THE POTENTIAL IMPACT OF ZERO ENERGY HOMES

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About the NAHB Research Center...
The NAHB Research Center, Inc. is a subsidiary of the National Association of Home Builders (NAHB). The NAHB has over 225,000 members who build more than 80 percent of new American homes. The NAHB Research Center conducts research, analysis, and demonstration programs in all areas related to home building and carries out extensive programs of information dissemination and interchange among members of the industry and between the industry and the public.

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1.0 Executive Summary

This study presents a far-reaching outlook into the possibilities for Zero Energy Home (ZEH) technologies in the new home market and their potential impact on U.S. energy consumption through 2050. Zero Energy Homes, which are connected to the utility grid, combine highly energy- efficient design and technology with solar electric and thermal systems to produce as much energy as they use on an annual basis.

This study examines three scenarios for the adoption of ZEH into the single-family home market and the effect of each scenario on residential energy consumption through 2050. A reference case, where household energy use remains relatively constant from today's usage levels, serves as a basis for comparison.[1]

Zero Energy Homes are technically feasible today. If cost trends continue and research milestones are accomplished in solar energy and efficiency technologies, ZEH will eventually become economically competitive with conventional construction when utility costs are included in the cost of homeownership. Market penetration of highly efficient homes with solar energy systems has already begun, and will continue in selected markets. Solar electric (photovoltaic) system costs have continued to decline while production continues to increase by nearly 30 percent annually. New, low-cost solar water heating designs are under development that will reduce costs and improve efficiency. At the same time, a portfolio of energy-efficiency improvements in appliances, building envelopes, windows, and mechanical systems is moving into the market. EPA ENERGY STAR™ home sales have experienced enormous growth, going from zero in 1995 to 130,000 in 2004, with up to 40 percent penetration into some markets.[1] Combined, all of these elements suggest a potential to build practical ZEH with a significant market potential. But critical questions remain, including the following key questions investigated in this study:

- Will homebuyers value the features and benefits of ZEH?
- How much are homebuyers willing to pay for ZEH?
- What level of impact would further investment into research and development and public policies have on hastening the adoption of ZEH and the resultant energy savings by 2050?

To answer these questions, the study aimed to:

- Evaluate homeowner attitudes and opinions about the features and benefits of ZEH and their willingness to pay more for a home that has increased comfort and environmental performance and fixed monthly costs (accounting for a higher mortgage to pay for ZEH features, but no utility bill)
- Determine at what year ZEH becomes cost effective under various economic scenarios
- Using technology diffusion curves, determine the projected rate of market adoption of ZEH and the final impact on energy consumption of the single-family housing stock to 2050

[1] The reference case is a direct extension of the Energy Information Administration's reference case outlined in the *2004 Annual Energy Outlook with Projections to 2025.*

To achieve these goals, a combination of techniques was employed including: focus group and Internet-based market research; computer optimization techniques to calculate the optimal combination of today's state-of-the-art energy-efficiency and solar technologies to achieve ZEH; and calculations to project market diffusion of ZEH using market adoption curves and solar technology cost projections.

Key Findings

- Market penetration of ZEH has the potential to reverse the upward trend in new home energy consumption and begins to decrease the energy consumption of the entire U.S. housing stock even as the cumulative number of homes continues to increase.
- Near-term action has a major influence on the ultimate impact of ZEH on energy consumption of the residential sector. Immediate action can speed the market penetration of ZEH technologies by at least a decade. Although the relatively slow replacement of housing stock and historically slow diffusion of new technology in the building industry means decades before ZEH reaches full market potential, aggressive near-term action leads to much earlier market acceleration and energy impact as ZEH builds to its full market potential.
- Technology is ready for early market penetration of ZEH; however it is currently not economically justifiable to construct ZEH without financial incentives.
- In order for ZEH to succeed in the marketplace, a coordinated effort is needed to conduct research and development (R&D) to reduce the cost of ZEH and to facilitate transformation of the new homes market. Activities would likely include outreach to consumers, builders, real estate agents, appraisers, and utilities; technical training; policy development; and R&D on the integration of ZEH technologies into the new home building process.

Overview of Results

The study demonstrates that R&D that supports Zero Energy Homes in conjunction with state and federal tax incentives can accelerate and significantly improve the energy performance of the residential sector in the United States. By 2050, ZEH with a tax incentive for solar technologies can reduce the energy consumption of all single-family homes by 19 percent while, over the same time, the stock of single-family homes increases by 39 percent.

With continued federal R&D programs to lower the cost of solar electric, solar thermal, and advanced building energy-efficiency technologies while providing tax credits to homeowners for renewable energy systems, the ZEH concept will begin to diffuse into the market as early as 2012 and result in annual energy savings in 2050 of approximately three Quads[2] or 17 percent of the U.S. energy consumption in single-family homes. In contrast, without tax incentives or the advantages of ZEH bundling (defined as a portfolio of energy-efficiency and solar technologies necessary to make ZEH), but with continued federally-supported R&D to reduce solar costs and develop advanced energy-efficient technologies, residential solar electric systems do not begin to diffuse into the marketplace until 2027 at the earliest and only realize a reduction of 0.4 Quads (2 percent) in the energy use of single-family homes by 2050. Table 1 summarizes the results for the three scenarios analyzed in this study, compared with a reference case, in terms of cumulative number of ZEH constructed, annual energy savings, and annual carbon emission reductions in 10-year increments from 2010 to 2050. (The scenarios listed in Table 1 are described in Section 3.5.1 Scenarios for Market Penetration.)

[2] One Quad represents 1,000,000,000,000,000 Btu.

Table 1. Summary of Study Results of the Impact of ZEH to 2050

	2010	2020	2030	2040	2050
Cumulative ZEH Installations					
Reference Case with PV	0	0	9,557	608,695	2,816,213
ZEH Integration	0	9,831	806,207	4,959,123	13,178,922
ZEH + 30% Tax Credit	0	167,339	2,673,119	9,793,654	19,584,250
Annual Energy Savings, Quadrillion BTUs					
Reference Case with PV	0.0	0.00	0.002	0.09	0.43
ZEH Integration	0.0	0.001	0.12	0.75	2.00
ZEH + 30% Tax Credit	0.0	0.03	0.41	1.49	2.98
Annual Carbon Displacement, Million Metric Tons					
Reference Case with PV	0.0	0.0	0.05	3.26	15.07
ZEH Integration	0.0	0.05	4.31	26.54	70.52
ZEH + 30% Tax Credit	0.0	0.90	14.30	52.41	104.80

The results illustrate how the potential market for ZEH could be accelerated with government investment in a robust ZEH R&D effort and consumer tax incentives. Market penetration of ZEH has benefits to consumers, homebuilders, electric utilities, and the environment. Consumers benefit from more stable, predictable home energy costs in the near-term and savings on combined mortgage and utility bills in the longer term (as utility bills rise for non-ZEH). Builders benefit from having a new product to offer consumers that enhances profit due to a higher sales price (but that does not affect affordability to the consumer). Electric utilities benefit from reductions in peak electric demand that help avoid expensive investments in new peak generating capacity. Lastly, society benefits from reduced air emissions and distributed generation that reduces the vulnerability of our energy infrastructure.

2.0 Background

2.1 Zero Energy Home Definition

The U.S. Department of Energy (DOE) Building Technologies Program defines a net zero energy building as “a residential or commercial building with greatly reduced needs for energy through efficiency gains, with the balance of energy needs supplied by renewable technologies.” A Zero Energy Home combines state-of-the-art, highly energy-efficient designs and equipment with on-site renewable energy generation (which typically includes a solar hot water production system and a rooftop photovoltaic, or PV, system) to return as much energy to the utility as it takes on an annual basis. Zero Energy Homes are designed to perform well, be comfortable, require only standard maintenance, and look no different from an ordinary home.

2.2 Typical Features of a Zero Energy Home

2.2.1 Efficiency Features

A typical ZEH is designed to be responsive to the climate and usually features: high levels of insulation and air sealing; windows with energy properties selected for the climate; careful design and installation of HVAC and plumbing systems to

minimize energy loss; ducts in conditioned space; high efficiency HVAC equipment sized according to industry standards; and high efficiency lights and appliances.

A ZEH can use conventional construction methods such as wood framing or innovative systems such as structural insulated panels. Similarly, a ZEH can use advanced energy technologies—such as windows that become tinted in the presence of sunlight, phase change materials for energy storage, and ventilation strategies that minimize the need for compressor cooling—or they can employ off-the-shelf technologies common in many conventional homes.

2.2.2 On-site Electrical Energy Production

The components of a photovoltaic system which produces electricity from solar energy in a Zero Energy Home are depicted in Figure 1. The Direct Current (DC) electrical output from a PV system is converted to Alternating Current (AC) power by an inverter. The AC power can be used in the home or fed back into the power grid. In the simplest system, power sent into the utility grid causes the home's electric meter to operate in reverse. In a ZEH, the power taken from the utility is designed to be equal to the power sent back by the PV system annually.

This study does not evaluate self-sufficient photovoltaic systems that include a battery back-up power supply and are independent from the utility grid. However, optional upgrades to Zero Energy Homes are possible that would allow independence from the utility grid in the event of a power outage.

2.2.3 On-site Thermal Energy Production

Solar energy can also be harnessed for space and water heating. The most common system is a solar domestic water heater. Components of a typical solar water heating system include a rooftop solar collector, depicted in Figure 2, and a hot water storage tank.

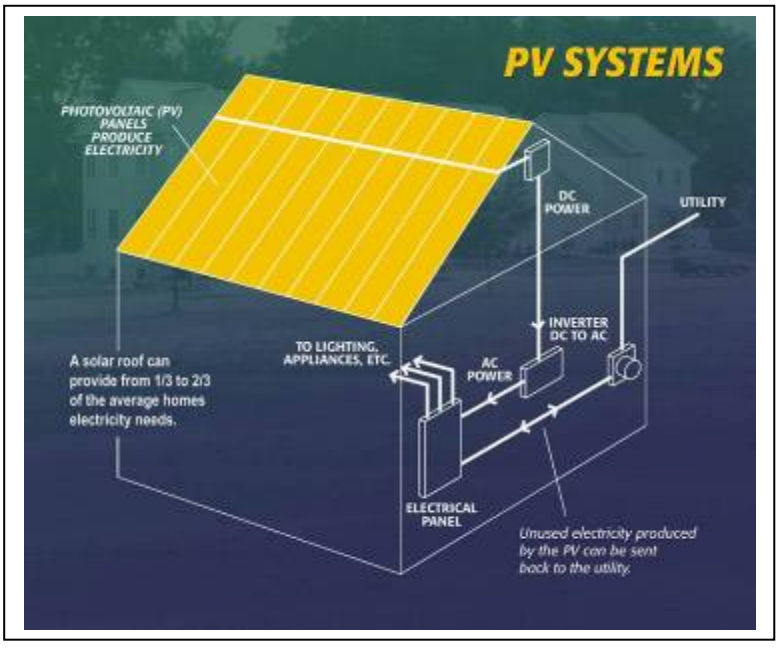

Figure 1. Components of a Grid-Connected Photovoltaic System

Photo courtesy NREL.

Figure 2. Roof-Mounted Solar Water Heaters

Water that runs through the roof-mounted solar collector is heated by the sun and stored in a hot water storage tank. Back-up electric or gas water heating is usually provided for periods when hot water demand exceeds system output, such as during long periods of cloudy weather.

2.3 National Benefits of Zero Energy Homes

Zero Energy Homes could be an important element for reducing residential energy consumption and improving the environment because:

- They can reverse the trend (see Figure 3) that, despite advances in energy-efficiency in the components of a house (e.g., windows, insulation, equipment, appliances, and lighting), per-household energy use is steadily increasing for new homes.
- They contribute progress toward the goals outlined in the National Energy Policy Act of 2002. The six goals that the National Energy Policy established to ensure America's continued growth and prosperity include: [2]

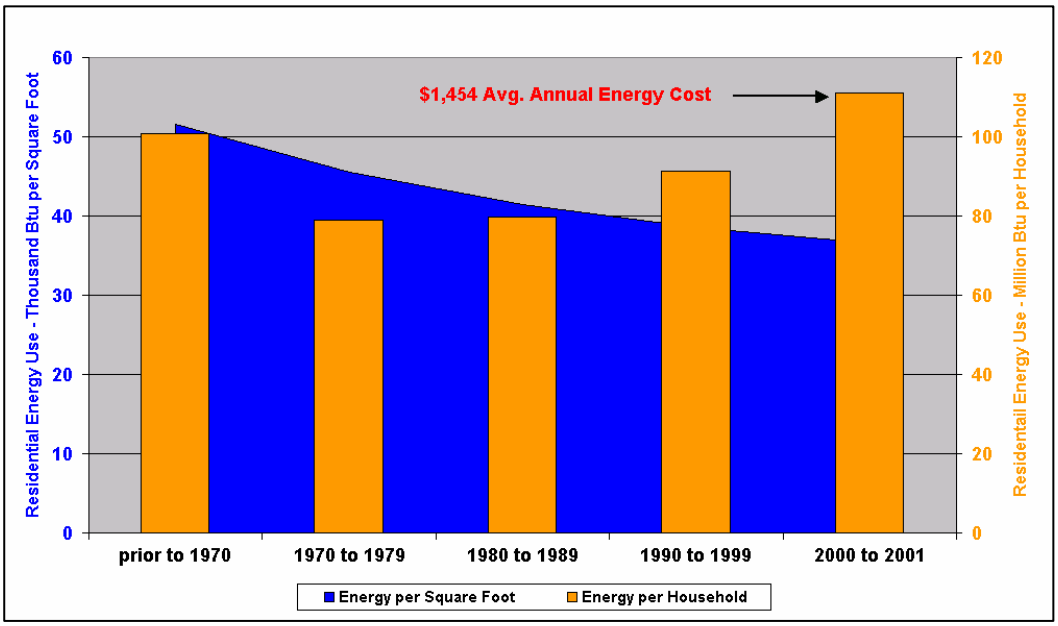

Figure 3. Residential Energy Use by Year of Construction

- To aggressively reduce energy demand by employing energy-efficient technologies and encouraging sound conservation measures
- To increase energy supply, with special emphasis on domestic supply
- To assure energy security by maintaining a diversity of fuel sources
- To dramatically upgrade our national energy infrastructure
- To accomplish energy goals while building on the successful record of environmental protection
- To provide a vision of the future beyond 20 years in which solutions transcend current thinking

2.4 Benefits of ZEH to Homebuyers

Homebuyers benefit from ZEH in that monthly housing costs—mortgage plus utilities—are predictable and stable. Homeowners also benefit from the performance of a ZEH including high levels of comfort, reliability, and indoor air quality.

2.5 Benefits of ZEH to Home Builders

Home builders can benefit from constructing ZEH because companies can:

- Offer a product that helps differentiate them from other companies.
- Increase profits by selling homes at a higher price (while offering the homebuyer a comparable monthly payment when factoring mortgage plus utility cost).
- Develop partnerships with organizations that have expertise in energy-efficiency and renewable energy.
- Receive media coverage from their participation, resulting in greater exposure to the homebuying public.
- Enhance their reputation among homebuyers as innovators.
- Appeal to a niche market of early adopters who prefer the attributes of a ZEH and are willing to pay more for it today.
- Position themselves to incorporate solar technologies in the construction process as the costs and performance of solar technologies are improved by research, market development, and state and local incentives.

2.6 Current Experience with Solar Energy and Energy Efficiency in New Homes

Figures 4 through 7 demonstrate that energy-efficient homes of today usually look no different from conventional homes, including typical rooftop solar systems. New solar energy systems are usually mounted flush with the roofline and, in the best case, are integrated into the roofing membrane and barely perceptible, such as in Figure 6. Home builders and homeowners have come to realize that, with newer systems' higher efficiency, along with the importance of aesthetics in the marketplace, systems should be integrated into the house as much as possible.

Although the homes shown are not ZEH, they are examples of what builders are doing today to investigate the technical and market potential of key components in a ZEH – solar power generation, solar water heating, high efficiency appliances, efficient building envelopes, windows, and HVAC systems – all of which are necessary for future Zero Energy Homes.

Figure 4. NAHB Research Center 21st Century Townhouses Roof on right has an integrated PV system.

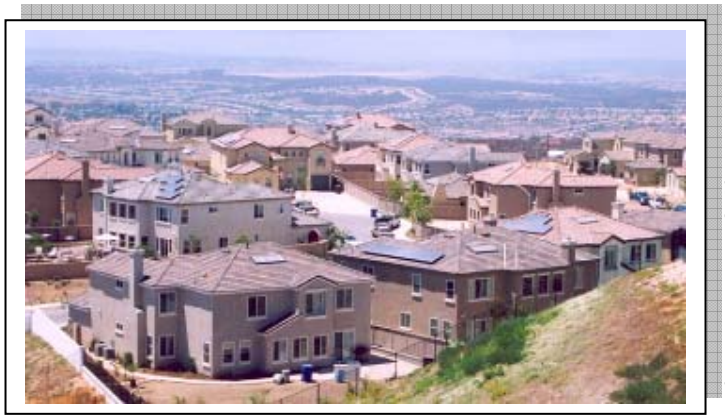

Photo courtesy of Shea Homes

Figure 5. Subdivision near San Diego Combining High Levels of Energy Efficiency with On-site Renewable Energy Production

Photo courtesy of Premier Homes

Figure 6. Roof Integrated photovoltaic System in California Subdivision

Photo courtesy of NREL.

Figure 7. Trellis Mounted PV System

2.7 Current Research and Development towards Zero Energy Homes

Zero Energy Homes are possible with today's technology. However, it is expensive and often difficult to design and build homes that integrate high efficiency materials and equipment with on-site renewable energy systems. Two programs of the U.S. Department of Energy (DOE) – Building Technologies and Solar Energy Technologies – are working towards improving efficiency and reducing the cost of integrating energy-efficiency and renewable energy technologies in new homes. The research examines improving and developing technologies for the thermal performance of buildings, HVAC and energy distribution systems, lighting, appliances, and solar technologies.

Under Building America (part of the Building Technologies Program), home building teams use a systems engineering approach to reduce the energy consumption of new homes without impacting the cost of homeownership. Appendix A lists Building America research homes that combine state-of-the-art energy-efficiency with grid-connected renewable power to make progress towards ZEH. To date, over 500 Building America homes integrating high efficiency and renewable energy have been completed and over 2,000 are planned or in progress.

Under the Solar Energy Technologies Program, the cost of PV and solar water heating systems are being reduced through research and systems testing. In addition, the Building Technologies Program is conducting research that integrates PV and solar thermal systems into conventional building products, e.g., roofing materials.

3.0 Study Methodology

Through a multidisciplinary approach, the researchers evaluated consumer attitudes about the Zero Energy Home concept, investigated consumer's willingness to pay for ZEH features, simulated when ZEH would become cost effective under various scenarios, and projected the diffusion of ZEH into the marketplace to 2050. The following sections describe each portion of the study in more detail.

3.1 Focus Groups

To gain perspective on consumer attitudes about the ZEH concept and to refine questions for the national Internet questionnaire, a focus group was conducted. The focus group gathered qualitative information on issues important to homebuyers and their perspective on the value of features and benefits inherent in Zero Energy Homes. The results of the focus group, found in Section 4.1, were used to help structure the questions for the Internet-based questionnaire.

3.2 Internet-Based Questionnaire

An Internet-based questionnaire was conducted to gather quantitative data (see section 4.2) about homebuyers' willingness to pay for the features and benefits inherent in Zero Energy Homes. Included in the ZEH description was the concept of annual net-zero energy, that a ZEH has little or no utility bills for the life of the home, and that ZEH is more comfortable, has better indoor air quality, is better for the environment, and may have a higher resale value than a conventional home. Results of the questionnaire can be found in Appendix B.

3.3 Optimization to Determine Cost Effectiveness of Zero Energy Homes

Energy use optimizations[3] were run for a typical U.S. house in representative cities from the four census regions to determine the year in which ZEH construction becomes cost effective for new homebuyers in each region. It was assumed that homebuyers do not adopt the portfolio of ZEH technologies until the additional cost of the ZEH is completely offset by energy savings. Four representative cities were chosen to represent each region in the analysis.

To calculate cost effectiveness in each region, inputs to the model included regional energy costs, fuel usage, cost of efficiency options including solar hot water systems, and projected cost of residential photovoltaic systems ($/kilowatt-AC) through the year 2050, as shown in Figure 8.[3] Other key assumptions include a PV system life of 30 years, 30-year mortgage term at 7 percent interest, a 5 percent discount rate, and natural gas cost of $1/therm, and a marginal income tax rate of 28 percent. The cost of electricity was $0.084/kWh for the Western region; $0.077/kWh for the South; $0.075/kWh for the Midwest; and $0.102/kWh for the Northeast. [4]

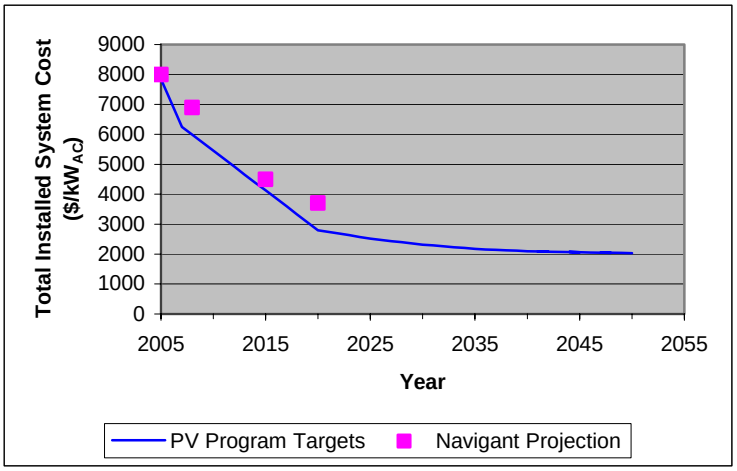

Figure 8. PV Cost Assumptions for Optimization Analysis

Using the optimization software, researchers examined thousands of combinations of energy-efficiency measures, solar water heating, and on-site PV power generation for a typical home in each of four cities representing the four U.S. census regions. The program finds the combination of efficiency features that maximizes energy-efficiency to a point where the marginal cost of improving efficiency is greater than the marginal cost of adding PV capacity. At that point, the program calculates the amount of PV needed to supply the rest of the home's power.

Knowing the optimal efficiency package and the PV capacity required to achieve ZEH, the required cost of the PV system is then iteratively solved. Using the PV cost targets from Figure 8, the year in which PV systems reach the required cost is the year in which market penetration begins. The effect of PV tax credits on the year of market penetration was also examined, since tax credits lower the effective cost of solar technologies and penetration can begin sooner.

[3] BEopt computer simulation software, developed by the National Renewable Energy Laboratory, was used in this analysis. For more information about BEOpt, see *Christensen, et al. (2004)*

Finally, market penetration continues until the early adopter market is saturated and the mainstream adopters begin to adopt the technology, up to the point of full market saturation. Once saturation is reached, the rate of diffusion will again level off.

3.3.1 Crediting Natural Gas Consumption with On-site Electricity Production

Since Zero Energy Homes can realistically return only electricity to the utility grid but might use both electricity and fossil fuels, it was necessary to create a consistent accounting system for crediting the production of on-site electricity against consumption of other fuels (in this case, natural gas). For this purpose, 1 Btu of on-site electricity is set equal to 3 Btu of natural gas at a central electrical power generation facility (also called source energy).[4] This accounting system is the basis for energy savings discussed later in this report. Further discussion on the topic can be found in Section 6.0 Barriers to Adoption of ZEH Technology.

3.4 Market Adoption of Zero Energy Homes

Starting with the date at which ZEH becomes cost effective for each of the four locations (determined by the optimization analysis), a diffusion curve was applied to determine the rate of market adoption of ZEH.

Diffusion curves for ZEH in each region were based on the Bass Model for diffusion of innovation—a standard market research model for estimating the rate of adoption of new technologies.[5] The model, which is presented conceptually in Figure 9, produces a classic S-shape curve that reflects a slow initial rate of adoption by early adopters; a curve that continues to get steeper as the technology becomes more widely accepted; and a subsequent flattening as the technology matures and approaches market saturation.

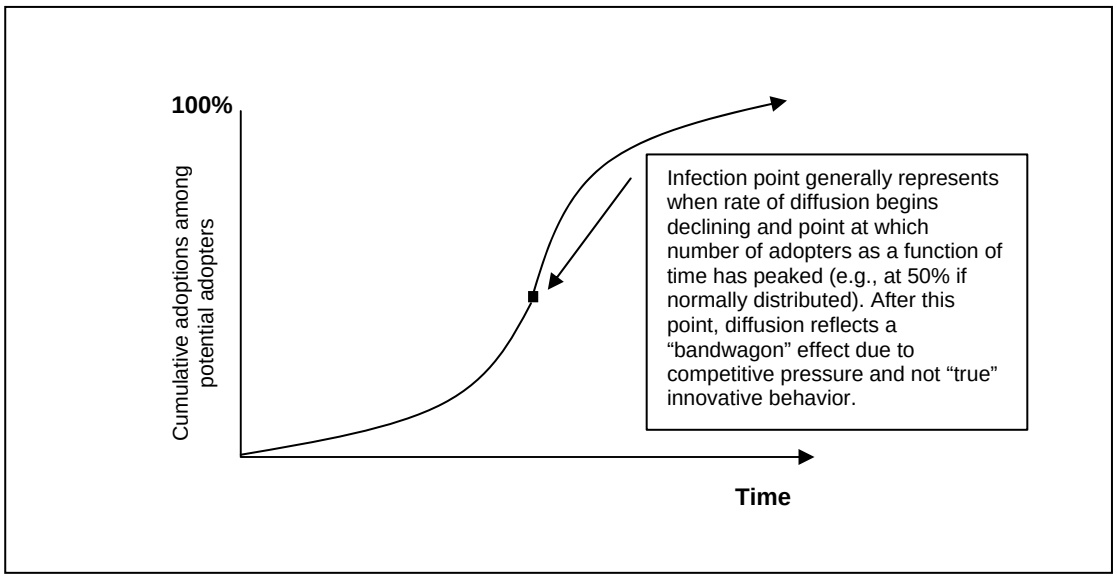

Figure 9. Conceptual Rendering of the Bass Model for Diffusion of Innovation

[4] The conversion accounts for the efficiency losses in the generation, transmission, and distribution of electricity. See, for example, U.S. DOE Energy Information Administration, *Commercial Buildings Expenditure and Consumption Survey,* 1995.
[5] See, for example, "Bass Model Overview" at http://www.frankmbass.org

It is important to note that this study only addresses the market adoption of homes that have all their energy needs provided by solar electric and solar thermal systems – i.e., Zero Energy Homes. The study does not address homes that only have a portion of their energy needs met by solar systems – even if that portion approaches 99 percent. It is reasonable to assume that as the U.S. residential construction market adopts Zero Energy Homes, more homes will be built with energy-efficient and solar technologies. However, any energy savings or carbon displacement attributed to these advanced, but non-zero energy, homes are not included in the analysis and results of this study.

3.5 Extrapolation of Market Adoption of Zero Energy Homes to Energy Savings in Single-Family Home Stock

The overall impact of Zero Energy Homes on the energy consumption of single-family homes was extrapolated from estimated energy savings for each ZEH and the number of ZEH in each region.

The energy saved by a ZEH was calculated by comparing its energy use to the Building America benchmark home – a typical home built in the mid-1990s. Energy consumption for each region is presented in Table 2. Numbers represent source energy for all uses within a house (space heating and cooling, water heating, lights, appliances, and plug loads).

Table 2. Per-Household Energy Use Assumptions for Four Census Regions (MBtu/year)[6]

Midwest	Northeast	South	West
180	175	160	195

Next, the number of Zero Energy Homes built each year and cumulatively was calculated using projections of single-family housing through 2050. Market penetration rates were then determined for each of the four regions under various scenarios. The overall energy savings attributed to the construction of ZEH was then calculated for each year by multiplying the number of Zero Energy Homes in each region by the energy savings per home. The resulting series of annual savings was combined into an estimate of cumulative annual energy savings accruing over time.

3.5.1 Scenarios for Market Penetration

Three scenarios for market penetration and one reference case were evaluated:

- Reference Case – Assumes that household energy consumption remains relatively flat as projected by the Energy Information Administration (EIA) through 2025.[7] The EIA reference case forecasts no significant market penetration of PV systems in single-family homes and also projects that any gains in household energy-efficiency due to advanced technology are offset by increased energy uses in the average house. Extension of the EIA residential

[6] Consumption numbers are based on the *Building America Research Benchmark*. More information about the Building America Research Benchmark can be found at http://www.eere.energy.gov/buildings/building_america/pdfs/37529.pdf

[7] The Reference Case is a direct extension of the Energy Information Administration's reference case outlined in the *2004 Annual Energy Outlook with Projections to 2025,* which shows very little change in overall energy performance from today's housing stock.

energy consumption forecast for the years 2026 to 2050 was done according to the methodology described in Wood and Margolis [5].

- Reference Case with PV – Same assumptions as the reference case, but as future PV costs decrease, this scenario assumes PV systems are included in new homes based on a break-even cashflow analysis that compares the increased monthly mortgage cost versus the decreased monthly utility bills. This scenario assumes that costs for PV systems will fall according to the DOE *Solar Energy Technologies Program Multi-Year Technical Plan, 2003 to 2007 and Beyond* [6] as depicted in Figure 8. Like the reference case, this scenario also assumes that energy-efficiency technologies and solar water heating are incorporated into new homes according to the nested fuel/technology choice methodology used in the EIA forecast.[8] Therefore, this scenario encompasses the installation of PV systems on EIA reference case homes in order to bring these homes to zero net energy consumption. To account for shading, lot orientation, and other factors that are likely to make solar impractical on some sites, this scenario (as well as the subsequent two scenarios) assumes that the PV home market becomes saturated if and when it reaches 70 percent of new home starts. However, this saturation level probably cannot ever be practically reached under the Reference Case with PV scenario, since there is generally not enough south-facing roof space available on most conventional (standard efficiency) homes to generate all the energy that the typical new home requires.
- Zero Energy Home (ZEH) Integration – This scenario accounts for the beneficial interaction of bundling energy efficiency, solar water heating, and PV technologies together when new homes are constructed. All these energy technologies are now included in new homes based on a break-even mortgage cost/utility bill cashflow analysis. All cost assumptions are the same as in the Reference Case with PV scenario, but this scenario differs from the Reference Case with PV scenario in that energy efficiency and solar water heating are now actively employed (based on monthly cash flow) to reduce the energy load of the new home before PV generation is applied. Therefore, the PV system size is considerably smaller than the PV system in the Reference Case with PV scenario and is typically able to fit on the available south-facing roof space of the Zero Energy Home. Duration from market introduction to full market saturation is set at 30 years.
- ZEH Integration + 30% Tax Credit – Combines the ZEH Integration scenario with a solar tax credit of 30 percent. This credit could be a combination of state and federal tax credits, with varying maximum amounts for each. For example, the *Energy Policy Act of 2005* provides for a 30 percent tax credit for the purchase of solar water heating or PV equipment with the maximum credit for each of these systems set at $2,000. In addition, the *Energy Policy Act of 2005* also provides a $2,000 tax credit for new homes that reduce energy consumption by 50 percent. Other assumptions in this scenario are the same as in the ZEH Integration scenario.

[8] *"Annual Energy Outlook 2003 With Projections to 2025,"* Energy Information Administration Office of Integrated Analysis and Forecasting U.S. Department of Energy, Washington, DC 20585 (http://www.eia.doe.gov/oiaf/archive/aeo03/pdf/0383(2003).pdf), pp. 233-234

3.5.2 Housing Start Projections

The impact of ZEH implementation on new single-family home construction is based on how much of the market can be penetrated by ZEH under each scenario and how large the single-family home market will be in each region. Information on the analysis for estimating the size of the single-family housing market to 2050 can be found in Appendix C.[9]

A summary of the cumulative housing stock to 2050 is shown in Figure 10. Note how homes built after 2005 become an increasing portion of the housing stock with time, which is key to the impact of ZEH on the energy consumption of the entire U.S. single-family home stock.

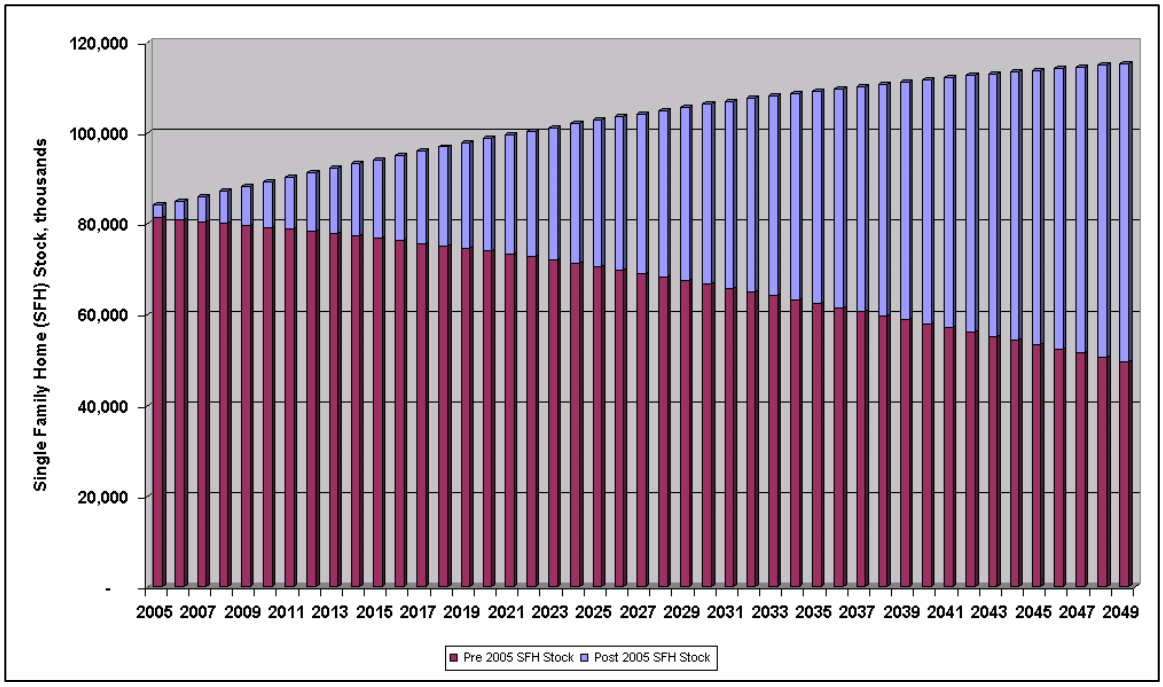

Figure 10. Total Housing Units Projected to 2050

4.0 Results

4.1 Focus Groups

The major findings of the focus groups were:

- Homeowners value comfort, energy-efficiency, indoor air quality, and resale value of the home.
- Homeowners believe the cost of selecting an environmentally responsible home will most likely be higher than any monetary return.
- Homeowners appear willing to pay for comfort, energy-efficiency, and environmental responsibility.

[9] Although ZEH retrofits are technically possible, they were not examined for this study because of their expense and, therefore, low probability of being a significant portion of the market. However, the ZEH retrofit market may be an important spin-off benefit of ZEH development and could be examined in a future study.

- Homeowners seem intrigued by the ZEH concept and are interested in possible financial incentives for ZEH.

4.2 Internet-Based Survey

The major findings of the Internet-based survey of homeowners were the following:

- Nearly 83 percent of respondents expressed willingness to buy a home in which savings in utility bills offset an increase in mortgage payments for energy technologies.
- Homeowners were interested in reducing the effect of energy price fluctuations—over 70 percent of respondents expressed willingness to pay a premium each month to eliminate utility price fluctuations.
- When asked about the importance of various factors in a home buyers' decision to purchase a home with ZEH features, the following percentage of buyers ranked as important or very important the following:
  - Warranty for solar energy system provided by local utility: 77%
  - Warranty for solar energy system provided by builder: 81.8%
  - Proven reliability: 81.6%
  - 5-year maintenance agreement provided: 83.4%
  - Predictability of future utility bills: 78.8%
  - Government tax incentive provided for home: 79.7%
- Once familiar with the ZEH concept, homeowners appear willing to pay extra for the comfort, energy-efficiency, and environmental performance of a ZEH. 42 percent of respondents expressed willingness to pay an additional $100 or more each month for the features and benefits of a ZEH. While the "willingness-to-pay" attribute is difficult to translate into actual consumer choices, the result highlights the high level of interest the respondents had in the concept of a home that could provide its own energy from renewable resources. The high level of interest, however, occurred only after the ZEH concept was described in detail, as might be part of a ZEH program effort. This group can be likened to the "early adopter" segment in the market diffusion model of those who, through a thoughtful analysis, come to adopt the new technology based on its merits. This group may be influenced by the Innovators who are more adventurous.[9] While the assignment of a purchase premium to the early adopter consumer is unclear at this juncture, the predilection value is unmistakable. If given a choice in housing including the ZEH option, a monthly equivalent cost approach will compete with the separate mortgage-utility option common today. Although a value of the ZEH concept was identified, this value was not incorporated in any of the ZEH diffusion scenarios.

4.3 Optimization to Determine Cost Effectiveness of Zero Energy Homes

A conceptual drawing of the optimization process is shown in Figure 11. From Point 1 (representing the Building America benchmark[10] home), energy use is reduced by adding efficiency options (e.g., improving wall R-value, furnace efficiency, etc.). A minimum annual cost occurs at Point 2 (assuming the minimum does not occur at Point 1). Additional efficiency options are then added until the marginal cost of increasing efficiency equals the cost of adding PV capacity (Point 3). Solar water heating is typically added between Point 2 and Point 3. From Point 3, PV capacity is added and energy savings are solely due to adding PV capacity, until ZEH is achieved at

[10] Building America benchmark is a home consistent with mid-1990s construction methods.

Point 4. The PV system cost that, when mortgaged, meets the constraint of no additional monthly cost is then calculated.

The year at which PV systems are projected to reach this calculated cost is the year that diffusion is expected to begin for each scenario.

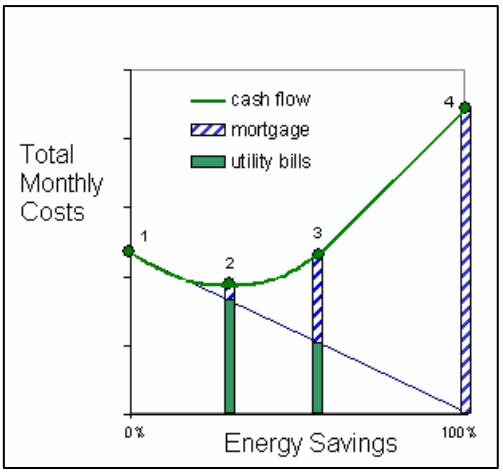

Figure 11. Conceptual Diagram of Optimization

4.4 Market Adoption

In general, the rate of market diffusion for ZEH should be similar to other building sector technologies and practices that range from 20 to 30 years to reach market maturity. The diffusion of ZEH is predicted to have a long initial growth period, which extends for a decade or more; then a period of rapidly accelerating growth, which extends for another decade before reaching a stable, mature market level.

The various market penetration scenarios (described in Section 3.5.1 Scenarios for Market Penetration) affect the timing of the onset of market diffusion, the market growth over time, and the final impact on the housing market.

The market saturation capacity was estimated at 70 percent and coefficients for the model were calculated using selected home building industry diffusion rates. Projections were compared to actual diffusion rates observed with the ENERGY STAR™ program and solar power programs in Japan and Germany [3] and found to be congruous.

Regional diffusion curves for two scenarios are shown in Figures 12 and 13. As mentioned previously, when the regional housing market is saturated, the diffusion curve becomes flat.

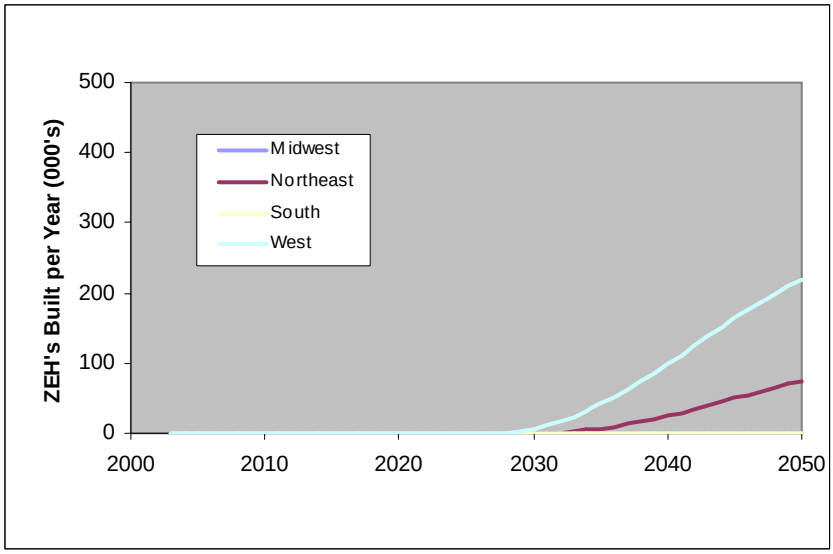

Figure 12. Diffusion of ZEH in Four Regions under Reference Case with PV Scenario

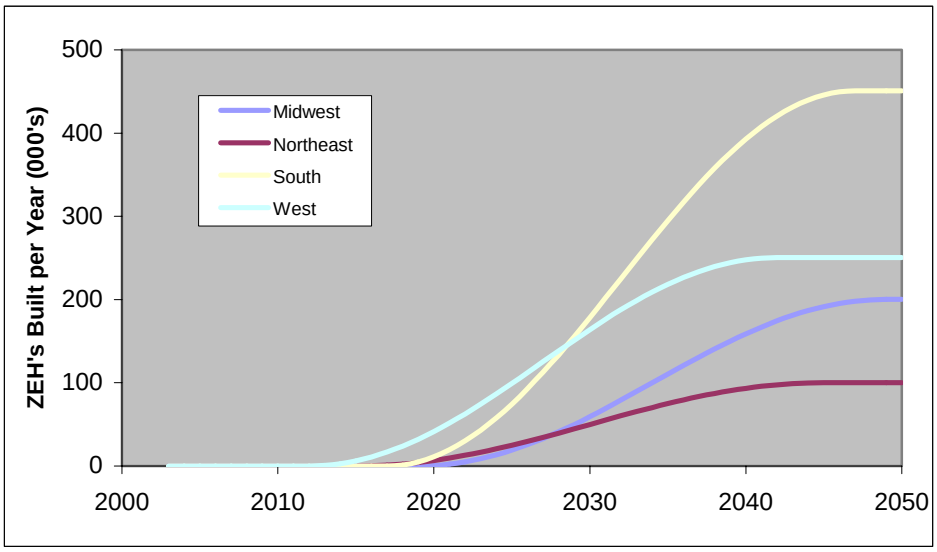

Figure 13. Diffusion in Four Regions under ZEH Integration + 30% Tax Credit Scenario

Table 3 presents the year in which ZEH begins to diffuse into the marketplace for each scenario and region. As this table shows, the ZEH Integration scenario has a profound effect on the acceleration of ZEH adoption by the marketplace: moving ZEH to the market 11 years earlier in the Northeast to more than 20 years in the Midwest over the Reference Case with PV scenario. Combining a 30% tax credit with ZEH moves adoption even earlier, from an acceleration of 15 years in the Northeast to more than 23 years in the South.

Table 3. Year of Inception of ZEH Market Diffusion under Four Scenarios

	Midwest	Northeast	South	West
Reference Case	>2050	>2050	>2050	>2050
Reference Case with PV	>2050	2030	>2050	2027
ZEH Integration	2030	2019	2023	2017
ZEH + 30% Tax Credit	2019	2015	2017	2012

Combining the regional data for diffusion of ZEH into a national curve results in national diffusion curves for each scenario depicted in Figure 14.

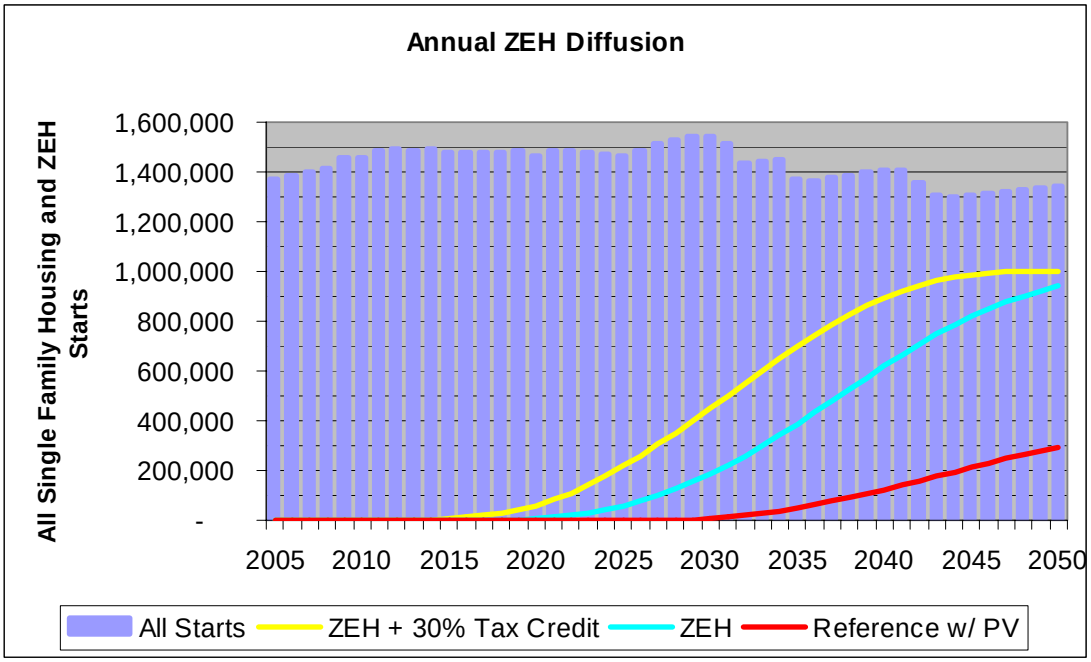

Figure 14. National Diffusion of ZEH into Single-Family Home Starts to 2050

The portion of new home starts which are ZEH in 2050 and the ZEH portion of the total U.S. housing stock in 2050 is presented in Table 4. Under the ZEH Integration + 30% Tax Credit scenario, there would be more than 19 Million ZEH by 2050.

Table 4. ZEH as Portion of Cumulative Housing Stock and Annual Single-Family Housing Starts in 2050

	Reference Case	Reference Case with PV	ZEH Integration	ZEH Integration + 30% Tax Credit
Portion of Cumulative Single-Family Housing **Stock**	--	2%	11%	17%
Portion of Annual Single-Family Housing **Starts** in 2050	--	20%	63%	67%

4.5 Extrapolation of Market Adoption of Zero Energy Homes to Total Single-Family Housing Energy Savings

How soon ZEH achieves its market potential has a major influence on the magnitude of its impact on residential sector energy use. The energy savings associated with ZEH

diffusion accumulates each year so that, by 2050, the annual energy consumption of single-family homes can be reduced by:

- *2 percent over the Reference Case scenario with the Reference Case with PV scenario*
- *11 percent over the Reference Case scenario by implementing the ZEH Integration scenario*
- *17 percent over the Reference Case scenario with the combined ZEH Integration + 30% Tax Credit scenarios.*

It is expected that many of the ZEH technologies will diffuse not only into the single-family home market, but also into existing and multifamily homes; therefore, this study may underestimate the impact of ZEH on the energy savings in the entire residential sector.

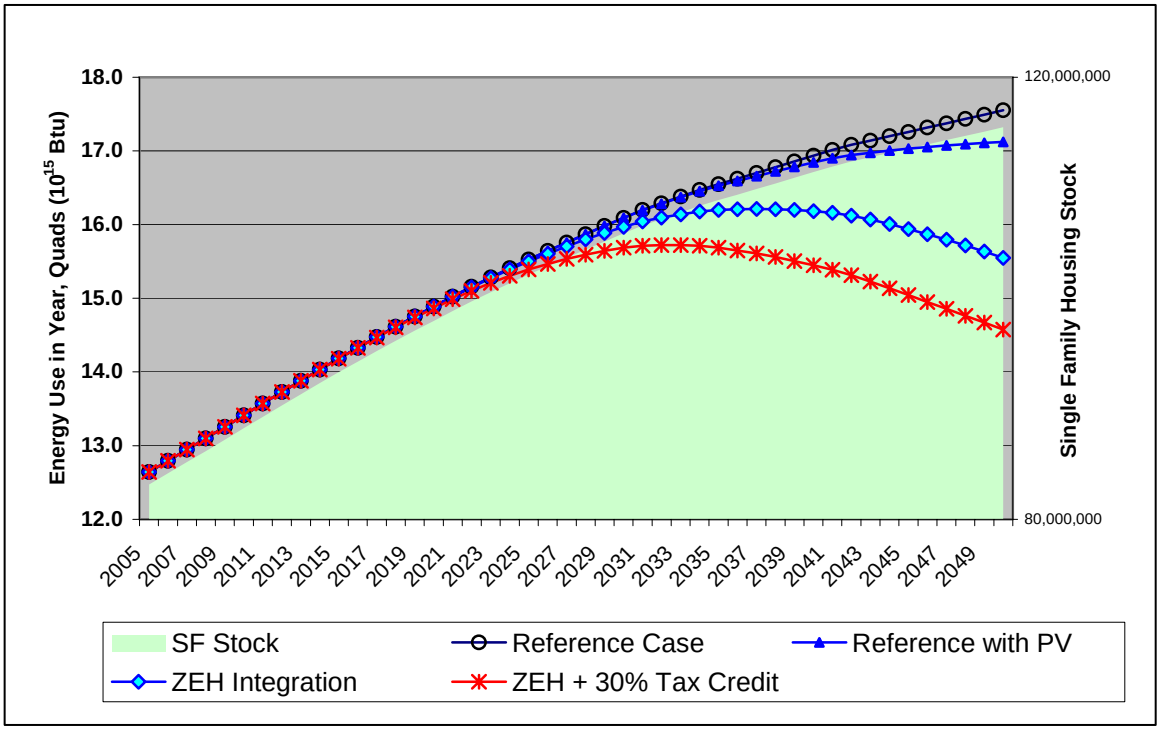

Figure 15. Effect of ZEH on Single-Family Home Energy Consumption under Various Diffusion Scenarios[11]

4.6 Extrapolation of Market Adoption of Zero Energy Homes to U.S. Environmental Emissions Reductions

The energy reduction due to ZEH market penetration can be also result in a reduction in its environmental emissions. Using the method outlined in the Government Performance and Results Act of 1993 for equating energy use to environmental emissions, Table 5 presents cumulative emissions avoidance through 2050. The ZEH Integration with a

[11] For the Reference scenario, per household energy consumption was determined by averaging per household energy consumption between 2005 and 2025 from the Energy Information Administration's *Annual Energy Outlook 2004 with Projections to 2025*. Projected gains in the thermal efficiency of homes is assumed to be offset by increased house size and increased consumption of other energy loads (e.g., central air conditioning, decorative fireplaces, and electronics).

30 percent tax credit scenario results in a tenfold reduction in accumulated emissions by 2050 over the reference case scenario.

Table 5. Cumulative Avoided Emissions through 2050 under Four Scenarios

	Reference Case	Reference Case with PV	ZEH Integration	ZEH Integration + 30% Tax Credit
Carbon Equivalent (million tons)	--	103	655	1,208
Sulfur Dioxide (million lbs)	--	2,587	16,506	30,458
Nitrogen Oxides (million lbs)	--	1,775	11,327	20,901

4.7 Summary of Results

Zero Energy Homes can have a significant impact on the energy consumption and environmental emissions attributed to U.S. single-family homes, thereby benefiting the economy and reducing the volatility of homeownership costs into the future. ZEH will increase domestic supply of energy, and are in direct alignment with the goals of the National Energy Policy Act. Furthermore, the technology is ready for today's marketplace; however, further research and development must be conducted to lower the cost and to help promote market demand.

5.0 Technology Pathways and Additional Factors Influencing the Adoption of ZEH, Energy Efficiency, and Renewable Energy Technologies

5.1 Technology Pathways

The DOE Building Technologies Program has the long-term goal to "Develop cost effective tools, techniques, and integrated technologies, systems, and designs for buildings that generate and use energy so efficiently that *buildings are capable of generating as much energy as they use*."

In order to meet this goal in the residential building market and have large scale, market viable Zero Energy Homes, significant advances in efficiency and cost reduction will be needed. Optimization analysis conducted outside of this study has confirmed that increasing building equipment and envelope efficiency to maximum technology will provide 69 percent energy reduction in new homes.[8] The remaining 31 percent of the energy needs must be supplied by renewable energy sources.

As determined by the independent ZEH analysis, Table 6 lists the technologies with the greatest potential for energy savings averaged across five U.S. climate regions. The technologies are listed in decreasing order according to their potential for energy savings across all climate regions. The desired efficiencies or characteristics for each of the technologies are also indicated.

Table 6. High Priority Technologies for Zero Energy Homes

Technology	Desired Efficiency / Characteristic	Average Energy Savings Potential (MMBtu)
Photovoltaic System	1.8 - 4.8 kilowatts (depending on climate)	76.04
Solar Thermal Space/ Water Heating	42 - 100% load reduction (depending on climate)	45.66
Lighting	100 lumens/watt	37.84
Water Heating	>=2.0 energy factor (solar thermal)	33.19
Windows	0.10 U-value 0.18 - 0.38 solar heat gain coefficient	26.08
Space Heating	6.8 - >10.0 heating seasonal performance factor (depending on climate)	25.62
Appliances	50% reduction in small appliance loads	16.90
	400 - 500 kWh/yr refrigerator	10.52
	3.9 - 4.3 cycle/kWh clothes dryer	10.50
Walls	0.023 – 0.060 U-value	6.48
Ducts	5% leakage	5.82
Foundation	0.033 – 0.064 U-value	3.40
Roof	0.025 – 0.033 U-value	2.68
Space Cooling	12.0 – 16.8 seasonal energy efficiency ratio (depending on climate)	2.30

The order of the technologies listed in Table 6 also indicates the priority for cost reduction research and development. Photovoltaic and solar thermal space and water heating can provide the most energy savings in all U.S. climate regions, but currently only for a large installed cost. Therefore, it is critical that the cost of these high-priority technologies be minimized in order to ensure that affordable solutions are available to reach the Zero Energy Home goal.

Additionally, at a quarter of the cost of photovoltaics, solar thermal systems can be used quite effectively to meet space-conditioning loads, in addition to water heating loads. With a 65 percent heating and water heating load reduction from a solar thermal system, the required PV system size necessary to provide for the remainder of these loads and the other electricity needs of a ZEH drops from 3.9 kW to 3.1 kW on average. [8]

Therefore, it is imperative that the costs of solar water and space heating systems be reduced along with costs of PV and energy-efficient technologies.

5.2 Additional Factors

A number of other factors will undoubtedly affect the adoption of ZEH in the housing market and ultimately the application of energy-efficient technologies and renewable energy systems. While not researched as a part of this study, these factors will unfold as the application of ZEH becomes more widespread. Activities to further understand these factors could include the following areas.

ZEH impact on other markets

This study examined the impact of ZEH on the single-family home market. Therefore, to broaden the scope of the study:

- Examine the potential of ZEH to accelerate the introduction of energy-efficiency and renewable energy components into the retrofit market. Currently, the retrofit market is much larger than the new housing market—about 98 percent of homes are existing homes—and, therefore, could have a significant impact on the energy use of single-family homes.
- Analyze the impact of ZEH on the entire residential sector by including its impact on new multifamily homes.
- Expand the current study to analyze each region in more detail, especially focusing on metropolitan areas that are projected to have the fastest growth in new construction.

Accounting systems for ZEH

- Develop an accounting system to credit the residential production of electricity against natural gas and fuel oil use for ZEH, which use multiple fuels.
- Establish a methodology for valuing the production of on-site power during peak utility demand.

Marketing of ZEH

- Investigate warranty policies for ZEH and the technologies included in them.
- Investigate mortgage products to encourage the adoption of ZEH.
- Identify regional housing markets that are inclined to adopt ZEH for involvement in early education and promotional efforts.

Standardization of ZEH

- Begin to develop a standard for the design of regional ZEH to estimate heating, cooling, lighting, and appliance loads.

6.0 Barriers to Adoption of ZEH Technology

The following are critical obstacles to home builder acceptance of the ZEH concept.

- Builders are often skeptical of homeowners' willingness to pay for advanced energy-efficiency and renewable energy systems.
- There is a big learning curve for builders to incorporate ZEH into their current building practices and for sales staff in selling ZEH.

- There is an increased transaction cost associated with selling and scheduling installation of ZEH features.
- Builders are concerned with the aesthetics of roof-mounted solar thermal and electric systems.
- Currently, it is expensive to build a ZEH.
- There is a lack of understanding of the ZEH concept among home builders.
- Builders are reluctant to add roof penetrations because of concerns over leaks.

The following barriers are critical to gaining homebuyer acceptance of ZEH.

- There is a lack of understanding of the ZEH concept among homeowners. Homeowners can only place value in ZEH if they have a basic understanding of the concept.
- Homebuyers are concerned about the aesthetics of roof-mounted solar thermal and electric systems.
- When ZEH is presented to a homebuyer as an option, there is competition for limited investment dollars between ZEH features, which are typically invisible, and other more tangible amenities.
- The cost of ZEH is prohibitive for many homebuyers.

The following barriers are key obstacles to utility acceptance of ZEH. Without utility support for ZEH, neither homeowners nor home builders are likely to pursue ZEH.

- Interconnectivity issues—utilities need to be involved with (and to allow) interconnected solar power systems. While numerous utilities have embraced the idea, not all utilities are receptive to grid-connected systems.
- Not all utilities are convinced of the peak load reduction benefits of ZEH, or of the potential of ZEH to improve grid reliability. ZEH systems need to be designed to have a zero peak load and operate in a way that contributes to grid reliability, and utilities need to be convinced of the benefits.
- Without regulatory intervention to address revenue issues, distributed generation can reduce utility revenues and increase the cost of capital assets for other rate payers, especially as ZEH becomes a larger share of the market.
- Homeowner remuneration for energy sent back to the utility grid — the economics of PV systems are most favorable when the retail value of electricity is credited for any power sent into the grid. Few utilities will credit retail value (some will simply not credit, or credit at an avoided cost rate) unless required to do so by law. (See www.dsireusa.org for a database of state and local regulations for grid-tied PV systems.)

7.0 Conclusions

Market Penetration and Energy Impact of ZEH

- Near-term action can have a major influence on the ultimate impact of ZEH on the energy consumption of single-family homes, even though the relatively slow replacement of housing stock and historically slow diffusion of new technology in the building industry will mean decades before ZEH can reach its full market potential. **Lack of near-term action will result in a lengthening of the time for ZEH to have an impact on the market.**

- **There is clearly an important government role in ZEH development that will require resources and long-term commitment.** By implementing the most aggressive scenario, ZEH Integration + 30% Tax Credit, ZEH begins to penetrate the market between 35 years (Northeast) and 33 years (South) earlier than the reference case scenario, resulting in a final (market saturation) impact by 2050 of 17 percent less energy use among all single-family homes compared to the Reference Case scenario.
- ZEH accrue benefits over time. **ZEH will not simply penetrate the new home market, but are projected to make up 17 percent of all single family housing stock by 2050 under the ZEH Integration + 30% Tax Credit scenario.** Under the Reference Case with PV scenario, ZEH is projected to make up only 2 percent of all single-family homes. Under the Reference Case scenario, ZEH market penetration is insignificant.
- **ZEH can have a significant market penetration by 2050 given government programs to support its development.** The projected share of ZEH among new housing starts in 2050 is 67 percent in the ZEH Integration + 30% Tax Credit scenario; 63% in the ZEH Integration scenario; 20 percent in the Reference Case with PV scenario, and insignificant in the Reference Case scenario. Under the most aggressive scenario, the total energy consumption of U.S. single-family homes will level off by approximately 2030 and continue to decline in following years. With no action, the total energy consumption will continue to increase as new homes are added.

Technology Needs

- **Research and development is needed for ZEH to reach its potential.** The technology for early market penetration of ZEH is ready, but research to improve the performance, reduce the cost, and develop the infrastructure for the energy-efficiency and energy generation components of ZEH is needed to bring the concept into the marketplace.

Market Needs

- **Market acceptance of the ZEH concept among homebuyers and home builders is crucial to its adoption by the U.S. housing industry.** It is important that U.S. government efforts like the DOE Building America program provide leadership in this area.
- **Active utility participation in the development and promotion of the ZEH concept will help to solidify consumer acceptance of ZEH.** Without utility participation, technical difficulties with system integration and net-metering regulations may stifle ZEH implementation.
- **Financial incentives such as tax credits for homebuyers and home builders are essential for near-term market adoption of ZEH.**

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Appendix A: Current and Planned Residential R&D Projects towards ZEH

Building America research homes completed in 2002 and 2003 include:

- Shea Homes, San Diego (100 of 300 homes)
- Centex Homes, Livermore, CA (1 home)
- John Wesley Miller Companies, Tucson, AZ (99 homes)
- Pardee Homes, Los Angeles, CA (Optional in 4 subdivisions)
- Pardee Homes, Las Vegas, NV (NAHB Show home + optional)
- Clarum Homes, East Palo Alto (20 Homes); Watsonville, CA (250 Homes)
- Morrison Homes, Sacramento, CA (12 Homes)
- Bradley Builders, Long Island, NY (1 Home); Leesburg, VA (1 home)
- Claretian Associates, Chicago, IL (3 Homes)
- Habitat for Humanity, Oak Ridge, TN (5 homes)

Projects in progress include:

- Premier Homes, Sacramento, CA (144 homes)
- Centex Homes, San Ramon, CA (2 models & optional)
- Northern Capital, Inc., San Diego, CA (50 homes)
- Lennar/BVHP, San Francisco, CA (1,600 homes)
- Ponderosa Homes, Pleasanton, CA (1 home)
- Clarum Homes, Menlo Park, CA (20 homes)
- Pardee Homes, San Diego, CA (126 homes)
- Pinnacle Homes, Las Vegas, NV (1 home)
- Western Massachusetts Electric Company (1 home)
- Clarum Homes, Borrego Springs, CA (4 homes)
- Habitat for Humanity, Sacramento, CA (1 home)
- Genesis Group, Atlantic City, NJ (6 homes)
- Austin Department of Housing + utility, Austin, TX (100 homes)
- Veridian Homes, Madison, WI (1 home)
- Grupe, Sacramento, CA (1 home)
- Monley-Cronin, Sacramento, CA (1 home)
- Bentwood Custom Homes, Dallas, TX (1 home)

Appendix B: Internet Survey – NAHB Research Center Questionnaire Responses

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
Q1. DO YOU OWN YOUR PRIMARY RESIDENCE?	*N*	*1,741*	*435*	*433*	*414*	*410*
Yes		100%	100%	100%	100%	100%
No		-	-	-	-	-
TOTAL		100%	100%	100%	100%	100%
Q2. WHAT IS YOUR AGE?	*N*	*1,741*	*435*	*433*	*414*	*410*
Less than 18		-	-	-	-	-
8 - 24		1.6%	1.1%	2.5%	1.4%	1.2%
25 - 29		5.9%	4.4%	6.5%	5.8%	7.1%
30 - 34		10.3%	9.9%	11.1%	9.4%	10.5%
35 - 39		9.5%	9.4%	8.3%	12.1%	7.8%
40 - 44		13.0%	12.4%	11.8%	15.5%	12.9%
45 - 49		16.6%	16.8%	19.6%	13.5%	14.6%
50 - 54		13.7%	16.3%	10.9%	14.0%	14.4%
55 - 59		12.6%	12.6%	13.6%	11.1%	13.4%
60 - 64		9.0%	10.3%	7.4%	9.7%	9.0%
65 - 69		4.1%	4.6%	4.4%	3.4%	4.4%
70 - 74		2.4%	0.9%	2.5%	2.4%	3.2%
75 or older		1.4%	1.1%	1.4%	1.7%	1.5%
TOTAL		100%	100%	100%	100%	100%
Q3. WHAT TYPE OF HOME DO YOU LIVE IN?	*N*	*1,741*	*435*	*433*	*414*	*410*
Single family detached home		94.8%	92.4%	95.6%	96.1%	94.4%
Duplex		1.7%	4.4%	0.9%	1.2%	0.2%
Triplex		0.2%	0.2%	-	0.2%	0.2%
Townhome		3.4%	3.0%	3.5%	2.4%	5.1%
Condominium		-	-	-	-	-
Apartment		-	-	-	-	-
Other		-	-	-	-	-
TOTAL		100%	100%	100%	100%	100%
Q4. WHAT IS THE APPROXIMATE FINISHED SQUARE FOOTAGE OF YOUR PRIMARY RESIDENCE?	*N*	*1,618*	*376*	*400*	*395*	*399*
Less than 1,000 sf		5.7%	5.9%	8.8%	3.5%	4.5%
1,000 - 1,499 sf		21.2%	17.6%	20.5%	19.0%	25.1%
1,500 - 1,999 sf		31.8%	23.7%	32.3%	37.7%	34.1%
2,000 - 2,499 sf		20.1%	20.5%	22.8%	18.5%	20.6%
2,500 - 2,999 sf		9.6%	13.6%	6.5%	9.9%	8.0%
3,000 - 3,499 sf		5.7%	8.5%	5.5%	5.6%	3.5%
3,500 - 3,999 sf		2.3%	2.7%	1.8%	2.8%	2.3%
4,000 - 4,499 sf		1.4%	3.5%	1.0%	0.8%	0.5%
4,500 - 5,000 sf		1.0%	1.9%	0.5%	1.0%	0.8%
More than 5,000 sf		1.2%	2.4%	0.5%	1.3%	0.8%
TOTAL		100%	100%	100%	100%	100%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
Q5. WHAT YEAR DID YOU PURCHASE YOUR PRIMARY RESIDENCE?	*N*	*1,733*	*431*	*433*	*414*	*406*
1919 or earlier		0.1%	0.2%	-	-	-
1920 to 1929		-	-	-	-	-
1930 to 1939		0.1%	0.5%	-	-	-
1940 to 1949		0.2%	0.5%	-	-	0.5%
1950 to 1959		0.9%	1.2%	0.7%	0.7%	1.2%
1960 to 1969		3.8%	4.6%	4.2%	2.7%	3.9%
1970 to 1974		2.8%	4.6%	2.8%	1.2%	2.7%
1975 to 1979		5.6%	8.4%	5.1%	4.3%	4.9%
1980 to 1984		6.2%	7.9%	6.2%	5.8%	5.4%
1985 to 1989		10.7%	12.5%	11.1%	9.7%	9.9%
1990 to 1994		14.5%	13.2%	15.2%	15.9%	13.8%
1995 to 1999		22.7%	19.7%	23.1%	25.1%	21.7%
2000 to 2004		32.3%	26.7%	31.6%	34.5%	36.0%
TOTAL		100%	100%	100%	100%	100%
Q6. WHAT IS YOUR ANNUAL HOUSEHOLD INCOME (BEFORE TAXES)?	*N*	*1,567*	*394*	*379*	*377*	*370*
Less than $25k		8.5%	6.9%	9.0%	9.0%	8.6%
$25k - $49k		28.0%	21.6%	31.7%	30.5%	27.6%
$50k - $74k		31.0%	29.7%	35.4%	32.9%	26.5%
$75k - $99k		17.7%	19.8%	15.0%	15.6%	20.3%
$100k - $124k		7.0%	9.9%	4.7%	5.0%	8.4%
$125k - $149k		3.4%	4.8%	1.1%	3.2%	4.6%
$150k - $174k		1.5%	2.5%	1.3%	0.8%	1.6%
$175k - $199k		0.9%	1.8%	-	1.1%	0.8%
$200k - $224k		0.3%	1.0%	-	-	0.3%
$225k - $249k		0.1%	0.3%	-	0.3%	-
$250k - $274k		0.1%	0.3%	-	0.3%	-
$275k - $299k		0.3%	0.3%	0.3%	0.5%	0.3%
$300k - $324k		0.1%	-	-	0.3%	0.3%
$325k - $349k		0.3%	0.5%	-	0.3%	0.5%
$350k - $374k		0.1%	-	-	0.3%	0.3%
$375k - $399k		0.1%	-	0.3%	-	-
$400k - $424k		0.1%	-	0.3%	-	-
$425k - $449k		-	-	-	-	-
$450k - $474k		0.1%	-	0.3%	-	-
$475k - $499k		0.1%	0.3%	-	-	-
More than $500k		0.3%	0.5%	0.8%	-	-
TOTAL		100%	100%	100%	100%	100%
Q7. WHAT WAS THE PURCHASE PRICE OF YOUR PRIMARY RESIDENCE?	*N*	*1,687*	*418*	*419*	*402*	*400*
Less than $50,000		23.8%	28.5%	27.9%	23.1%	15.0%
$50,000 - $99,000		30.0%	24.9%	35.8%	37.8%	22.5%
$100,000 - $149,000		20.7%	17.0%	21.2%	20.1%	24.0%
$150,000 - $199,000		11.9%	13.9%	8.6%	8.7%	16.0%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$200,000 - $249,000		5.7%	7.4%	3.8%	4.2%	6.5%
$250,000 - $299,000		3.7%	3.3%	1.7%	3.0%	7.5%
$300,000 - $349,000		1.4%	2.4%	0.2%	1.0%	2.0%
$350,000 - $399,000		1.2%	1.0%	0.7%	1.0%	2.3%
$400,000 - $449,000		0.4%	0.5%	-	-	1.0%
$450,000 - $499,000		0.4%	0.7%	-	0.5%	0.5%
$500,000 - $549,000		0.5%	0.2%	-	-	1.8%
$550,000 - $599,000		-	-	-	-	-
$600,000 - $649,000		0.1%	-	-	-	0.5%
$650,000 - $699,000		0.1%	-	-	-	0.3%
$700,000 - $749,000		-	-	-	-	-
$750,000 - $799,000		0.1%	0.2%	-	-	-
$800,000 - $849,000		0.1%	-	-	0.2%	-
$850,000 - $899,000		0.1%	-	-	-	0.3%
$900,000 - $949,000		-	-	-	-	-
$950,000 - $999,000		0.1%	-	-	0.2%	-
More than $1,000,000		-	-	-	-	-
TOTAL		100%	100%	100%	100%	100%
Q8. WHAT IS THE CURRENT MARKET VALUE OF YOUR PRIMARY RESIDENCE?	*N*	*1,665*	*414*	*417*	*395*	*391*
Less than $50,000		4.6%	2.4%	5.8%	8.6%	1.0%
$50,000 - $99,000		18.3%	15.9%	25.2%	23.8%	7.7%
$100,000 - $149,000		22.5%	17.6%	29.3%	28.6%	14.8%
$150,000 - $199,000		17.1%	14.3%	17.5%	17.2%	17.6%
$200,000 - $249,000		10.6%	10.9%	10.1%	9.1%	12.3%
$250,000 - $299,000		6.4%	8.5%	5.3%	3.0%	8.4%
$300,000 - $349,000		5.5%	8.7%	2.6%	2.5%	9.0%
$350,000 - $399,000		4.5%	7.2%	1.7%	2.8%	6.6%
$400,000 - $449,000		2.6%	3.6%	1.4%	1.5%	4.1%
$450,000 - $499,000		1.8%	3.6%	0.2%	0.5%	3.1%
$500,000 - $549,000		1.3%	2.4%	0.2%	0.8%	2.0%
$550,000 - $599,000		0.8%	1.2%	-	0.8%	1.5%
$600,000 - $649,000		0.8%	0.2%	0.2%	-	2.8%
$650,000 - $699,000		0.5%	1.0%	0.2%	0.3%	0.8%
$700,000 - $749,000		0.5%	0.7%	-	-	1.3%
$750,000 - $799,000		0.6%	0.5%	-	-	2.0%
$800,000 - $849,000		0.4%	0.5%	-	-	1.3%
$850,000 - $899,000		0.4%	-	-	-	1.5%
$900,000 - $949,000		0.1%	0.2%	-	0.3%	-
$950,000 - $999,000		0.1%	0.2%	-	0.3%	-
More than $1,000,000		0.6%	0.2%	0.2%	-	2.0%
TOTAL		100%	100%	100%	100%	100%
Q9. WHAT IS THE TERM OF THE MORTGAGE ON YOUR PRIMARY RESIDENCE?	*N*	*1,603*	*396*	*396*	*388*	*376*
10 years		4.7%	6.1%	6.1%	4.4%	2.1%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
15 years		20.0%	22.2%	20.7%	20.1%	16.5%
30 years		53.0%	44.9%	50.8%	54.9%	61.7%
Other		22.3%	26.8%	22.5%	20.6%	19.7%
TOTAL		100%	100%	100%	100%	100%
Q10. HOW MUCH IS THE TYPICAL COMBINED MONTHLY MORTGAGE, HOMEOWNER INSURANCE, AND TAX PAYMENT ON YOUR PRIMARY RESIDENCE?	*N*	*1,741*	*435*	*433*	*414*	*410*
Less than $500		23.5%	22.3%	27.0%	26.3%	17.6%
$500 - $749		19.1%	13.3%	24.9%	23.4%	14.6%
$750 - $999		17.6%	16.6%	19.6%	17.4%	17.3%
$1,000 - $1,249		13.8%	12.9%	13.2%	15.5%	13.2%
$1,250 - $1,499		8.8%	11.0%	4.8%	6.0%	13.2%
$1,500 - $1,749		6.2%	8.3%	5.3%	4.1%	7.1%
$1,750 - $1,999		3.4%	4.6%	1.6%	1.9%	6.1%
$2,000 - $2,249		2.5%	3.7%	0.5%	2.4%	3.7%
$2,250 - $2,499		1.4%	1.8%	0.7%	1.4%	2.0%
$2,500 - $2,749		0.9%	1.1%	0.5%	0.5%	1.7%
$2,750 - $2,999		0.6%	1.1%	0.2%	-	1.2%
$3,000 - $3,249		0.7%	0.9%	0.5%	0.2%	1.2%
$3,250 - $3,499		0.3%	0.7%	0.5%	0.2%	-
$3,500 - $3,749		0.3%	0.5%	0.2%	-	0.5%
$3,750 - $3,999		0.1%	-	0.2%	-	-
$4,000 - $4,249		0.1%	-	-	-	0.5%
$4,250 - $4,499		-	-	-	-	-
$4,500 - $4,749		0.1%	0.2%	-	0.2%	-
$4,750 - $4,999		0.1%	-	0.2%	-	0.2%
More than $5,000		0.3%	0.9%	-	0.2%	-
TOTAL		100%	100%	100%	100%	100%
Q11. HOW MANY HOMES AS YOUR PRIMARY RESIDENCE HAVE YOU OWNED?	*N*	*1,717*	*428*	*425*	*409*	*407*
1 home		49.7%	58.4%	48.9%	45.2%	45.0%
2 homes		26.2%	24.1%	30.6%	26.2%	24.1%
3 homes		12.8%	10.5%	10.4%	14.9%	16.0%
4 homes		6.0%	4.4%	4.9%	6.8%	7.9%
5 homes		3.4%	1.9%	3.8%	3.9%	3.9%
6 homes		1.1%	0.5%	0.9%	1.5%	1.7%
7 homes		0.3%	0.2%	0.2%	0.5%	0.5%
8 homes		0.3%	-	0.2%	0.7%	0.5%
9 homes		0.1%	-	-	-	-
10 or more homes		0.2%	-	-	0.2%	0.5%
TOTAL		100%	100%	100%	100%	100%
Q12. WILL THE NEXT HOME YOU PURCHASE AS YOUR PRIMARY RESIDENCE BE A: (a starter home suggests a first-time owner home or	*N*	*1,741*	*435*	*433*	*414*	*410*

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
entry-level home; in this sense, it is a basic home with not many frills. It can be the level that someone moves down to, to retire or it can be the type of home in which a person lives throughout his or her adult life. Move-up homes suggest a step up in amenities from the starter home but a lesser level than a luxury home.)						
Starter home		17.6%	19.5%	18.2%	15.5%	17.6%
Move-up home		65.4%	63.7%	67.9%	65.7%	63.4%
Luxury home		16.9%	16.8%	13.9%	18.8%	19.0%
TOTAL		100%	100%	100%	100%	100%
Q13. HOW MANY MORE YEARS DO YOU PLAN TO RESIDE IN YOUR CURRENT PRIMARY RESIDENCE?	*N*	*1,375*	*352*	*342*	*316*	*328*
Less than 1 year		6.6%	5.7%	7.3%	5.7%	8.2%
At least 1 year but less than 2 years		7.7%	9.7%	7.0%	7.6%	6.4%
At least 2 years but less than 5 years		21.2%	19.6%	19.9%	21.2%	24.1%
At least 5 years but less than 10 years		22.3%	20.2%	21.9%	23.4%	22.9%
At least 10 years but less than 20 years		17.8%	16.2%	21.1%	18.7%	15.9%
At least 20 years but less than 30 years		7.9%	12.5%	8.5%	5.4%	4.9%
More than 30 years		16.5%	16.2%	14.3%	18.0%	17.7%
TOTAL		100%	100%	100%	100%	100%
Q14. WHAT IS YOUR AVERAGE ELECTRIC BILL, PER MONTH, DURING YOUR COOLING SEASON(S)?	*N*	*1,741*	*435*	*433*	*414*	*410*
$0 / No electric bill		0.2%	-	0.7%	-	-
At least $1 but less than $10		-	-	-	-	-
$10 - $19		0.5%	0.5%	0.2%	0.2%	1.0%
$20 - $29		2.0%	0.9%	1.8%	1.0%	3.7%
$30 - $39		4.7%	4.6%	4.6%	1.4%	8.0%
$40 - $49		4.9%	5.5%	5.3%	1.4%	7.6%
$50 - $59		7.1%	6.4%	9.0%	1.7%	11.0%
$60 - $69		8.4%	9.7%	10.2%	2.9%	10.0%
$70 - $79		7.4%	8.7%	7.9%	4.8%	6.8%
$80 - $89		7.8%	8.7%	11.3%	4.8%	6.3%
$90 - $99		5.2%	5.7%	5.5%	5.3%	4.6%
$100 - $109		9.5%	12.0%	10.2%	9.9%	6.1%
$110 - $119		6.5%	6.9%	6.2%	8.0%	5.1%
$120 - $129		6.5%	5.5%	6.9%	8.5%	5.6%
$130 - $139		3.5%	2.8%	5.3%	3.1%	2.2%
$140 - $149		4.0%	3.0%	3.0%	8.0%	2.7%
$150 - $159		3.7%	3.0%	3.0%	4.8%	3.9%
$160 - $169		2.5%	2.5%	1.8%	3.9%	1.5%
$170 - $179		1.4%	1.1%	1.8%	2.2%	0.5%
$180 - $189		2.0%	1.6%	1.6%	3.9%	1.0%
$190 - $199		1.1%	0.7%	0.9%	1.9%	1.2%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$200 - $209		3.2%	3.2%	1.2%	5.1%	3.7%
$210 - $219		1.0%	0.5%	0.2%	2.7%	1.0%
$220 - $229		1.2%	0.9%	0.5%	3.4%	0.2%
$230 - $239		1.0%	1.4%	0.2%	1.7%	1.0%
$240 - $249		0.9%	0.7%	-	1.9%	1.2%
$250 - $259		0.9%	0.9%	0.2%	1.9%	0.7%
$260 - $269		0.3%	0.5%	-	0.2%	0.7%
$270 - $279		0.4%	-	0.2%	0.7%	0.7%
$280 - $289		0.3%	0.2%	-	0.5%	0.7%
$290 - $299		0.2%	-	-	0.7%	0.2%
$300 - $309		0.7%	0.7%	-	1.9%	0.2%
$310 - $319		0.2%	0.2%	-	0.5%	0.2%
$320 - $329		-	-	-	-	-
$330 - $339		-	-	-	-	-
$340 - $349		0.1%	-	-	0.2%	-
$350 - $359		0.1%	-	-	0.2%	-
$360 - $369		-	-	-	-	-
$370 - $379		0.1%	-	-	-	0.2%
$380 - $389		-	-	-	-	-
$390 - $399		-	-	-	-	-
$400 - $409		0.2%	0.5%	-	0.2%	-
$410 - $419		-	-	-	-	-
$420 - $429		-	-	-	-	-
$430 - $439		-	-	-	-	-
$440 - $449		-	-	-	-	-
$450 - $459		0.1%	-	-	-	0.2%
$460 - $469		-	-	-	-	-
$470 - $479		0.1%	0.2%	-	-	-
$480 - $489		-	-	-	-	-
$490 - $499		0.1%	-	-	0.2%	-
$500 - $509		-	-	-	-	-
$510 - $519		-	-	-	-	-
$520 - $529		-	-	-	-	-
$530 - $539		-	-	-	-	-
$540 - $549		-	-	-	-	-
$550 - $559		0.1%	0.2%	-	-	-
$560 - $569		-	-	-	-	-
$570 - $579		-	-	-	-	-
$580 - $589		-	-	-	-	-
$590 - $599		-	-	-	-	-
More than $600		-	-	-	-	-
TOTAL		100%	100%	100%	100%	100%
Q15. WHAT IS YOUR AVERAGE ELECTRIC BILL, PER MONTH, DURING YOUR HEATING SEASON(S)?	*N*	*1,741*	*435*	*433*	*414*	*410*
$0 / No electric bill		0.5%	0.2%	0.7%	0.7%	-

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
At least $1 but less than $10		0.1%	-	0.2%	-	0.2%
$10 - $19		0.5%	0.7%	0.2%	1.0%	0.2%
$20 - $29		3.2%	1.1%	4.2%	2.9%	4.9%
$30 - $39		6.6%	6.4%	8.5%	3.1%	8.5%
$40 - $49		7.2%	9.4%	8.1%	3.9%	8.0%
$50 - $59		8.9%	8.5%	9.9%	6.3%	11.2%
$60 - $69		9.4%	9.7%	10.9%	5.1%	11.2%
$70 - $79		9.8%	10.3%	10.9%	9.7%	8.8%
$80 - $89		9.0%	10.6%	9.0%	9.2%	6.8%
$90 - $99		4.9%	4.1%	4.4%	6.0%	5.4%
$100 - $109		8.9%	9.0%	7.2%	10.4%	8.3%
$110 - $119		4.1%	2.8%	4.2%	4.1%	5.4%
$120 - $129		4.8%	3.4%	4.4%	7.2%	3.9%
$130 - $139		3.0%	2.1%	2.8%	4.1%	2.7%
$140 - $149		3.2%	3.9%	2.8%	4.1%	2.2%
$150 - $159		3.3%	3.0%	3.2%	4.8%	2.0%
$160 - $169		1.7%	1.6%	1.2%	2.2%	2.0%
$170 - $179		1.4%	0.9%	0.9%	2.4%	1.5%
$180 - $189		1.3%	1.8%	1.6%	1.4%	0.5%
$190 - $199		1.1%	1.1%	0.9%	1.7%	0.7%
$200 - $209		1.9%	2.1%	0.9%	3.1%	1.5%
$210 - $219		1.0%	0.5%	0.7%	1.9%	0.7%
$220 - $229		0.6%	0.5%	-	1.2%	1.0%
$230 - $239		0.4%	0.7%	0.5%	-	0.5%
$240 - $249		0.6%	1.6%	-	0.5%	0.2%
$250 - $259		0.9%	1.4%	0.9%	1.0%	0.2%
$260 - $269		0.3%	0.5%	0.2%	0.5%	-
$270 - $279		0.2%	0.5%	-	-	0.5%
$280 - $289		0.2%	-	0.2%	0.2%	0.2%
$290 - $299		0.1%	-	-	0.2%	0.2%
$300 - $309		0.2%	0.5%	0.2%	0.2%	-
$310 - $319		-	-	-	-	-
$320 - $329		0.1%	0.2%	-	-	-
$330 - $339		-	-	-	-	-
$340 - $349		0.1%	-	-	0.2%	-
$350 - $359		0.1%	0.2%	-	-	0.2%
$360 - $369		0.1%	-	-	0.2%	-
$370 - $379		0.1%	0.2%	-	-	-
$380 - $389		-	-	-	-	-
$390 - $399		0.1%	-	-	-	0.2%
$400 - $409		0.1%	0.5%	-	-	-
$410 - $419		0.1%	-	-	0.2%	-
$420 - $429		-	-	-	-	-
$430 - $439		-	-	-	-	-
$440 - $449		-	-	-	-	-
$450 - $459		-	-	-	-	-

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$460 - $469		-	-	-	-	-
$470 - $479		-	-	-	-	-
$480 - $489		-	-	-	-	-
$490 - $499		-	-	-	-	-
$500 - $509		-	-	-	-	-
$510 - $519		-	-	-	-	-
$520 - $529		-	-	-	-	-
$530 - $539		-	-	-	-	-
$540 - $549		-	-	-	-	-
$550 - $559		0.1%	-	0.2%	-	-
$560 - $569		-	-	-	-	-
$570 - $579		-	-	-	-	-
$580 - $589		-	-	-	-	-
$590 - $599		-	-	-	-	-
More than $600		-	-	-	-	-
TOTAL		100%	100%	100%	100%	100%
Q16. WHAT IS YOUR AVERAGE GAS / FUEL OIL BILL, PER MONTH, DURING YOUR COOLING SEASON(S)?	*N*	*1,741*	*435*	*433*	*414*	*410*
$0 / No gas bill		27.3%	20.7%	15.7%	47.8%	25.1%
At least $1 but less than $10		2.8%	0.9%	2.8%	4.1%	2.9%
$10 - $19		7.9%	3.4%	10.4%	6.5%	12.0%
$20 - $29		14.5%	12.0%	16.2%	11.6%	18.3%
$30 - $39		11.9%	11.3%	12.9%	9.4%	14.4%
$40 - $49		8.0%	9.9%	9.9%	5.1%	6.1%
$50 - $59		5.9%	6.4%	6.2%	4.8%	6.1%
$60 - $69		4.5%	5.3%	5.1%	3.1%	3.9%
$70 - $79		3.6%	5.5%	3.7%	1.9%	3.4%
$80 - $89		2.6%	2.5%	4.4%	1.2%	2.7%
$90 - $99		1.7%	3.2%	2.5%	0.7%	0.5%
$100 - $109		2.9%	5.3%	3.7%	1.4%	1.5%
$110 - $119		1.4%	1.8%	2.8%	0.2%	0.7%
$120 - $129		0.7%	1.1%	0.9%	0.5%	0.2%
$130 - $139		0.9%	2.8%	0.5%	-	0.2%
$140 - $149		0.7%	1.6%	0.9%	0.2%	-
$150 - $159		0.6%	0.7%	0.7%	1.0%	0.2%
$160 - $169		0.2%	0.5%	-	-	0.5%
$170 - $179		0.3%	0.9%	0.5%	-	-
$180 - $189		0.3%	0.5%	-	-	0.5%
$190 - $199		0.1%	0.2%	-	-	0.2%
$200 - $209		0.4%	0.9%	-	0.2%	0.2%
$210 - $219		0.1%	0.5%	-	-	-
$220 - $229		-	-	-	-	-
$230 - $239		0.1%	0.2%	-	-	-
$240 - $249		0.1%	0.2%	-	-	-
$250 - $259		0.2%	0.5%	0.2%	-	-

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$260 - $269		-	-	-	-	-
$270 - $279		-	-	-	-	-
$280 - $289		0.1%	0.2%	-	-	-
$290 - $299		-	-	-	-	-
$300 - $309		0.1%	0.2%	-	-	-
$310 - $319		0.1%	0.2%	-	-	0.2%
$320 - $329		0.1%	0.2%	-	-	-
$330 - $339		-	-	-	-	-
$340 - $349		-	-	-	-	-
$350 - $359		-	-	-	-	-
$360 - $369		-	-	-	-	-
$370 - $379		-	-	-	-	-
$380 - $389		-	-	-	-	-
$390 - $399		-	-	-	-	-
$400 - $409		-	-	-	-	-
$410 - $419		-	-	-	-	-
$420 - $429		-	-	-	-	-
$430 - $439		-	-	-	-	-
$440 - $449		-	-	-	-	-
$450 - $459		-	-	-	-	-
$460 - $469		-	-	-	-	-
$470 - $479		-	-	-	-	-
$480 - $489		0.1%	0.2%	-	-	-
$490 - $499		-	-	-	-	-
$500 - $509		-	-	-	-	-
$510 - $519		-	-	-	-	-
$520 - $529		-	-	-	-	-
$530 - $539		-	-	-	-	-
$540 - $549		-	-	-	-	-
$550 - $559		-	-	-	-	-
$560 - $569		-	-	-	-	-
$570 - $579		-	-	-	-	-
$580 - $589		-	-	-	-	-
$590 - $599		-	-	-	-	-
More than $600		-	-	-	-	-
TOTAL		100%	100%	100%	100%	100%
Q17. WHAT IS YOUR AVERAGE GAS / FUEL OIL BILL, PER MONTH, DURING YOUR HEATING SEASON(S)?	*N*	*1,741*	*435*	*433*	*414*	*410*
$0 / No gas bill		21.3%	8.7%	11.3%	41.3%	23.4%
At least $1 but less than $10		0.2%	-	0.2%	-	0.5%
$10 - $19		1.6%	0.9%	0.7%	1.7%	3.2%
$20 - $29		2.6%	1.8%	0.7%	2.9%	5.4%
$30 - $39		3.9%	2.3%	1.6%	3.9%	7.8%
$40 - $49		4.8%	1.8%	3.5%	6.3%	7.6%
$50 - $59		5.2%	2.8%	4.6%	5.6%	8.0%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$60 - $69		4.8%	3.0%	5.1%	3.9%	7.3%
$70 - $79		6.5%	5.5%	7.4%	4.8%	8.5%
$80 - $89		6.0%	4.8%	8.1%	5.3%	6.1%
$90 - $99		4.9%	5.5%	6.9%	3.6%	3.9%
$100 - $109		9.0%	12.4%	11.8%	4.8%	6.3%
$110 - $119		4.6%	5.7%	7.9%	1.7%	2.4%
$120 - $129		4.1%	5.5%	7.4%	1.9%	1.7%
$130 - $139		2.8%	3.4%	4.2%	2.4%	1.0%
$140 - $149		2.3%	4.6%	2.5%	1.0%	0.7%
$150 - $159		3.1%	3.7%	4.6%	3.1%	1.2%
$160 - $169		1.1%	1.4%	1.4%	0.5%	1.2%
$170 - $179		1.5%	2.8%	1.4%	1.7%	0.2%
$180 - $189		1.1%	1.8%	2.1%	0.5%	0.2%
$190 - $199		0.5%	1.4%	0.5%	-	0.2%
$200 - $209		2.3%	4.8%	1.6%	1.0%	1.7%
$210 - $219		0.3%	0.5%	0.9%	-	-
$220 - $229		0.5%	1.6%	0.2%	-	-
$230 - $239		0.3%	0.9%	0.2%	-	-
$240 - $249		0.5%	1.6%	-	0.2%	-
$250 - $259		1.1%	2.3%	0.9%	0.7%	0.5%
$260 - $269		0.2%	0.7%	0.2%	-	-
$270 - $279		0.4%	0.7%	0.2%	0.2%	0.5%
$280 - $289		0.2%	0.5%	0.2%	-	-
$290 - $299		0.1%	-	0.2%	0.2%	-
$300 - $309		0.7%	2.1%	0.7%	0.2%	-
$310 - $319		0.1%	0.2%	-	-	0.2%
$320 - $329		0.1%	0.2%	-	-	-
$330 - $339		0.1%	0.2%	0.2%	-	-
$340 - $349		0.1%	-	0.2%	0.2%	-
$350 - $359		0.3%	1.1%	-	-	-
$360 - $369		0.1%	0.2%	-	-	-
$370 - $379		0.1%	0.5%	-	-	-
$380 - $389		-	-	-	-	-
$390 - $399		0.1%	0.2%	-	-	-
$400 - $409		0.1%	-	-	0.2%	-
$410 - $419		-	-	-	-	-
$420 - $429		-	-	-	-	-
$430 - $439		-	-	-	-	-
$440 - $449		-	-	-	-	-
$450 - $459		-	-	-	-	-
$460 - $469		-	-	-	-	-
$470 - $479		-	-	-	-	-
$480 - $489		-	-	-	-	-
$490 - $499		-	-	-	-	-
$500 - $509		0.2%	0.5%	0.2%	-	-
$510 - $519		-	-	-	-	-

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$520 - $529		-	-	-	-	-
$530 - $539		-	-	-	-	-
$540 - $549		-	-	-	-	-
$550 - $559		0.1%	0.2%	-	-	-
$560 - $569		-	-	-	-	-
$570 - $579		0.1%	0.2%	-	-	-
$580 - $589		-	-	-	-	-
$590 - $599		-	-	-	-	-
More than $600		0.2%	0.7%	-	-	-
TOTAL		100%	100%	100%	100%	100%
Q18. PLEASE CONSIDER A HOME WITH NEW ENERGY TECHNOLOGIES THAT ALLOW YOU TO ELIMINATE MOST OR ALL OF YOUR GAS, FUEL OIL AND ELECTRIC BILLS. WOULD YOU BUY A HOME WITH THESE NEW ENERGY TECHNOLOGIES IF THE SAVINGS ON YOUR ENERGY BILL OFFSET THE INCREASE IN YOUR MORTGAGE?	*N*	*1,741*	*435*	*433*	*414*	*410*
Yes		82.7%	80.7%	82.0%	86.0%	82.0%
No		17.3%	19.3%	18.0%	14.0%	18.0%
TOTAL		100%	100%	100%	100%	100%
Q19. TAKING INTO CONSIDERATION THAT UTILITY PRICES FLUCTUATE OVER TIME, HOW MUCH MORE MONTHLY WOULD YOU BE3 WILLING TO PAY TO AVOID FLUCTUATIONS IN YOUR ENERGY COSTS?	*N*	*1,740*	*434*	*433*	*414*	*410*
Percent						
$0 / None		28.3%	26.3%	27.9%	29.0%	30.2%
At least $1 but less than $10		10.7%	9.0%	11.1%	9.4%	13.4%
$10 - $19		10.9%	11.3%	11.5%	9.7%	11.7%
$20 - $29		10.3%	10.8%	10.9%	9.9%	9.3%
$30 - $39		5.4%	5.1%	6.5%	6.0%	4.4%
$40 - $49		4.4%	4.8%	3.9%	5.8%	2.7%
$50 - $59		10.2%	12.2%	10.9%	10.1%	7.1%
$60 - $69		1.1%	0.9%	1.4%	1.4%	0.7%
$70 - $79		1.4%	0.9%	1.2%	1.7%	1.7%
$80 - $89		1.5%	0.7%	0.9%	1.9%	2.4%
$90 - $99		1.3%	1.6%	1.2%	0.7%	2.0%
$100 - $109		7.7%	7.8%	7.4%	8.0%	7.1%
$110 - $119		0.7%	0.7%	0.5%	1.0%	0.2%
$120 - $129		0.6%	0.2%	0.7%	0.5%	1.2%
$130 - $139		0.3%	0.2%	0.5%	0.5%	-
$140 - $149		0.3%	0.9%	0.2%	0.2%	-
$150 - $159		1.6%	1.8%	1.4%	1.9%	1.2%
$160 - $169		0.1%	0.2%	-	-	-
$170 - $179		0.3%	0.5%	0.2%	0.2%	0.2%
$180 - $189		0.1%	-	-	-	0.2%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$190 - $199		0.4%	0.2%	0.5%	0.2%	0.7%
$200 - $209		1.2%	1.6%	0.5%	0.7%	2.2%
$210 - $219		-	-	-	-	-
$220 - $229		-	-	-	-	-
$230 - $239		0.2%	0.2%	-	0.2%	0.2%
$240 - $249		-	-	-	-	-
$250 - $259		0.4%	0.7%	0.2%	0.7%	-
$260 - $269		0.1%	-	-	-	0.2%
$270 - $279		0.1%	0.2%	-	-	-
$280 - $289		0.1%	0.2%	-	-	-
$290 - $299		0.1%	-	0.2%	-	-
$300 - $309		0.1%	-	0.2%	-	0.2%
$310 - $319		0.1%	-	-	-	0.2%
$320 - $329		-	-	-	-	-
$330 - $339		-	-	-	-	-
$340 - $349		-	-	-	-	-
$350 - $359		-	-	-	-	-
$360 - $369		-	-	-	-	-
$370 - $379		-	-	-	-	-
$380 - $389		0.1%	-	-	-	0.2%
$390 - $399		-	-	-	-	-
$400 - $409		0.1%	0.2%	-	-	-
$410 - $419		-	-	-	-	-
$420 - $429		-	-	-	-	-
$430 - $439		-	-	-	-	-
$440 - $449		-	-	-	-	-
$450 - $459		-	-	-	-	-
$460 - $469		-	-	-	-	-
$470 - $479		-	-	-	-	-
$480 - $489		-	-	-	-	-
$490 - $499		-	-	-	-	-
$500 - $509		0.1%	0.5%	-	-	-
$510 - $519		-	-	-	-	-
$520 - $529		-	-	-	-	-
$530 - $539		-	-	-	-	-
$540 - $549		-	-	-	-	-
$550 - $559		-	-	-	-	-
$560 - $569		-	-	-	-	-
$570 - $579		-	-	-	-	-
$580 - $589		-	-	-	-	-
$590 - $599		-	-	-	-	-
More than $600		0.1%	-	0.2%	-	-
TOTAL		100%	100%	100%	100%	100%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
Q20. TAKING INTO CONSIDERATION THAT ENERGY (ELECTRIC, GAS AND OIL FROM THE UTILITY COMPANY) USED IN A HOME PRODUCES A SIGNIFICANT AMOUNT OF POLLUTION, HOW MUCH MORE MONTHLY WOULD YOU BE WILLING TO PAY FOR A HOME THAT USES NON-POLLUTING SOURCES OF ENERGY?	*N*	*1,740*	*434*	*433*	*414*	*410*
$0 / None		22.1%	21.7%	21.5%	24.2%	22.0%
At least $1 but less than $10		11.6%	10.4%	11.3%	11.4%	12.9%
$10 - $19		12.0%	10.8%	13.9%	9.9%	13.9%
$20 - $29		12.1%	12.9%	13.9%	10.4%	11.5%
$30 - $39		6.7%	5.5%	8.3%	8.0%	5.1%
$40 - $49		4.5%	5.1%	3.7%	6.0%	3.4%
$50 - $59		11.5%	13.1%	9.5%	11.6%	11.5%
$60 - $69		1.0%	0.5%	1.8%	0.5%	1.2%
$70 - $79		1.3%	1.2%	1.2%	1.7%	1.0%
$80 - $89		1.2%	1.2%	1.2%	1.2%	1.2%
$90 - $99		2.0%	2.3%	2.3%	1.0%	2.2%
$100 - $109		7.9%	7.8%	7.2%	8.5%	7.6%
$110 - $119		0.6%	0.7%	0.2%	0.5%	0.7%
$120 - $129		0.5%	0.2%	0.9%	0.2%	0.7%
$130 - $139		0.3%	0.2%	0.5%	0.2%	-
$140 - $149		0.2%	0.2%	0.2%	0.2%	-
$150 - $159		1.6%	2.5%	0.9%	1.7%	1.0%
$160 - $169		0.1%	-	0.2%	-	-
$170 - $179		0.2%	0.2%	0.2%	0.5%	-
$180 - $189		-	-	-	-	-
$190 - $199		0.2%	0.5%	0.2%	0.2%	-
$200 - $209		1.1%	1.6%	0.5%	0.7%	1.7%
$210 - $219		0.1%	-	-	-	0.2%
$220 - $229		0.1%	-	-	0.2%	0.2%
$230 - $239		0.1%	-	-	-	0.2%
$240 - $249		0.1%	0.2%	-	-	-
$250 - $259		0.2%	0.2%	-	0.5%	-
$260 - $269		0.1%	-	-	-	0.2%
$270 - $279		0.2%	0.5%	-	-	0.2%
$280 - $289		-	-	-	-	-
$290 - $299		-	-	-	-	-
$300 - $309		0.2%	-	-	-	0.7%
$310 - $319		-	-	-	-	-
$320 - $329		-	-	-	-	-
$330 - $339		-	-	-	-	-
$340 - $349		-	-	-	-	-
$350 - $359		-	-	-	-	-
$360 - $369		-	-	-	-	-

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$370 - $379		-	-	-	-	-
$380 - $389		-	-	-	-	-
$390 - $399		-	-	-	-	-
$400 - $409		-	-	-	-	-
$410 - $419		-	-	-	-	-
$420 - $429		-	-	-	-	-
$430 - $439		-	-	-	-	-
$440 - $449		-	-	-	-	-
$450 - $459		-	-	-	-	-
$460 - $469		-	-	-	-	-
$470 - $479		-	-	-	-	-
$480 - $489		0.1%	-	-	-	0.2%
$490 - $499		-	-	-	-	-
$500 - $509		0.2%	0.5%	-	0.2%	-
$510 - $519		-	-	-	-	-
$520 - $529		-	-	-	-	-
$530 - $539		-	-	-	-	-
$540 - $549		-	-	-	-	-
$550 - $559		-	-	-	-	-
$560 - $569		-	-	-	-	-
$570 - $579		0.1%	-	0.2%	-	-
$580 - $589		0.1%	-	-	0.2%	-
$590 - $599		0.1%	-	-	-	0.2%
More than $600		0.1%	-	0.2%	0.2%	-
TOTAL		100%	100%	100%	100%	100%
Q21. ASSUMING YOU WILL BUY ANOTHER HOME, HOW LIKELY WOULD YOU BE TO PURCHASE THIS CONCEPT HOME?	*N*	*1,741*	*435*	*433*	*414*	*410*
Very likely		18.8%	16.6%	14.8%	17.6%	26.1%
Somewhat likely		66.8%	67.1%	68.6%	68.8%	63.2%
Not at all likely		14.4%	16.3%	16.6%	13.5%	10.7%
TOTAL		100%	100%	100%	100%	100%
Q22. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT ARE EACH OF THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: (Average score based on 1 = very unimportant through 5 = very important)						
The concept home is offered as a standard feature by the builder – it is not optional		3.5	3.5	3.5	3.6	3.6
People you know own a concept home		2.8	2.9	2.8	2.8	2.8
Homes in your neighborhood are concept homes		2.9	2.9	2.8	2.9	2.9
Government provides tax incentives for purchasing concept homes		4.1	4.1	4.0	4.1	4.1

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
Government is promoting concept homes		3.2	3.2	3.2	3.2	3.2
Reduced mortgage rates on concept homes		4.1	4.1	4.1	4.2	4.1
Local utility warranties the solar system on concept homes		4.0	4.0	4.0	4.1	4.1
Home builder warranties the solar system on concept homes		4.2	4.2	4.2	4.3	4.2
Concept home has proven over time to have reliable performance		4.2	4.2	4.2	4.2	4.2
Free 5 year annual maintenance on the heating/cooling/solar systems of concept homes		4.2	4.1	4.2	4.3	4.2
Predictability of future bills (utility/mortgage)		4.0	4.0	4.0	4.0	4.1
Q22A. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT ARE IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCENT HOME: THE CONCEPT HOME IS OFFERED AS A STANDARD FEATURE BY THE BUILDER – IT IS NOT OPTIONAL	*N*	*1,729*	*431*	*430*	*412*	*408*
1 = Very Unimportant		5.9%	5.1%	7.9%	5.3%	4.9%
2 = Unimportant		5.7%	7.2%	4.9%	4.4%	6.9%
3 = Neutral		36.1%	38.5%	36.5%	35.9%	34.1%
4 = Important		33.6%	32.0%	34.0%	34.0%	33.8%
5 = Very Important		18.6%	17.2%	16.7%	20.4%	20.3%
TOTAL		100%	100%	100%	100%	100%
Q22B. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: (PEOPLE YOU KNOW OWN A CONCEPT HOME.)	*N*	*1,733*	*434*	*431*	*410*	*409*
1 = Very Unimportant		14.3%	12.9%	14.8%	15.4%	13.7%
2 = Unimportant		19.7%	18.0%	18.8%	19.0%	22.7%
3 = Neutral		40.5%	41.2%	39.9%	40.5%	40.3%
4 = Important		20.0%	23.0%	20.9%	19.0%	17.8%
5 = Very Important		5.5%	4.8%	5.6%	6.1%	5.4%
TOTAL		100%	100%	100%	100%	100%
Q22C. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: (HOMES IN YOUR NEIGHBORHOOD ARE CONCEPT HOMES.)	*N*	*1,735*	*433*	*432*	*412*	*409*
1 = Very Unimportant		11.9%	10.9%	14.4%	12.4%	9.5%
2 = Unimportant		20.1%	20.6%	19.4%	19.2%	20.8%
3 = Neutral		44.9%	44.8%	44.0%	44.2%	47.7%
4 = Important		17.2%	16.6%	17.1%	17.7%	16.6%
5 = Very Important		5.9%	7.2%	5.1%	6.6%	5.4%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
TOTAL		100%	100%	100%	100%	100%
Q22D. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: GOVERNMENT PROVIDES TAX INCENTIVES FOR PURCHASING CONCEPT HOMES.	*N*	*1,738*	*434*	*433*	*413*	*409*
1 = Very Unimportant		5.4%	5.1%	6.7%	5.6%	4.4%
2 = Unimportant		2.1%	1.8%	2.3%	1.5%	2.9%
3 = Neutral		12.7%	13.6%	11.8%	11.6%	14.2%
4 = Important		39.1%	35.9%	40.0%	42.9%	37.4%
5 = Very Important		40.6%	43.5%	39.3%	38.5%	41.1%
TOTAL		100%	100%	100%	100%	100%
Q22E. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: GOVERNMENT IS PROMOTING CONCEPT HOMES	*N*	*1,734*	*433*	*432*	*411*	*409*
1 = Very Unimportant		9.7%	9.2%	10.6%	10.5%	8.3%
2 = Unimportant		11.1%	11.1%	9.7%	10.2%	13.9%
3 = Neutral		40.2%	39.3%	40.0%	40.9%	40.6%
4 = Important		26.1%	28.4%	27.3%	23.8%	23.7%
5 = Very Important		12.9%	12.0%	12.3%	14.6%	13.4%
TOTAL		100%	100%	100%	100%	100%
Q22F. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: REDUCED MORTGAGE RATES ON CONCEPT HOMES	*N*	*1,736*	*432*	*433*	*412*	*410*
1 = Very Unimportant		5.8%	5.8%	6.5%	5.1%	6.1%
2 = Unimportant		2.2%	3.0%	3.0%	1.0%	1.7%
3 = Neutral		11.6%	11.6%	12.0%	9.5%	12.9%
4 = Important		35.7%	35.2%	35.1%	40.3%	32.2%
5 = Very Important		44.8%	44.4%	43.4%	44.2%	47.1%
TOTAL		100%	100%	100%	100%	100%
Q22G. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: LOCAL UTILITY WARRANTIES THE SOLAR SYSTEM ON CONCEPT HOMES	*N*	*1,736*	*433*	*432*	*412*	*410*
1 = Very Unimportant		5.5%	6.5%	6.0%	4.6%	4.9%
2 = Unimportant		2.0%	1.6%	2.3%	1.5%	2.4%
3 = Neutral		15.3%	17.1%	14.4%	15.0%	15.4%
4 = Important		37.3%	36.7%	35.4%	39.3%	37.1%
5 = Very Important		39.9%	38.1%	41.9%	39.6%	40.2%
TOTAL		100%	100%	100%	100%	100%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
Q22H. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: HOME BUILDER WARRANTIES THE SOLAR SYSTEM ON CONCEPT HOMES	*N*	*1,734*	*433*	*433*	*411*	*408*
1 = Very Unimportant		5.7%	6.0%	5.8%	5.6%	5.4%
2 = Unimportant		1.8%	2.5%	2.3%	0.7%	1.5%
3 = Neutral		10.7%	10.6%	9.9%	9.7%	12.3%
4 = Important		29.1%	31.4%	29.8%	30.2%	26.0%
5 = Very Important		52.7%	49.4%	52.2%	53.8%	54.9%
TOTAL		100%	100%	100%	100%	100%
Q22I. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: CONCEPT HOME HAS PROVEN OVER TIME TO HAVE RELIABLE PERFORMANCE	*N*	*1,731*	*433*	*430*	*412*	*407*
1 = Very Unimportant		5.3%	6.0%	5.3%	5.3%	4.4%
2 = Unimportant		1.6%	1.2%	2.1%	1.2%	2.0%
3 = Neutral		11.5%	12.0%	11.2%	11.2%	11.5%
4 = Important		34.1%	33.5%	33.7%	34.5%	33.9%
5 = Very Important		47.5%	47.3%	47.7%	47.8%	48.2%
TOTAL		100%	100%	100%	100%	100%
Q22J. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: FREE 5 YEAR ANNUAL MAINTENANCE ON THE HEATING/COOLING/SOLAR SYSTEMS OF CONCEPT HOMES	*N*	*1,734*	*431*	*432*	*413*	*410*
1 = Very Unimportant		5.5%	6.5%	6.0%	5.1%	4.4%
2 = Unimportant		1.4%	1.9%	1.9%	0.2%	2.0%
3 = Neutral		9.7%	10.2%	8.3%	8.5%	11.7%
4 = Important		33.6%	33.4%	34.7%	36.6%	29.5%
5 = Very Important		49.8%	48.0%	49.1%	49.6%	52.4%
TOTAL		100%	100%	100%	100%	100%
Q22K. ASSUMING YOU WILL BUY ANOTHER HOME, HOW IMPORTANT IS THE FOLLOWING IN DECIDING WHETHER TO PURCHASE A CONCEPT HOME: PREDICTABILITY OF FUTURE BILLS (UTILITY/MORTGAGE)	*N*	*1,731*	*431*	*429*	*413*	*409*
1 = Very Unimportant		5.3%	5.6%	6.1%	5.1%	4.6%
2 = Unimportant		2.3%	3.0%	1.6%	1.5%	2.7%
3 = Neutral		13.6%	14.4%	14.2%	13.6%	11.7%
4 = Important		43.1%	42.7%	41.5%	46.2%	43.3%
5 = Very Important		35.7%	34.3%	36.6%	33.7%	37.7%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
TOTAL		100%	100%	100%	100%	100%
Q23. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS THEY RELATE TO THIS CONCEPT HOME: 7 = Most Important through 1 = Least Important						
Resale value of the home		4.0	3.6	4.2	4.0	4.1
State of the art technology		2.2	2.3	2.0	2.2	2.2
Physical comfort		4.7	4.7	4.7	4.8	4.7
Indoor air quality		4.2	4.4	4.1	4.1	4.1
Energy efficiency		5.3	5.3	5.3	5.2	5.3
Safety		4.7	4.8	4.7	4.7	4.5
Environmental friendliness		3.0	3.0	3.0	3.0	3.1
Q2A3. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS IT RELATES TO THIS CONCEPT HOME: RESALE VALUE OF THE HOME	*N*	*1,741*	*435*	*433*	*414*	*410*
1 = Least Important		13.6%	17.7%	11.3%	14.0%	11.7%
2		17.1%	21.6%	14.3%	15.9%	15.9%
3		13.3%	13.3%	12.7%	13.5%	13.7%
4		14.1%	12.9%	15.5%	11.6%	15.6%
5		12.8%	8.0%	13.9%	14.5%	14.9%
6		13.6%	13.8%	13.4%	16.4%	11.2%
7 = Most Important		15.7%	12.6%	18.9%	14.0%	17.1%
TOTAL		100%	100%	100%	100%	100%
Q23B. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS IT RELATES TO THIS CONCEPT HOME: STATE OF THE ART TECHNOLOGY	*N*	*1,739*	*434*	*432*	*414*	*410*
1 = Least Important		50.3%	46.3%	54.4%	51.4%	48.5%
2		21.3%	24.4%	21.3%	18.8%	20.5%
3		10.8%	9.2%	9.3%	12.8%	12.7%
4		5.7%	6.2%	4.9%	5.1%	6.3%
5		5.4%	6.0%	5.1%	4.6%	6.1%
6		3.7%	4.1%	3.7%	3.6%	3.4%
7 = Most Important		2.8%	3.7%	1.4%	3.6%	2.4%
TOTAL		100%	100%	100%	100%	100%
Q23C. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS IT RELATES TO THIS CONCEPT HOME: PHYSICAL COMFORT	*N*	*1,738*	*434*	*432*	*413*	*410*
1 = Least Important		3.7%	3.7%	5.6%	3.1%	2.2%
2		7.5%	7.4%	7.9%	7.3%	8.0%
3		13.6%	14.7%	12.5%	12.1%	13.2%
4		17.8%	14.3%	16.9%	18.4%	22.7%
5		20.7%	23.7%	20.4%	21.5%	16.8%
6		20.1%	20.0%	20.1%	21.3%	19.0%
7 = Most Important		16.7%	16.1%	16.7%	16.2%	18.0%
TOTAL		100%	100%	100%	100%	100%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
Q23D. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS IT RELATES TO THIS CONCEPT HOME: INDOOR AIR QUALITY	*N*	*1,739*	*434*	*432*	*414*	*410*
1 = Least Important		5.0%	4.8%	3.9%	6.0%	5.1%
2		10.9%	5.8%	14.8%	10.9%	13.2%
3		20.0%	18.0%	22.7%	19.3%	19.8%
4		20.8%	24.4%	18.1%	20.5%	19.8%
5		20.2%	21.4%	18.1%	19.3%	21.2%
6		16.2%	19.1%	15.5%	17.1%	13.9%
7 = Most Important		7.0%	6.5%	6.9%	6.8%	7.1%
TOTAL		100%	100%	100%	100%	100%
Q23E. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS IT RELATES TO THIS CONCEPT HOME: ENERGY EFFICIENCY	*N*	*1,740*	*435*	*432*	*414*	*410*
1 = Least Important		1.6%	0.9%	1.6%	1.4%	2.0%
2		4.7%	3.2%	5.1%	5.8%	4.6%
3		9.8%	11.0%	9.3%	8.5%	10.7%
4		14.1%	16.1%	13.7%	15.5%	11.5%
5		17.4%	17.9%	17.6%	20.0%	14.9%
6		23.5%	20.9%	22.9%	22.5%	26.8%
7 = Most Important		28.9%	29.9%	29.9%	26.3%	29.5%
TOTAL		100%	100%	100%	100%	100%
Q23F. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS IT RELATES TO THIS CONCEPT HOME: SAFETY	*N*	*1,740*	*435*	*432*	*414*	*410*
1 = Least Important		5.2%	6.0%	4.6%	3.4%	7.3%
2		10.8%	8.5%	9.5%	12.8%	11.7%
3		14.1%	14.5%	14.1%	12.8%	15.1%
4		15.0%	14.5%	15.0%	16.2%	14.9%
5		15.8%	15.2%	17.6%	13.5%	16.8%
6		14.7%	14.7%	16.0%	14.0%	13.4%
7 = Most Important		24.4%	26.7%	23.1%	27.3%	20.7%
TOTAL		100%	100%	100%	100%	100%
Q23G. PLEASE RANK THE FOLLOWING IN ORDER OF IMPORTANCE AS IT RELATES TO THIS CONCEPT HOME: ENVIRONMENTAL FRIENDLINESS	*N*	*1,739*	*434*	*432*	*414*	*410*
1 = Least Important		20.6%	20.5%	18.5%	20.3%	23.2%
2		27.7%	29.0%	27.1%	28.5%	26.1%
3		18.5%	19.1%	19.4%	21.0%	14.9%
4		12.5%	11.5%	16.0%	12.8%	9.3%
5		7.8%	7.8%	7.4%	6.5%	9.3%
6		8.2%	7.4%	8.3%	5.1%	12.2%
7 = Most Important		4.7%	4.6%	3.2%	5.8%	5.1%
TOTAL		100%	100%	100%	100%	100%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
Q24. HOW MUCH MORE MONTHLY WOULD YOU BE WILLING TO PAY FOR A CONCEPT HOME THAT IS COMPARABLE TO YOUR EXISTING HOME?	*N*	*1,741*	*435*	*433*	*414*	*410*
$0 / None		16.7%	17.2%	17.8%	15.9%	16.3%
At least $1 but less than $10		4.8%	3.7%	4.6%	4.8%	5.6%
$10 - $19		4.7%	4.4%	3.7%	4.6%	6.1%
$20 - $29		5.3%	4.8%	6.5%	4.3%	5.4%
$30 - $39		3.3%	3.0%	3.7%	3.4%	3.2%
$40 - $49		3.4%	2.3%	4.6%	4.1%	3.2%
$50 - $59		11.4%	11.3%	12.5%	10.4%	12.2%
$60 - $69		1.7%	2.1%	1.8%	1.4%	1.5%
$70 - $79		2.1%	2.5%	1.8%	2.2%	1.5%
$80 - $89		2.1%	1.6%	1.8%	2.7%	2.4%
$90 - $99		2.6%	2.3%	4.4%	1.4%	2.4%
$100 - $109		21.3%	22.8%	20.6%	23.2%	18.3%
$110 - $119		1.4%	0.7%	1.6%	1.7%	1.5%
$120 - $129		2.2%	1.8%	2.3%	2.2%	2.0%
$130 - $139		0.5%	0.9%	0.2%	-	0.5%
$140 - $149		0.8%	1.1%	0.7%	0.7%	0.5%
$150 - $159		4.0%	3.2%	3.9%	4.6%	4.1%
$160 - $169		0.1%	0.2%	0.2%	-	-
$170 - $179		0.4%	0.5%	0.2%	0.7%	0.2%
$180 - $189		0.3%	-	0.5%	0.2%	0.5%
$190 - $199		0.6%	0.9%	0.2%	0.5%	0.7%
$200 - $209		5.5%	6.2%	4.2%	4.3%	7.1%
$210 - $219		0.1%	-	-	-	0.5%
$220 - $229		0.4%	0.2%	-	0.7%	0.7%
$230 - $239		0.2%	0.2%	-	-	0.2%
$240 - $249		0.3%	0.7%	0.2%	0.2%	-
$250 - $259		0.6%	0.7%	0.2%	1.7%	-
$260 - $269		0.2%	0.2%	-	0.5%	0.2%
$270 - $279		0.2%	0.5%	-	0.2%	-
$280 - $289		-	-	-	-	-
$290 - $299		-	-	-	-	-
$300 - $309		0.9%	1.4%	0.5%	0.7%	0.7%
$310 - $319		-	-	-	-	-
$320 - $329		0.2%	0.5%	0.5%	-	-
$330 - $339		-	-	-	-	-
$340 - $349		0.1%	0.2%	-	-	0.2%
$350 - $359		0.3%	0.5%	-	-	0.7%
$360 - $369		-	-	-	-	-
$370 - $379		-	-	-	-	-
$380 - $389		-	-	-	-	-
$390 - $399		-	-	-	-	-
$400 - $409		0.3%	-	-	0.7%	0.7%

Consumer Question	N*	Total U.S.	Northeast (Divisions 1&2)	Midwest (Divisions 3&4)	South (Divisions 5&6&7)	West (Divisions 8&9)
$410 - $419		-	-	-	-	-
$420 - $429		0.1%	-	-	-	0.2%
$430 - $439		-	-	-	-	-
$440 - $449		-	-	-	-	-
$450 - $459		0.1%	-	-	-	0.2%
$460 - $469		-	-	-	-	-
$470 - $479		-	-	-	-	-
$480 - $489		-	-	-	-	-
$490 - $499		-	-	-	-	-
$500 - $509		0.6%	1.1%	-	1.2%	0.2%
$510 - $519		-	-	-	-	-
$520 - $529		-	-	-	-	-
$530 - $539		-	-	-	-	-
$540 - $549		-	-	-	-	-
$550 - $559		-	-	-	-	-
$560 - $569		-	-	-	-	-
$570 - $579		-	-	-	-	-
$580 - $589		-	-	-	-	-
$590 - $599		-	-	-	-	-
More than $600		0.3%	0.2%	0.7%	0.5%	-
TOTAL		100%	100%	100%	100%	100%

*N is equal to the number of respondents to the question.

Appendix C: Housing Start Projections

The impact of ZEH implementation on new single-family home construction is based on how much of the market can be penetrated by ZEH under each scenario and how large the single-family home market will be in each region. Therefore, an analysis was conducted to estimate the size of the single-family housing market to 2050.[12]

First, the population was estimated using the U.S. Bureau of the Census's projections under a moderate emigration scenario, as presented in Table 7. [7]

Table 7. Projected Size of U.S. Population to 2050

Year	U.S. Projected Population
2010	308,936,000
2020	335,805,000
2030	363,584,000
2040	391,946,000
2050	419,854,000

To determine the size of the single-family home market to 2050, the following information was used as a basis:

- In 2004, there are approximately 82 million single-family homes in the U.S. comprised of 75 million detached homes and 7 million attached homes (townhouses)
- Annual single-family new home starts have exceeded 1 million every year for the past 12 years and have exceeded 1.2 million every year since 1998
- In 2003, about 1.5 million single-family homes were constructed
- Most new homes are built to accommodate the growing number of households, and are therefore additions to the existing housing stock
- A small number of new homes serve as replacements for units that are removed from the stock due to age, natural disasters, zoning changes, or other reasons. Although this number is not well documented, it is estimated to be about 0.3% of the housing stock

Housing projections were based on the projected change in the size of the national population and the following assumptions:[13]

[12] Although ZEH retrofits are technically possible, they were not examined for this study because of their expense and, therefore, unlikelihood of being a significant portion of the market. However, the ZEH retrofit market may be an important spin-off benefit of ZEH development and could be examined in a future study.

[13] It should be noted that economic factors such as interest rates and the general state of the economy were not explicitly considered in housing projections. Long-term projections are driven by population changes, while economic factors mainly affect the timing of events.

- The average number of people per household will decline from its present level of 2.6 to around 2.4 by 2029, when it will level off.[14]
- Housing removals will rise from a rate of 0.3% of the stock to 0.5% as the increasing share of aging stock is replaced
- A vacancy rate of 13% will gradually rise to 14%
- Manufactured housing recovers from its recent low share of 7% to around 10%
- Multifamily housing's share of starts is expected to account for about 33% of starts by 2030 and drop to 28% by 2050.

The projection of housing starts to 2050 is presented in Figure 16. The cumulative housing stock to 2050 is shown in Figure 17. Note how homes built after 2005 become an increasing portion of the housing stock with time, which is key to the impact of ZEH on the energy consumption of the entire U.S. single-family home stock.

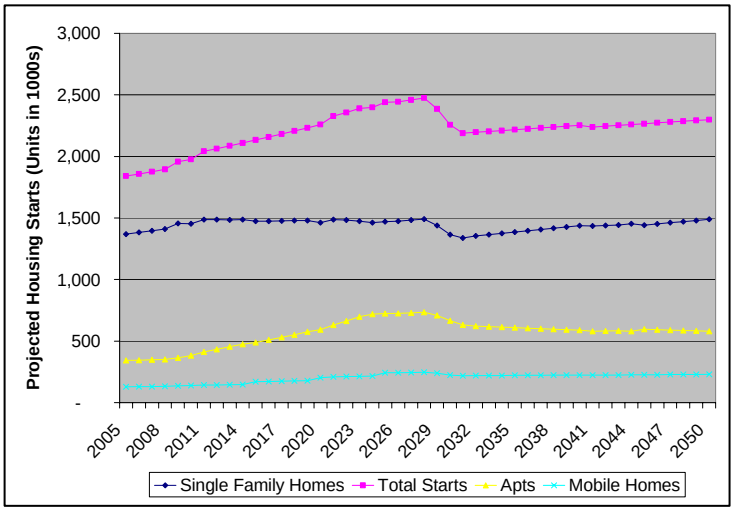

Figure 16. Projected Housing Starts 2005-2050

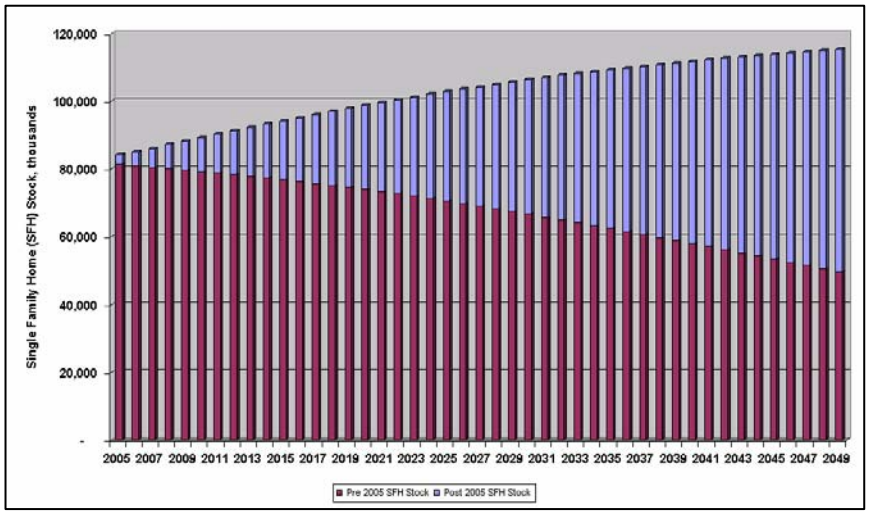

Figure 17. Total Housing Units Projected to 2050

[14] The decline in people per household is associated with an anticipated increase in the share of multifamily housing starts prompted by the entry of echo boomers (those born 1980 and after) into the housing market. As echo boomers begin to reach middle age around 2030, multifamily housing is expected to begin to account for a shrinking share of starts; thus, the single family market benefits from an increased share of starts.

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