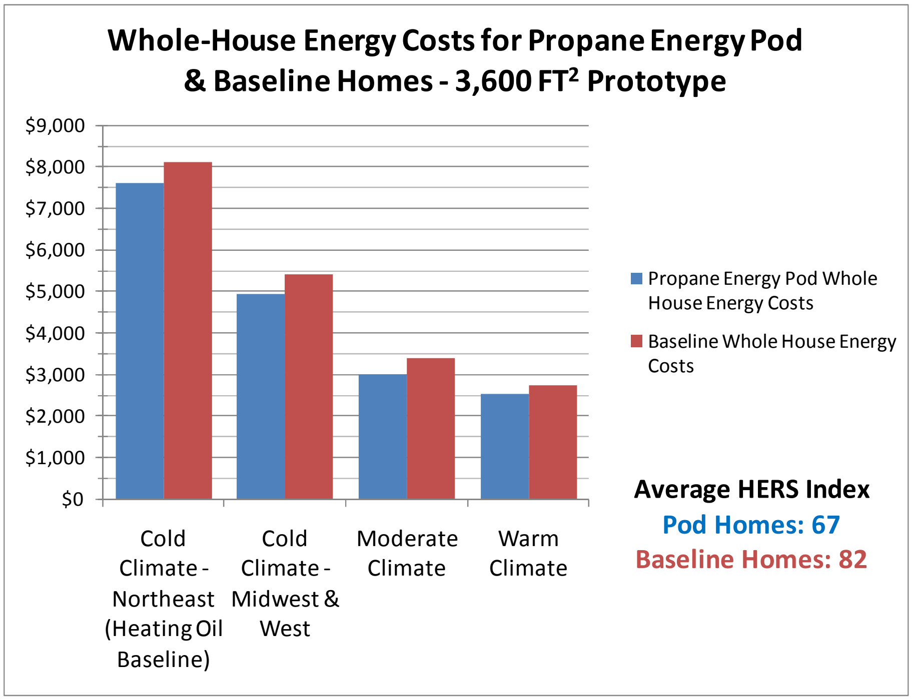
The energy and environmental performance of the Propane Energy Pod homes and the standard homes were modeled in 16 different locations throughout the United States for two prototype new homes: one at 2,400 square feet and another at 3,600 square feet. The technologies modeled in the two prototypes were consistent, with the main differences being the number of systems and the size (capacity) of the systems. For example, the 3,600-square-foot house, which represents a typical custom home, had two heating systems, while the 2,400-square-foot prototype had one. Other building characteristics of the Propane Energy Pod homes and the standard homes — such as foundation type, wall insulation levels, and number of stories — were based on data from the Energy Department's Energy Information Administration (EIA), the U.S. Census Bureau, and the 2009 International Energy Conservation Code (IECC).

The energy costs for propane, electricity, and heating oil were derived at the state level from EIA prices reported for 2010. The factors used to calculate CO_2 emissions were sourced from EPA's eGRID2010 Version 1.0 database.

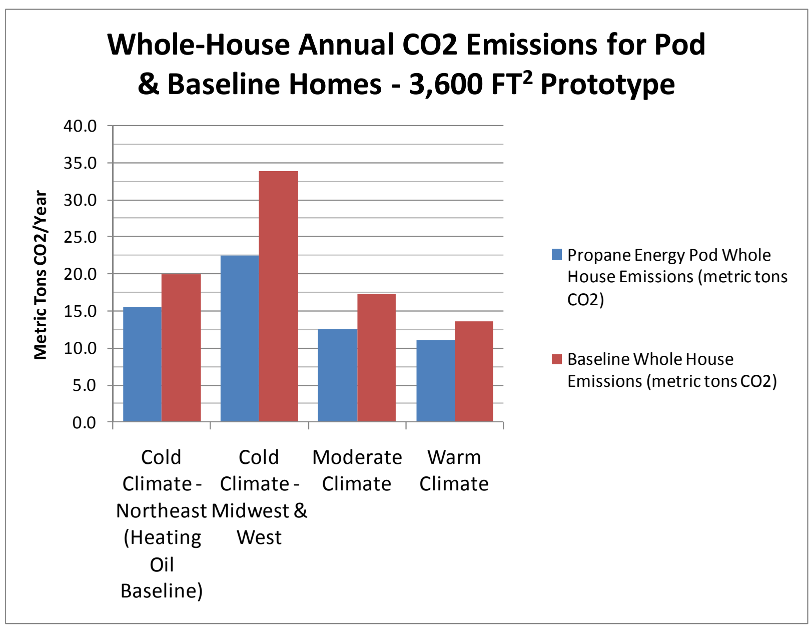
Energy & Environmental Analysis Results

The end result of this energy and environmental analysis was data that reflected whole-house energy use, energy costs, and annual CO_2 emissions data for both the Propane Energy Pod homes and standard homes in each climate region. Home Energy Rating System (HERS) Indexes were also generated for each analysis location. (The HERS Index is a system that measures the energy efficiency of a home on a scale of 0 to 100; the lower the score the better.) A bar chart depicting energy costs across the four climate zones and HERS results for the 3,600-square-foot home is shown below.

As the chart illustrates, annual energy costs for the Propane Energy Pod homes ranged from 6 percent (Northeast climate) to 11 percent (Moderate climate) **lower** than for the Baseline homes. While the percentage of reduction in annual energy costs was lowest in the Northeast, at 6 percent, the dollar savings ($502) were actually the highest in this region due to generally higher energy prices. In the other three regions, the Propane Energy Pod homes averaged about $345 less in annual energy costs than for the standard homes when modeled for the 3,600-square-foot prototype. For the 2,400-square-foot prototype, the annual energy costs were also lower in the Propane Energy Pod homes by an average of $387 across all 16 locations.



The graph above also notes the average HERS Index for the Propane Energy Pod home and the Baseline home. The average HERS Index of 67 for the Pod homes indicates that the homes are roughly 33% (100-67) more efficient than a standard code-compliant home, while the Baseline homes are estimated to be about 18% more efficient. A variety of energy efficiency labeling programs and incentives use the HERS Index as a metric, with threshold levels often in the range of 70 to 80. Several national production builders have also announced that, beginning in 2011, they will label all of their new homes with a HERS Index.



The CO2 emissions of the Propane Energy Pod homes were found to be significantly lower than for the standard homes, with "pod" homes emitting 5.3 metric tons less CO2 annually (see graph at right). This efficiency is equivalent to removing one passenger car from the road for every year that the Propane Energy Pod home is in use.

Contents

Introduction

Bundles or collections of building systems in homes can form the basis of an energy package or "pod". Pods of this type can be the foundation for high performance homes which deliver energy and CO2 emissions savings by outperforming "typical" new homes in the marketplace. For example, the "PATH" program on advanced housing technology developed a series of "Tech Sets" (see Figure 1) which highlighted synergistic packages of innovative building systems[1]. Bundles of innovative building systems arranged in this manner provide builders and contractors with an approach to infusing advanced technology in buildings.

The objectives of this research project were to formulate climate-appropriate propane-based pods for new home construction, and then evaluate these technology bundles in typical homes as compared to standard technology packages in the same homes. To achieve these goals, a technology assessment was used to develop specifications for three climate-based "Propane Energy Pods." The Propane Energy Pods were then applied to two prototype homes across different climate zones, and evaluated for their energy and environmental performance relative to the prototype homes equipped with standard efficiency technology packages. The intent of this analysis was to illustrate the collective performance benefits which are possible with bundles of high performance, propane-based building systems.

1. Materials with Low VOCs
2. Ventilation, Humidity Control and Air Filtration
3. Durable Building Envelope Details
4. Sealed Combustion Appliances
5. Occupant Vigilance

Figure 1: PATH "Tech Set" Showing Indoor Air Quality Technology Bundle

Methodology

A detailed methodology was developed to guide this analysis of multiple building systems in prototype homes across multiple locations in the U.S. This methodology provided for a consistent approach to the analysis across the many variables which were involved. A basic overview of the analysis methodology is shown below in Figure 2.

[1] "PATH" was the Partnership for Advancing Technology in Housing, a decade-long public-private partnership administered by the U.S. Department of Housing and Urban Development (HUD) until 2008.

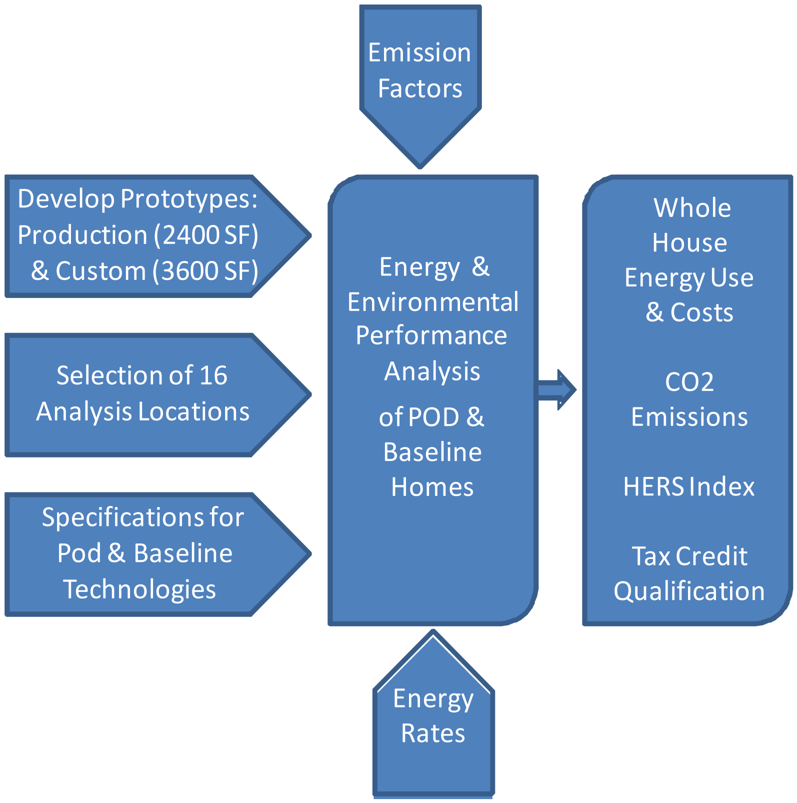


Figure 2: Research Methodology

Prototype Homes

The backdrop for the energy simulations which were used to evaluate the Propane Energy Pod technologies were two prototype homes. For each of the 16 analysis locations in this study, a "production" and a "custom" home were modeled. Both homes were single-family, detached, with the production home prototype at 2400 square feet (SF) and the custom home prototype at 3600 square feet of above grade conditioned floor area. The custom home prototype varied slightly from the production home in areas such as zoning, where the custom home was assumed to have two space heating/cooling systems to cover a larger floor area.

The characteristics of the two prototype homes were based on the following data sources: U.S. Department of Energy's Residential Energy Consumption Survey (RECS), the 2009 International Energy Conservation Code (IECC), and the U.S. Census Bureau. RECS and Census Bureau data were used to define and establish floor area, number of bedrooms, number of stories, and foundation type (based on location). Further, the building envelopes were designed to meet the standards of the 2009 IECC. This energy code governs current residential construction practices related to insulation and energy in much of the U.S., and therefore served as an appropriate reference for defining the prototypes.

Analysis Locations

The Propane Energy Pods were developed to be climate-appropriate, so the research incorporated a range of analysis locations where the appropriate Pods were modeled and evaluated. A total of 16 analysis locations were selected to represent three climate regions for which the Pods were developed. Three of these cities were in the "Warm" climate region (i.e., climate zones 1 and 2 as defined by the IECC). Six of these cities were located in the "Moderate" climate region (i.e., climate zones 3 and 4 of the IECC), and seven of these cities were in the "Cold" climate region (i.e., climate zones 5-8 of the IECC). The geographic distribution of the selected analysis locations can be seen in Figure 3. These locations represent a range of climate conditions, as well as diversity in energy prices (discussed below).

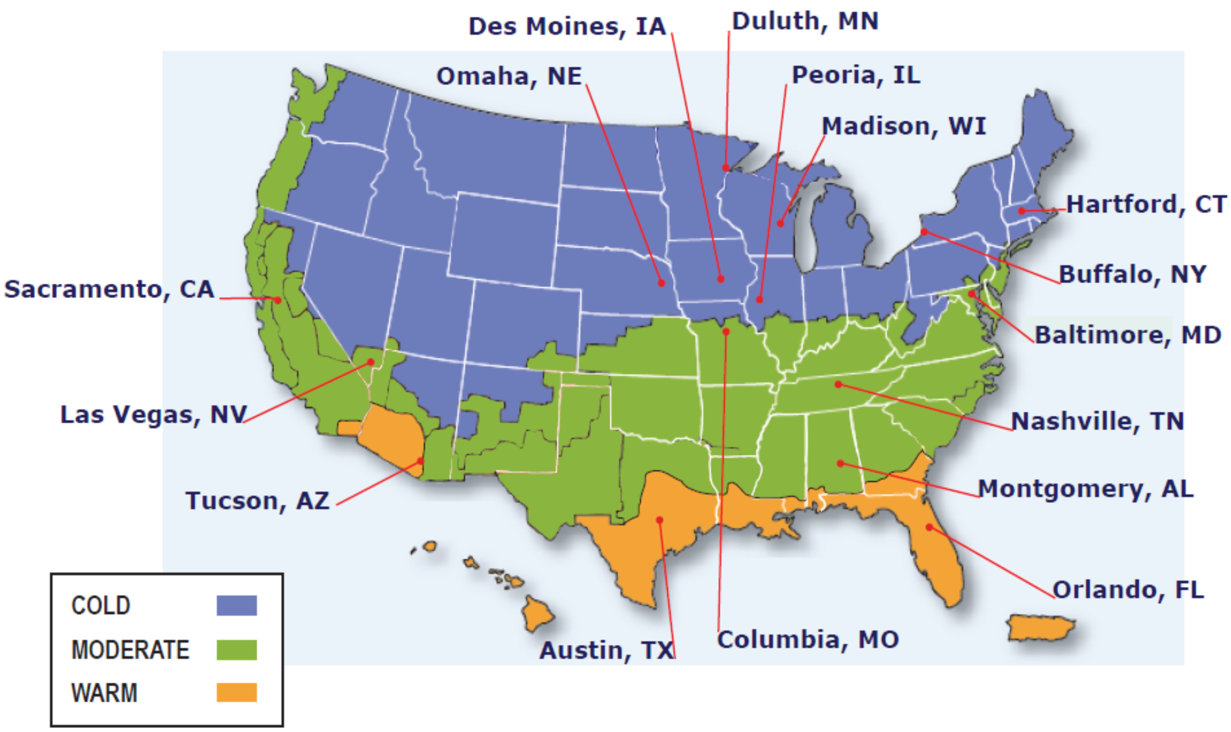
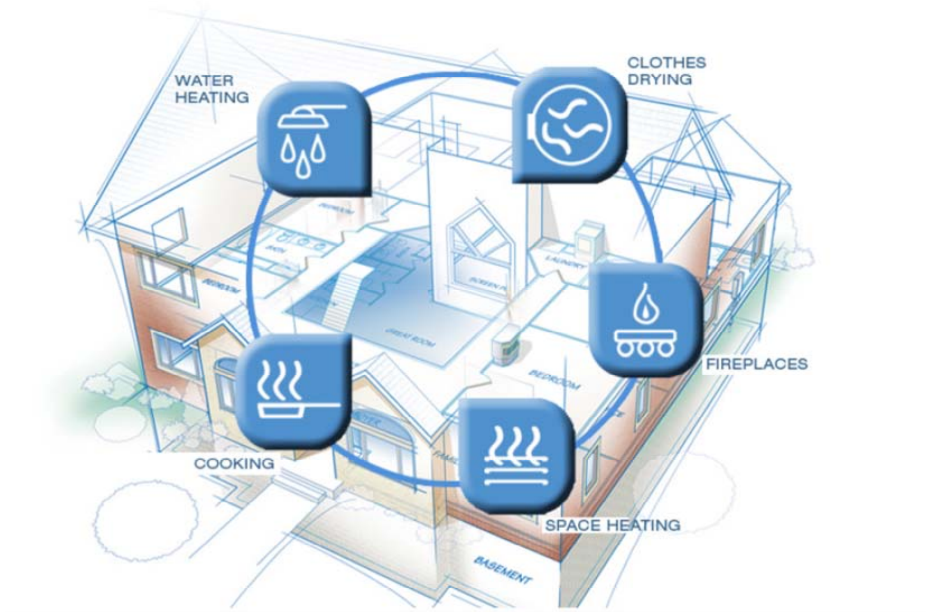


Figure 3: Analysis Locations in Warm, Moderate, and Cold Climate Zones

Propane Energy Pod Specifications

For each of the three climate regions (Cold, Moderate, Warm), a specific Propane Energy Pod was developed. Each Propane Energy Pod included a technology for space heating, water heating, cooking, clothes drying, and a fireplace (see Figure 4).

The specifications for the five technologies within each Pod were based on current product offerings in the marketplace, as well as the climate (for climate-sensitive applications like space heating). For example, in the Cold Climate Propane Energy Pod, the specified heating system was a 95 AFUE forced-air propane furnace. This is a high efficiency furnace easily found in the marketplace, especially in heating-dominated regions. In the Moderate Climate Pod (where heating demand is not as severe) a “dual-fuel” heat pump system using a high efficiency heat pump with a high efficiency propane furnace back-up was specified as the heating system.



Source: Hanley Wood

Figure 4: The Five Energy End-Uses in the Propane Energy Pod

The specifications for clothes dryers, ovens/ranges, and fireplaces were based on data from DOE analyses and market data, for both the propane systems and the standard (electric) baselines. Electric “baseline” - or comparison - systems were specified for water heating (electric storage tank water heater) and space heating (air source heat pump), as well as for the fireplace, cooking, and clothes dryer applications. One exception was analysis locations in the Northeast, where the space heating system was a heating oil-fired furnace. In all cases, the efficiency levels for the baseline water and space heating systems were set at the current minimum federal standards.

Appendix A contains the full specifications for the Cold, Moderate, and Warm Climate Energy Pods, as well as for the Baseline home in each of these climate regions. Additionally, Figure 5 below relates characteristics about the two prototype homes and how the five Propane Energy Pod technologies were applied to each of the prototypes.

Building Characteristic	Production Home Prototype	Custom Home Prototype
Size in Square Feet (SF)	2400	3600
Foundation	Climate appropriate	Climate appropriate
Insulation levels	2009 IECC compliant	2009 IECC compliant
Heating System	1 heating system	2 heating systems
Water Heating System	1 water heater (tankless for the Pod home)	1 tankless water heater in the Pod home; Baseline home has 2 electric storage water heaters (anticipating large HW demand in the custom home)
Fireplaces	1 fireplace	2 fireplaces
Cooking	1 high efficiency cooktop and oven	1 high efficiency cooktop and oven
Clothes Dryers	1 standard efficiency clothes dryer	1 standard efficiency clothes dryer

Figure 5: Characteristics of the Prototype Homes and the Pod, Baseline Technology Packages

Energy Prices and Emissions Factors

Monthly data from the U.S. Department of Energy's Energy Information Administration (EIA) was used to develop annual average energy prices for heating oil, electricity, and propane at a state level for each location analyzed. The most recent full year of data available (2010) was used in developing prices. Figure 6 contains the state-level energy prices for those locations included in the study. Heating oil prices are only presented for two states in the Northeast, because heating oil systems were only considered as part of the Baseline home in this section of the country. In all other areas, the Baseline home was assumed to have all electric building systems.

Analysis Location		**Propane ($/gallon)**	**Heating Oil ($/gallon)**	**Electricity ($/kWh)**
Montgomery	AL	$2.28	N/A	$0.11
Tucson	AZ	$2.44	N/A	$0.11
Sacramento	CA	$2.44	N/A	$0.15
Hartford	CT	$2.46	$2.78	$0.19
Orlando	FL	$2.60	N/A	$0.12
Des Moines	IA	$1.55	N/A	$0.10
Peoria	IL	$1.80	N/A	$0.12
Baltimore	MD	$2.57	N/A	$0.14
Duluth	MN	$1.73	N/A	$0.10
Columbia	MO	$1.74	N/A	$0.09
Omaha	NE	$1.52	N/A	$0.09
Las Vegas	NV	$2.44	N/A	$0.12
Buffalo	NY	$2.49	$2.82	$0.19
Nashville	TN	$1.80	N/A	$0.09
Austin	TX	$2.28	N/A	$0.12
Madison	WI	$1.69	N/A	$0.13
AVERAGE		**$2.11**	**$2.80**	**$0.12**

Figure 6: Energy Prices at the State Level for Analysis Locations in the Study

The CO_2 emissions associated with energy consumption were estimated using emissions factors sourced from the U.S. Environmental Protection Agency (EPA). Electricity emissions factors were sourced from EPA's eGRID2010 v1.0 at the state level for each location analyzed. Heating oil and propane emissions factors were also sourced from the EPA. While the state-level emissions factors were used to calculate CO_2 emissions data for each analysis location, the *average* emissions factors used in the study are compiled in Figure 7.

Analysis Location	CO2 Emissions (metric tons per billion Btu)		
	Propane	Heating Oil	Electricity
Average of 16 States in the Study	63	73	167

Figure 7: Residential CO2 Emissions Factors Associated with Consumption of Various Fuels

Building Energy Analysis & Simulations

Simulations were conducted to generate energy use estimates for space heating and water heating with REM/Rate v12, using the aforementioned building characteristics and locations. Because fireplaces are not addressed specifically in REM/Rate, calculations for fireplace performance were conducted within a spreadsheet. These calculations accounted for fireplace size, efficiency, run time, energy use, and space heating energy savings that resulted from the useful heat contributed by the fireplace. Usage schedules were developed to estimate run time per year according to the climate zone, with annual run times varying from 48 hours in the warm climate zones to 120-168 hours in the cold climate zone. The propane fireplace efficiency level in the Pod was based on a Canadian database of available products[2], with the Pod fireplace set to the minimum efficiency of the upper quarter of market-available products in this database. Electric fireplace efficiency levels were set at 100% in the analysis.

For appliance energy use, U.S. Department of Energy's Technical Support Documents (TSDs) were used in lieu of REM/Rate. The TSDs were selected because they represent recent and detailed investigations of the DOE into appliance energy consumption and because the Home Energy Rating Standard from which REM/Rate's appliance algorithms are derived was undergoing an update at the time of the modeling.

From the DOE TSD[3] review of market-available clothes dryers, the minimum efficiency levels were selected for both the propane clothes dryer and the electric clothes dryer. Minimum, or

[2] Natural Resources Canada – Energy Efficiency Ratings for Gas Fireplaces. Last accessed June 22, 2011.http://oee.nrcan.gc.ca/residential/business/manufacturers/search/fireplace-search.cfm?attr=12.
[3] *Residential Clothes Dryers and Room Air Conditioners Direct Final Rule Technical Support Document*. http://www1.eere.energy.gov/buildings/appliance_standards/residential/residential_clothes_dryers_room_ac_direct_final_rule_tsd.html.

“standard”, efficiency levels were selected for both product classes because the labeling of these products was deemed inadequate to permit consumers to distinguish between efficiency levels. Energy use associated with these units was also sourced from the same document and was provided independent of household size and climate zone.

The performance of cooking ranges, composed of an oven and a cooktop, was also sourced from DOE’s TSD[4] on cooking. For both electric and propane models, energy use data was collected for standard cooktops paired with self-cleaning ovens. Propane units did not employ a pilot light. In keeping with the DOE study, energy use for cooktops and ovens was assumed to be static and independent of household size and climate zone.

Energy & Environmental Analysis Results

Whole-House Energy Costs

Figures 8 and 9 below illustrate the whole-house, annual energy costs for both prototype homes as equipped with the Propane Energy Pods and the baseline equipment package. While there are three climate-based Pods, the results are broken down into four climate-based categories. The Cold Climate Region is separated into a Cold/Northeast zone – where the Baseline home was assumed to have a heating oil-fired furnace for space heating, and a Cold/Midwest and West zone – where the Baseline home was all electric. See Appendix A for full specifications for the Pod and Baseline homes.

As the two bar graphs indicate, the annual whole-house energy costs are lower for Propane Energy Pod homes for both prototypes across all regions. *Whole-house* energy cost is presented, as opposed to just the energy costs for the five end-uses in the Pod, because whole-house energy cost is generally a more meaningful number to industry professionals and homeowners.

Further, the energy cost differences in each climate region are due exclusively to the five technologies contained in the Pod: a furnace or dual-fuel air-source heat pump (ASHP) for space heating; a tankless water heater; and propane-fired cooking, clothes drying, and fireplace. Within the Warm and Moderate Climate Pods, the dual-fuel heat pump specified for the Propane Pod included a high efficiency ASHP (15 SEER, HSPF 8.5) with a high efficiency

[4] *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Dishwashers, Dehumidifiers, and Cooking Products, and Commercial Clothes Washers*. September, 2008. http://www1.eere.energy.gov/buildings/appliance_standards/residential/home_appl_tsd.html

propane-fired backup furnace (95 AFUE). In this case, because the Propane Energy Pod home used higher efficiency equipment for cooling than did the Baseline home (13 SEER cooling), the dual fuel HP system also provided significant cooling energy and CO_2 reductions for the Pod home (especially in the Warm Climate Region). This was considered as an ancillary benefit of the high efficiency heating system in the Pod. In the Cold Climate region, a 95 AFUE propane furnace was the heating system within the Pod Home, so there was no difference in cooling energy or cost.

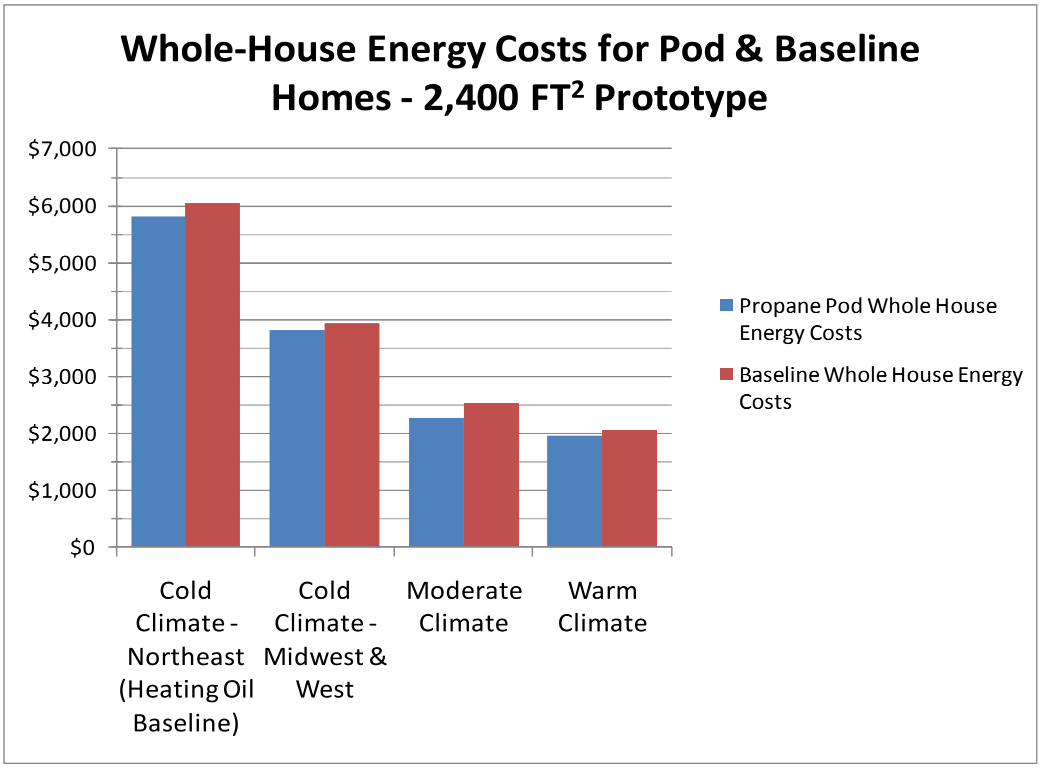


Figure 8: Annual Whole-House Energy Costs for the 2,400 SF Prototype Home

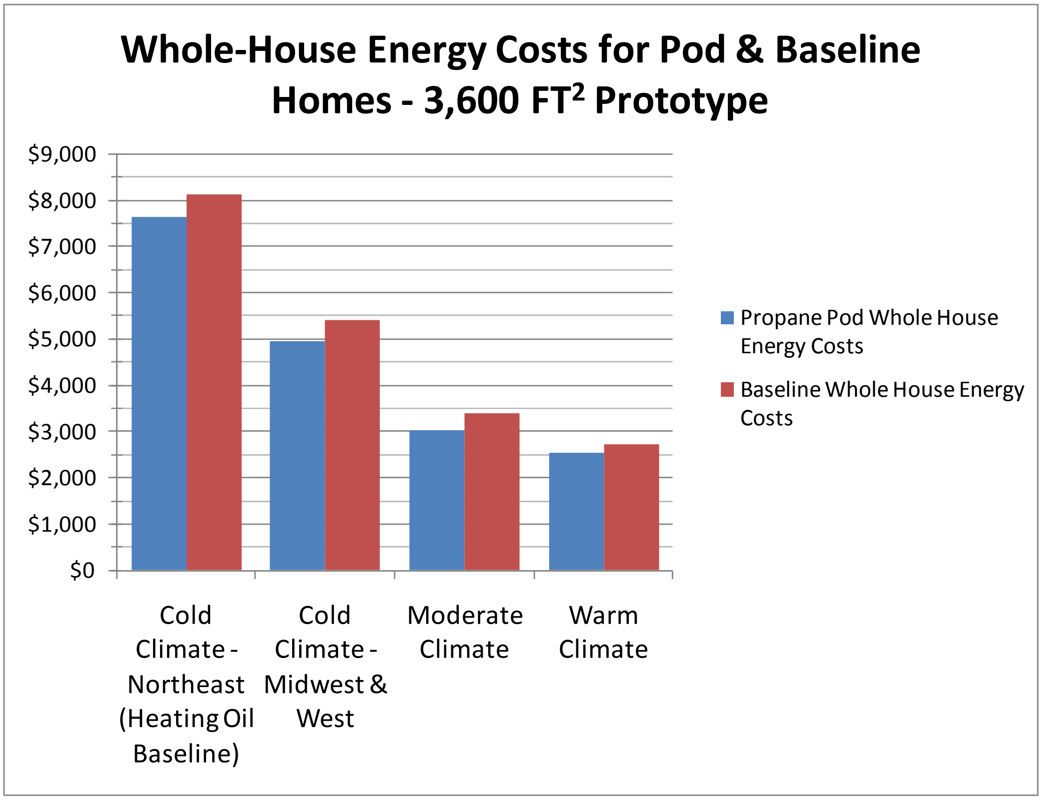


Figure 9: Annual Whole-House Energy Costs for the 3,600 SF Prototype Home

Based on the data embedded in the two bar graphs in Figures 8 and 9, the following observations can be made:

- Annual energy costs for the Pod homes ranged from 6% (Northeast climate) to 11% (Moderate climate) lower than for the Baseline homes, for the Custom Home (3600 SF) prototype.
- The Custom Propane Energy Pod Home (3600 SF) in the Northeast had annual energy costs $502 lower than the Baseline home. In the other three regions, the Custom Propane Energy Pod home averaged about $345 less per year than the Baseline home.
- Annual energy costs for the Pod homes range from 4% (Northeast & Cold/Non-Northeast) to 10% (Moderate climate) lower than for the Baseline homes, for the Production Home (2400 SF) prototype.
- The Production Propane Energy Pod Home (2400 SF) showed annual energy cost savings of about $250 in both the Northeast and the Moderate Climate Zone. The Pod Home in the Cold Climate Mid-west/West had savings of $137, and savings of $98 were found in the Warm Climate.

- When averaged across all 16 analysis locations, average savings for the Propane Energy Pod home were $387 (3600 SF Custom Home Prototype) and $187 (2400 SF Production Home Prototype).

Whole-House CO_2 Emissions

Whole-house CO_2 emissions associated with the prototype homes' energy usage were calculated for Propane Energy Pod and Baseline homes across the different climate regions. *Whole-house* CO2 emissions, rather than emissions associated just with the five end-uses in the Pods, were calculated and are presented below in Figures 10 and 11. However, the *differences* in whole-house CO2 emissions between Pod and Baseline homes were attributed wholly to the five end-use technologies.

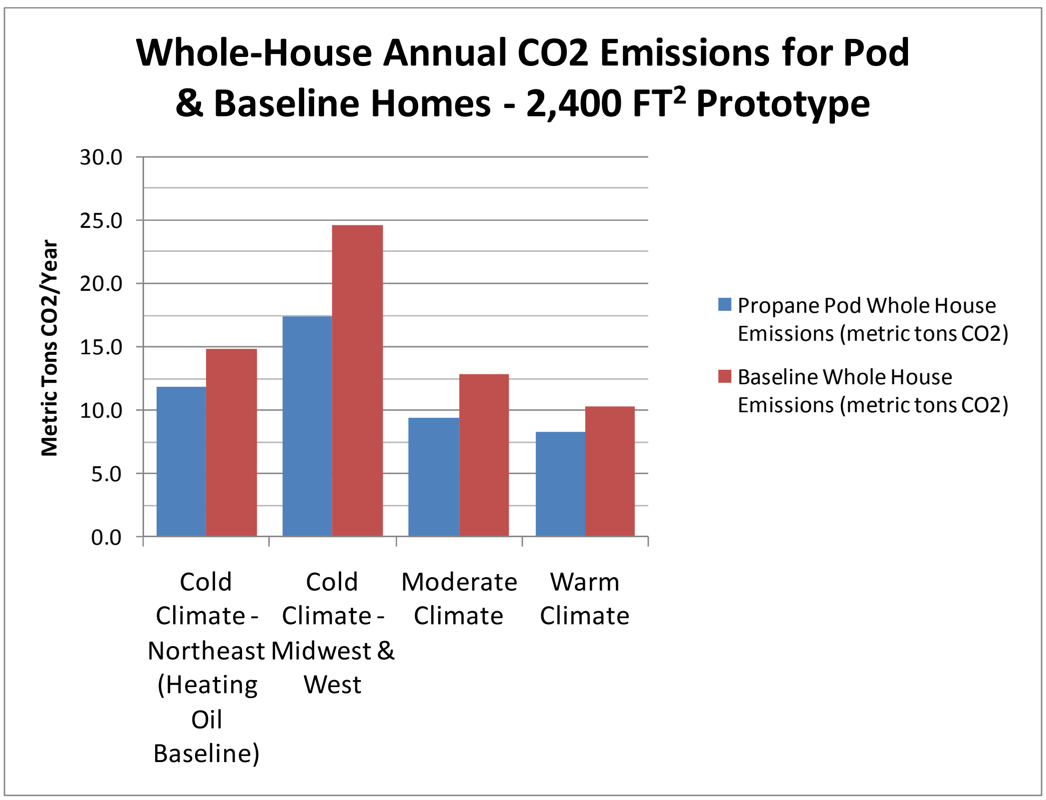


Figure 10: Annual Whole-house CO_2 Emissions for the 2,400 SF Prototype Home

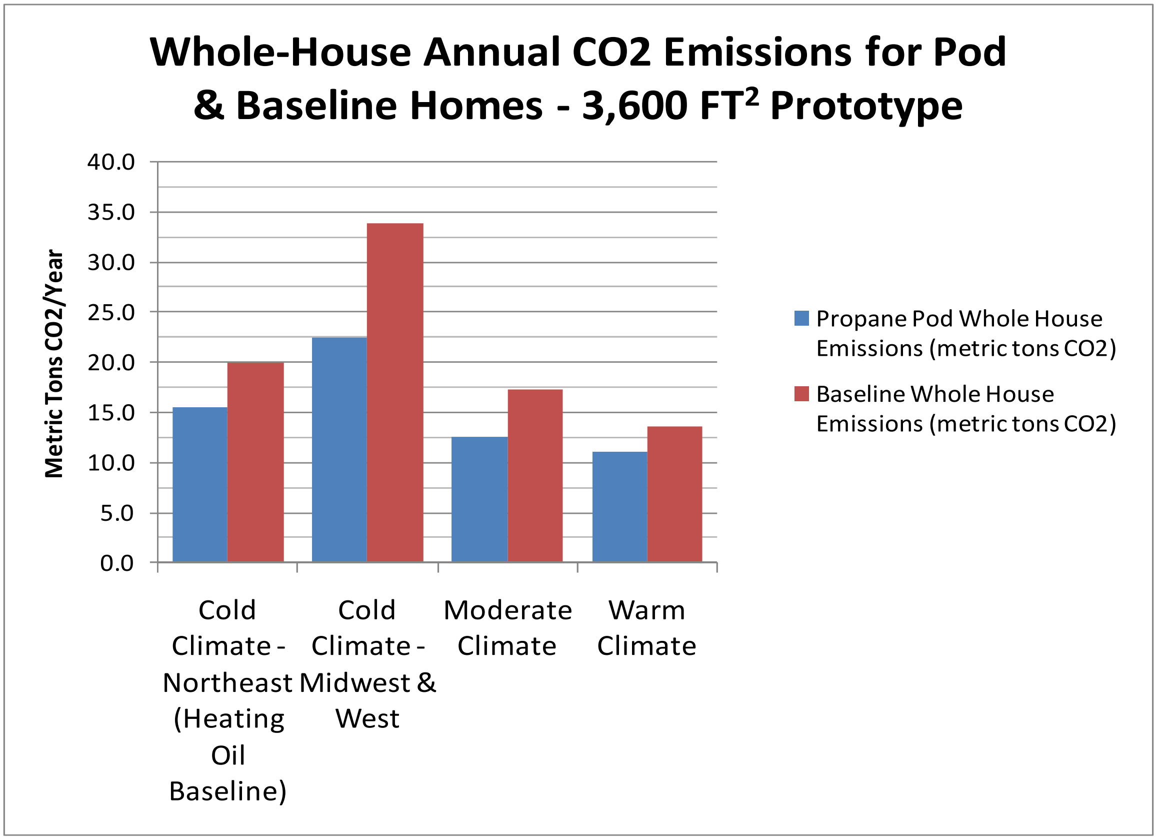


Figure 11: Annual Whole-house CO_2 Emissions for the 3,600 SF Prototype Home

Based upon the data in these two bar graphs, the following observations can be made:

- The largest difference in CO_2 emissions was for the 3600 SF prototype in the cold (non-northeast), at 11.3 metric tons CO_2 annually. This CO_2 reduction is like offsetting or eliminating the annual emissions from 2 passenger cars - - each year[5].
- The lowest CO_2 emissions difference was found in the Production Home Prototype (2400 SF) in the Warm Climate Zone at 2.0 metric tons CO_2/year. This is mainly due to lower differences in electric consumption in this region (less heating load at low temperatures).

[5] CO_2 equivalency metric is based on data from U.S. EPA's Greenhouse Gas Equivalencies Calculator: www.epa.gov/cleanenergy/energy-resources/calculator.html. Last accessed June 22, 2011.

- The average CO_2 emissions reduction - across both prototypes and *all 16 analysis locations* – was about 5.3 metric tons CO2/year. This is equivalent to the CO_2 emissions from a passenger car for a year – so operating the Pod home each year is like eliminating a car's CO_2 emissions each year.
- The relatively higher CO_2 emissions for the Cold/Midwest & West region – for both the Pod and Baseline home – are driven in part by electricity emissions factors (metric tons CO_2/kWh) which averaged 28% higher than for the other analysis locations in the study. This is due to a high proportion of power in this region coming from coal-fired electric generation plants.

Federal Energy-Efficient New Homes Tax Credit

As part of this research, the Propane Energy Pod homes were evaluated to determine if they qualified for the federal energy efficient new home tax credit for builders. To qualify for this $2,000 tax credit, a home must reduce heating and cooling energy consumption by 50% relative to the IECC. Importantly, building envelope component improvements must account for at least 20% of the reduction in energy consumption.

Because the prototype homes in this study were designed with thermal envelopes meeting (but not exceeding) the 2009 IECC, Propane Energy Pod homes did not have adequate envelopes to allow the home to qualify for this credit. However, adjusting wall R-values or air infiltration levels to be somewhat more efficient typically was enough to qualify a Propane Energy Pod home for this tax credit.

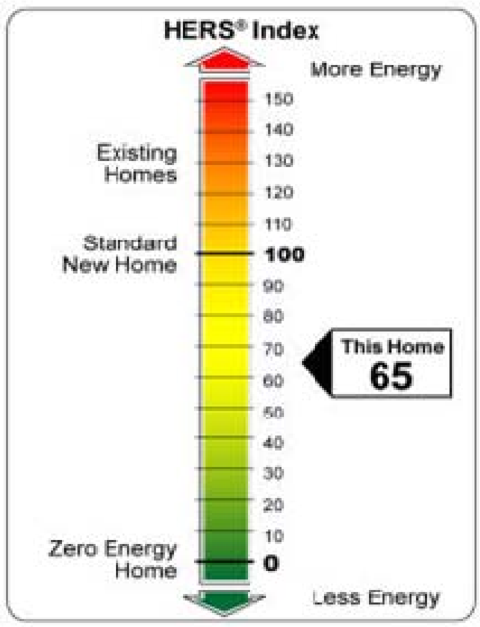
In general, a Propane Energy Pod can help a builder qualify a home for the federal Energy-Efficient New Homes Tax Credit, when combined with one or two strategic upgrades to the building envelope. More information on tax incentives for high performance building systems can be found at www.dsireusa.org.

Home Energy Ratings of Propane Energy Pod Homes

"HERS" stands for the Home Energy Rating System. This system of scoring and labeling home energy performance has been established over the last 15 years by the Residential Energy Services Network (RESNET). The product of a home energy rating using the HERS system is a "HERS Index," which is intended to be like car's MPG sticker – but for homes.

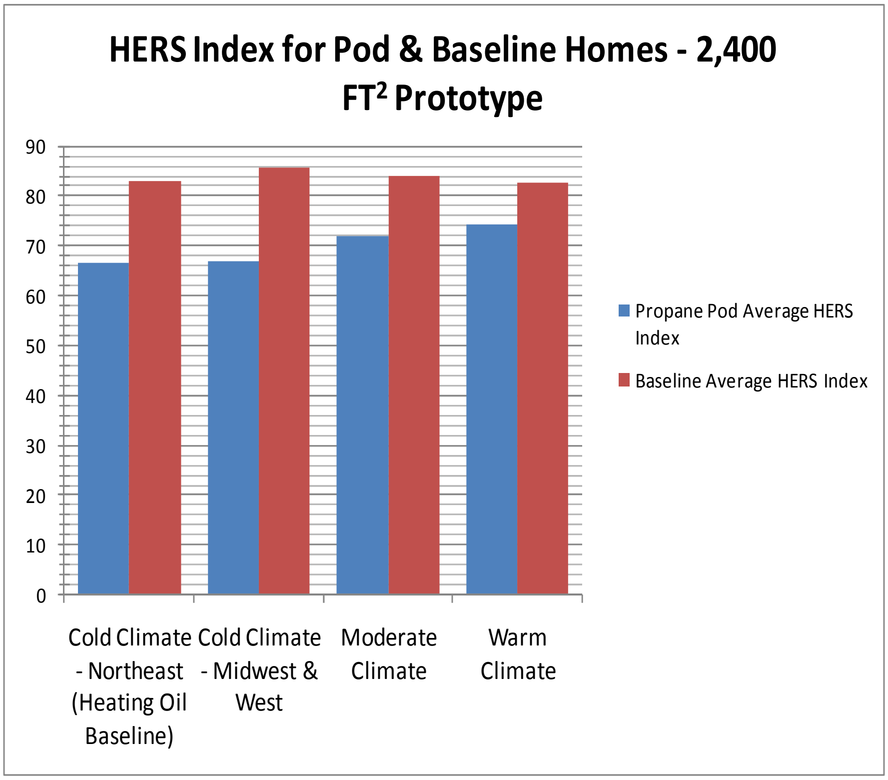
As Figure 12 illustrates, a "standard new home" on the HERS Index scale is anchored at 100. Each point below 100 represents a 1% reduction in energy use, relative to this reference home at 100 on the scale. A HERS Index value for a home reflects "whole house" energy usage, including the efficiency of the building envelope, HVAC systems, water heating, and appliances.

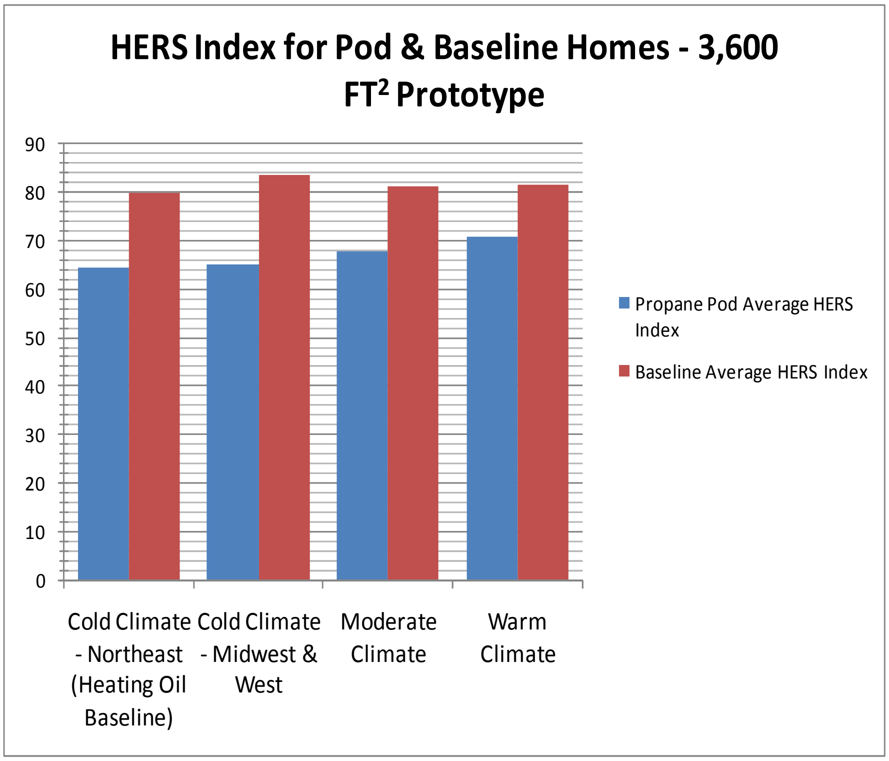
As part of the building energy simulations conducted in this research, the Pod and Baseline homes were evaluated in terms of the HERS Index they achieved in the modeling software. Results are shown in Figures 13 and 14 below.



Source: RESNET

Figure 12: Home Energy Rating System (HERS) Label for Rating Home Energy Performance





Figures 13 & 14: HERS Index Values for the 2,400 SF Prototype Home and the 3,600 SF Prototype Home, Respectively

As shown in Figure 13 above, the 2,400-square-foot Propane Energy Pod home in the Cold Climate Region (Midwest & West) showed the biggest difference between paired scores, with a HERS Index of 67, 19 points lower than the study's baseline home (HERS Index 86). The 3,600 SF Pod home in this same climate region was 18 points lower than the baseline home. This large gap between the Pod and Baseline homes' HERS Indices reflects the high efficiency of the 95 AFUE propane furnace in the Cold Climate Pod.

For the Custom Home Prototype (3600 SF) across all regions, the average HERS Index of 67 for the Pod home indicates that the homes are roughly 33% (100-67=33) more efficient than the "standard new home" on the HERS scale. This "standard" new home is a theoretical reference home of the same design as the modeled home, but built to the provisions of an earlier version of the IECC (2006). Thus, homes in the marketplace today built to the current energy code (typically the 2009 IECC) would likely score lower than 100. As evidence of this, the Baseline home across all regions was estimated to be about 17% more efficient (HERS 83) than the "standard new home" on the scale.

HERS Index as a Market Differentiation Tool for Builders

In the first half of 2011, several national and regional builders have committed to having their new homes rated and labeled with the HERS Index. Groups like RESNET and the Earth Advantage Institute are tracking this market trend, which is seen as a method for builders to clearly communicate the energy performance of their homes and differentiate them from competing new and existing homes. For more information visit RESNET at www.natresnet.org.

Conclusions

The key conclusion of this research is that packages or bundles of high performance propane-based building systems can be used as an integrated energy approach to new home construction, and that "Pods" of this type can outperform standard efficiency packages in terms of annual energy cost, CO_2 emissions, and HERS Index ratings. It should be noted that this analysis did not incorporate economic analysis to examine the return on investment or payback from the initial investment in high performance equipment.

The data presented in this report quantify the estimated performance benefits of Propane Energy Pod homes in a typical production home prototype and a custom home prototype, across different climate regions. The five core technologies within the Propane Energy Pod were varied slightly as a function of climate. It is the intent of this research to offer builders a model for addressing the energy systems in new home construction, along with a sense of the performance benefits which can result from a Propane Energy Pod.

Appendix A – Pod and Baseline Specifications

Cold Climate Pod & Baseline Specifications

Application	Propane Pod	Product/System Specs	Baseline Home	Product/System Specs
Space heating	High efficiency forced-air furnace	Energy Star qualified and federal tax credit-eligible 95 AFUE unit; direct vented (sidewall)	Federal minimum ASHP or federal minimum heating oil furnace	ASHP: 13 SEER; HSPF 7.7 Heating Oil Furnace: 78 AFUE *(Northeast Locations only)*
Water heating	High efficiency tankless water heater (condensing)	Energy Star qualified and federal tax credit-eligible with an Energy Factor = 0.94; 4 GPM with a 75 F temp rise	Electric standard efficiency storage tank	Energy Factor = 0.90 (federal minimum for this product) with First Hour Rating ≥ 67 gallons/hour; 50 gallons
Cooking	Standard efficiency cooktop and oven	Propane unit with electronic ignition; 1.57 MMBtu/yr and 55 kWh/yr propane and electric consumption, based on DOE TSD for rulemaking	Electric standard efficiency cooktop and oven	Electric cooktop and oven; 299 kWh/yr electric consumption, based on DOE TSD for rulemaking
Clothes dryer	Standard efficiency clothes dryer	3.14 CEF for gas (2.53 MMBtu/year and 42 kWh/yr), based on DOE TSD for rulemaking	Electric standard efficiency clothes dryer	3.55 CEF; 718 kWh/yr electricity consumption, based on DOE TSD for rulemaking
Fireplace	High efficiency, direct vent, zero clearance unit	Fireplace Efficiency (FE) of 64% (minimum efficiency of top 25% of zero clearance unit efficiencies listed in Natural Resources Canada's fireplace database)	Electric fireplace with efficiency of 100%	Electric: EF=100%

Moderate Climate Pod & Baseline Specifications

Application	Propane Pod	Product/System Specs	Baseline Home	Product/System Specs
Space heating	Dual Fuel: High Efficiency ASHP w/ High Efficiency Propane Furnace Back-up	15 SEER; HSPF 8.5; 95 AFUE (both systems meet Energy Star qualified level and the federal tax credit threshold)	Federal minimum ASHP	ASHP: 13 SEER; HSPF 7.7
Water heating	High efficiency tankless water heater (non-condensing)	Energy Star qualified and federal tax credit-eligible with an Energy Factor = 0.82; 4 GPM with a 75 F temp rise	Electric standard efficiency storage tank	Energy Factor = 0.90 (federal minimum for this product) with First Hour Rating ≥ 67 gallons/hour; 50 gallons
Cooking	Standard efficiency cooktop and oven	Propane unit with electronic ignition; 1.57 MMBtu/yr and 55 kWh/yr propane and electric consumption, based on DOE TSD for rulemaking	Electric standard efficiency cooktop and oven	Electric cooktop and oven; 299 kWh/yr electric consumption, based on DOE TSD for rulemaking
Clothes dryer	Standard efficiency clothes dryer	3.14 CEF for gas (2.53 MMBtu/year and 42 kWh/yr), based on DOE TSD for rulemaking	Electric standard efficiency clothes dryer	3.55 CEF; 718 kWh/yr electricity consumption, based on DOE TSD for rulemaking
Fireplace	High efficiency, direct vent, zero clearance unit	Fireplace Efficiency (FE) of 64% (minimum efficiency of top 25% of zero clearance unit efficiencies listed in Natural Resources Canada's fireplace database)	Electric fireplace with efficiency of 100%	Electric: EF=100%

Warm Climate Pod & Baseline Specifications

Application	Propane Pod	Product/System Specs	Baseline Home	Product/System Specs
Space heating	Dual Fuel: High Efficiency ASHP w/ High Efficiency Propane Furnace Back-up	15 SEER; HSPF 8.5; 95 AFUE (both systems meet Energy Star qualified level and the federal tax credit threshold)	Federal minimum ASHP	ASHP: 13 SEER; HSPF 7.7
Water heating	High efficiency tankless water heater (non-condensing)	Energy Star qualified and Federal tax credit-eligible with an Energy Factor = 0.82; 4 GPM with a 75 F temp rise	Electric standard efficiency storage tank	Energy Factor = 0.90 (federal minimum for this product) with First Hour Rating ≥ 67 gallons/hour; 50 gallons
Cooking	Standard efficiency cooktop and oven	Propane unit with electronic ignition; 1.57 MMBtu/yr and 55 kWh/yr propane and electric consumption, based on DOE TSD for rulemaking	Electric standard efficiency cooktop and oven	Electric cooktop and oven; 299 kWh/yr electric consumption, based on DOE TSD for rulemaking
Clothes dryer	Standard efficiency clothes dryer	3.14 CEF for gas (2.53 MMBtu/year and 42 kWh/yr), based on DOE TSD for rulemaking	Electric standard efficiency clothes dryer	3.55 CEF; 718 kWh/yr electricity consumption, based on DOE TSD for rulemaking
Fireplace	High efficiency, direct vent, zero clearance unit	Fireplace Efficiency (FE) of 64% (minimum efficiency of top 25% of zero clearance unit efficiencies listed in Natural Resources Canada's fireplace database)	Electric fireplace with efficiency of 100%	Electric: EF=100%