ENERGY AND COST IMPLICATIONS OF THE FLORIDA ENERGY STAR® RESIDENTIAL HVAC REBATE PROGRAM

By

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To the 2010 Florida Legislature’s Budget Committee and Florida Energy Office

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Abstract of Thesis Presented to the Graduate School
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In July 2010, the Florida's Governors Energy Office released the Florida ENERGY STAR Residential HVAC Rebate Program. The program was funded by a grant from the Federal Recovery and Reinvestment Act and allocated $15 Million (M) for the Florida ENERGY STAR Residential HVAC Rebate Program. The Program was designed to provide a $1,500 State Rebate for home owners who purchase and install a new HVAC system. This amounts to 10,000 rebates for Florida homeowners. The program started on August 1, 2010.

On September 14, 2010 the program was put on hold by the Leaders of the Florida State Legislature. On November 16, 2010, the Florida State Legislature held special session and made a ruling, Rule 16B, on the Florida ENERGY STAR Residential HVAC Rebate Program. The final decision ruled that the rebates would only be paid out to homeowners who had their HVAC systems contracted to be replaced in a 2 week window, from August 31, 2010 – September 14, 2010, and installed on or before November 30, 2010. The rest of allocated funds would be used to fund outstanding

solar rebates unrelated to the HVAC and Appliance Rebate Program for the Florida Solar Energy System Incentives Program.

In July 2011 a final report was released by the Florida Office of Energy on the Florida ENERGY STAR Residential HVAC Rebate Program. It showed a total of 4,286 rebates were approved and paid as a result of the Program. There was an additional 1,088 rebate applications that were rejected. In February 2012, the Florida Office of Energy released their 2011 annual report, which contained supplemental data pertaining to how the reallocated funds were spent on the Florida Solar Incentives Program's outstanding rebates for solar photovoltaic systems and solar hot water systems.

This study aims to determine the energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate Program by comparing the Program's potential energy and cost implications to the Program's outcome energy and cost implications.

The findings of this study showed that the outcome energy and cost savings of the Florida ENERGY STAR Residential HVAC Rebate Program exceeded the potential energy and cost savings by approximately 50,000 megawatt hours (mWh) of energy, or approximately $5 M. The main driver of the outcome energy and cost savings was the low rebate amount for solar hot water systems which made up 25% of the outcome energy and cost savings, but only cost 4% in rebates paid.

CHAPTER 1
LITERATURE REVIEW

Florida ENERGY STAR® Residential HVAC Rebate Program

Overview

A literature review was completed to provide background information and data pertaining to the energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate Program. This chapter discusses the HVAC Rebate Program history and requirements, and an overview of the typical Florida home.

Program History

The United States Congress approved the State Energy-Efficient Appliance Rebate Program (SEEARP) through the American Recovery and Reinvestment Act (ARRA) (USDOE 2012). According to the U. S. Department of Energy (USDOE), The Recovery Act provided $296 M nationwide to establish USDOE support for State rebate programs for residential ENERGY STAR appliance products. In addition to SEEARP funds, Florida also received State Energy Program (SEP) funds to initiate programs within the state to save energy within the residential home. States received formula-based funding and the objectives are:

Save energy by encouraging appliance replacement through consumer rebates.

Make rebates available to consumers.

Encourage energy efficiency within the home.

Keep administrative costs low while adhering to monitoring and evaluation requirements.

Promote state and national tracking and accountability.

Use existing ENERGY STAR consumer education and outreach materials.

In 2009, the Florida Governor's Office allowed the Florida Energy and Climate Commission (FECC) to apply for the federal grant. The State of Florida received $17.58 M to establish an ENERGY STAR appliance rebate program and an additional $15 M to develop a residential program to increase energy efficiency within the home. The grant came with specific guidelines on how the state program should be structured as established by the US Department of Energy. The FECC conducted a series of public workshops during the summer of 2009 to design a program specific to Florida's needs while also meeting the guidelines established by the USDOE. That program was approved by the FECC and adopted through formal rule making. Florida's ENERGY STAR Appliance Rebate Program and the Florida ENERGY STAR Residential HVAC Rebate Program focus on replacing residential appliances and improving energy efficiency in Florida homes (Florida ENERGY STAR Residential HVAC Rebate Program 2010).

On August 31, 2010, the Governor's Energy Office made the Florida ENERGY STAR Residential HVAC Rebate Program public and encouraged Florida homeowners to invest in a more efficient HVAC system. The Program was embraced by homeowners, HVAC contractors and energy Raters. According to the Florida Office of Energy (FOE), over 1,500 applications were received in the first week (FOE 2010).

On September, 14, 2010, the Governor's Energy Office released a statement saying that the program was on hold until further notice. On November 16, 2010, the Florida Legislature held a special session and passed rule 16B (Appendix A). Rule 16B is the final decision pertaining to the Florida ENERGY STAR Residential HVAC Rebate Program and the Florida ENERGY STAR Appliance Rebate Program. The Ruling

decided that rebates for the Florida ENERGY STAR Residential HVAC Rebate Program would only be paid to those who contracted to have their HVAC system replaced after August 29, 2010 and before September 14, 2010. Rebates would also only be paid to those who mailed in their rebate form and required documentation on or before November 30, 2010. The ruling appropriated $2,467,244 in funds for HVAC rebates and re-appropriated $28,902,623, less any outstanding HVAC rebates, for outstanding solar rebates from the Florida Solar Energy Incentives Program (Florida Legislature 2010).

In early 2011, the State estimated that approximately 3,000 homeowners qualified for the Florida ENERGY STAR Residential HVAC Rebate Program. On July 25, 2011, a final report was released on the Florida ENERGY STAR Residential HVAC Rebate Program from the FOE. It showed a total of 4,286 Rebates were approved and paid out as a result of the program (Appendix A). There was also an additional 1,088 Rebate applications that were rejected (FOE 2011).

Program Overview

According to the Florida ENERGY STAR Residential HVAC Rebate Program, “The Florida ENERGY STAR Residential HVAC Rebate Program is designed to encourage existing homeowners to replace their old energy-inefficient heating and cooling system with a properly-sized energy efficient system and to ensure that their heating and cooling duct system has minimal leakage (Florida ENERGY STAR Residential HVAC Rebate Program 2010). Qualifying HVAC systems have been set by the federal government to meet the Federal Energy Tax Credits Standards. Systems that meet Federal Energy Tax Credits Standards will also meet the Florida ENERGY STAR Residential HVAC Rebate Program Standards.

In addition to purchasing a new central air-conditioner, air source heat pump or geothermal heat pump in Florida that meets the Federal Energy Tax Credits standards, Florida homeowners must also hire either a Florida Class 1 Rater, a State of Florida licensed Mechanical Contractor, or a recognized Test and Balance Agent to perform a duct test on their home to document that the home has no more than 15% leakage to the outside (as indicated by a score of 0.10 Qn.out[1]). Home Owners that meet all of the referenced criteria are entitled to a rebate in the amount of $1,500 (Florida ENERGY STAR Residential HVAC Rebate Program 2010).

According to the Florida ENERGY STAR Residential HVAC Rebate Program, the Program aims to provide a financial incentive to homeowners to upgrade their system to an energy efficient unit and to have their home ducting system checked and corrected concurrent with replacing their HVAC system.

Program Requirements

HVAC systems

Homeowners must install a new HVAC System that qualifies for the Florida ENERGY STAR Residential HVAC Rebate Program. There was a list of approved models available on the Governor;s Energy Office Website, http://www.rebates.com/floridahvac/ (Florida Rebate 2010).

Manual J report

A Manual J Report is a computer generated report used as a sizing tool for HVAC Systems (RESNET 2012). The Manual J Software calculates system sizing through a procedure developed by the Air Conditioning Contractors of America (ACCA) and is

1 “Qn.out – Normalized ADS (Air Distribution System) leakage is the total volumetric air leakage rate of the ADS to and from outdoors when the ADS system is depressurized to 25 pascals, normalized to the floor area of the house. Specifically Qn.out = CFM25/Conditioned Floor Area” (Moyer, et al. 1998).

provided by independent software companies. The software uses building data and climate information to calculate the most effective sized unit for the building.

Building permit

The program requires that all HVAC Systems are installed legally by getting a building permit. Building permits are applied for and received by the HVAC Contractor and all new HVAC installations are inspected upon completion. A copy of the Building Permit is posted onsite.

Duct testing

A duct test, or Air Distribution System test, is required by the program to make sure that the efficient HVAC system installed is going to perform to its full potential. A duct test is a scientific performance based test performed by a qualified Third Party Verifier. The duct test involves a multi step process of testing the duct system and checks the ducts systems' total leakage as a percentage to floor area.

A duct test or ADS test, is performed according to the steps listed in Appendix B and is documented with an air distribution system test report.

Program Funding and Distribution

The Florida ENERGY STAR Residential HVAC Rebate Program was funded through a grant from the Federal Recovery and Reinvestment Act. This Act was signed into law on February 17, 2009. The Act was created to turn around the economic downturn to help promote infrastructure and jobs. Title XVI Section 1607 of the Federal Recovery and Reinvestment Act governs how the funds are distributed and the appropriate use of funds (Federal Recovery and Reinvestment Act 2010).

Though the program was directly funded through a grant from the Federal government, funds were allocated and distributed by the State. Florida Statute 216.212 governs how federally distributed funds are allocated by the State Legislature.

Federal Recovery and Reinvestment Act, Title XVI, Section 1607

The Federal Recovery and Reinvestment Act, Title XVI, Section 1607 (Appendix C) refers to additional funding distribution and assurance of appropriated funds. The section states that all funds must be certified by the Governor of the State. It further requires the State Governor to request funds provide by this Act and to ensure that the funds are used to create jobs and promote economic growth. The section also states that if the funds are not acceptance for use by the Governor, the State Legislature shall be able to adopt a concurrent resolution and provide funding to their state. Only if the Governor does not accept the funds for their State, the Legislature can accept the funds and distribute the funds throughout the state.

Florida State Statutes Chapter 216.212

The Florida State Statutes are a permanent collection of State laws organized by subject area into a code made up of titles, chapters, parts and sections. The Florida Statutes are updated annually by laws that create, amend, transfer, or repeal statutory material (Florida Legislature 2012).

Florida State Statute Chapter 216.212 governs how the State is allowed to use Federal funds and dictates the procedure for distributing said funds (Appendix D). According to the Statute, the Governor and the Chief Financial Officer are responsible for the developing and implementing a plan for the allocation of Federal grants and funding. The Office of the Governor is also responsible for creating a clearinghouse that is responsible for distributing the all federal grants and funds throughout the State. The

Statute further states that all federal funds appropriated by Congress must be approved for distribution by the State Legislature, however, the Executive Office of the Governor or the Chief Justice of the Supreme Court may, after consultation with the legislatures Appropriations Committee, receive and distribute federally appropriated funds (Florida Legislature 2012).

The Florida Solar Energy System Incentives Program

Program History

The Florida Solar Energy System Incentives Program was created in 2006 under the Florida Energy Technologies and Energy Efficiency Act (Florida Legislature 2012). The Program began on July 1, 2006 and was slated to run through June 20, 2010. The program was administered by the FECC. Thousands of Florida home owners and business owners took advantage of the rebates and purchased qualifying solar systems. Over $59 M in outstanding rebates had been applied for by the public and accepted by the FECC before the Governer's Office were able to publicly announce that funds had been depleted. The outstanding funds from the Program were eventually paid partially through the reallocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program.

Typical Florida Home

A typical Florida home was developed to create a baseline to complete this research. In order to develop the typical Florida home, data was collected from the US Energy Administration, 2010 US Census and the Shimberg Center for Housing Studies at the M. E. Rinker, Sr. School of Building Construction, University of Florida.

Home Characteristics

Information from the US Energy Administration's 2009 RECS survey data for housing characteristics was used. The dataset used for housing characteristics was "USEA HC2.10 Structural and Geographic in South Region." The 2010 US Census data on Florida households was used to determine the average household size of owner occupied homes in Florida. The Shimberg Center's data for home sales in Florida was used to determine the average home size in Florida.

Home Equipment and Appliances

To determine the equipment and appliances included in the typical Florida home, information from the US Energy Administration's 2009 RECS Survey Data was used. The following data sets were used:

USEA HC 1.10 Fuels Used and End Uses in South Region
USEA HC 3.10 Appliances in South Region
USEA HC 6.10 Space Heating in South Region
USEA HC 7.20 Air Conditioning in South Region
USEA HC 8.10 Water Heating in South Region

Building Energy Modeling

For this research, three building energy models were developed. Building Energy Modeling (BEM) is a computer simulated approach to estimate energy usage in a building. A list of approved BEM software is available on the USDOE website, http://apps1.eere.energy/gove/building/tools_directory/alpha_list.cfm (EERE 2011). BEM estimates the energy use of a building according to model inputs per building plans and specifications. BEM can also be used to estimate energy savings of existing buildings by simulating potential upgrades.

To develop relevant building energy models that represent the typical Florida home, typical Florida home with HVAC Rebate, and typical Florida home with solar hot

water rebate, Energy Gauge USA (Energy Gauge 2012) software was used. Energy Gauge USA is a user friendly, sophisticated home energy simulation software tool designed specifically for evaluating home energy efficiency. The software uses DOE 2.1-E hourly building energy simulation software to estimate energy use and provides evaluation of both energy use and economic and financial impacts of home energy efficiency decision making.

HVAC Systems

Heating, Ventilating, and Air Conditioning (HVAC) equipment perform heating and/or cooling for residential, commercial or industrial buildings. The HVAC system may also be responsible for providing fresh outdoor air to dilute interior airborne contaminants such as odors from occupants, Volatile Organic Compounds (VOCs) emitted from interior furnishings, chemicals used for cleaning, etc. A properly designed system will provide a comfortable indoor environment year round when properly maintained (FSEC 2012).

Common types of HVAC systems used include Cooling Only Split System, Cooling Only Packaged System, Heat Pump, Chilled Water, Window Air Conditioners and Packaged Thermal Heat Pump. According to the US Energy Administration, the system that is most prevalently used in Florida is a central air conditioner with electric heat pump.

System Efficiencies

For this research, HVAC system efficiencies must be determined for both of the Building Energy Models in order to calculate the potential energy and cost implications and outcome energy and cost implications.

The first, or existing, system efficiency must be determined for Building Energy Model 1 “Typical Florida Home.” To determine the efficiency of the HVAC system for Building Energy Model 1, information from the Energy Policy Act of 1992 was used (USDOE 2012). This Act sets standards for Seasonal Energy Efficiency Ratio (SEER) and Heating Seasonal Performance Factor (HSPF) ratings for all residential heating and cooling equipment. The minimum standards for HVAC systems under this act were 10 SEER and 6.8 HSPF. Because the life span of HVAC systems is approximately 15 years, as discussed below, efficiencies from the 2006 Energy Policy Act were not used.

The second, or upgraded, efficiency for Building Energy Model 2, “Typical Florida Home with HVAC Upgrade,” was determined by using the majority SEER rating from the Florida ENERGY STAR Residential HVAC Rebate Program list of approved air conditioning equipment (Florida Rebate 2010). A corresponding high efficiency heat pump rating was then used to calculate the HSPF rating. The efficiencies used for Building Energy Model 2 are 16 SEER and 9.2 HSPF equipment ratings for the Typical Florida Home with HVAC upgrade.

System Life Spans and Degradation

According to the USDOE, the lifespan of a central air conditioner is about 15 to 20 years (USDOE 2012). According to the National Association of Builders (NAHB), the life span of a central air conditioner is 10 to 15 years and the life span of an electric heat pump is 15 to 16 years (NAHB 2012). For the purpose of this research, a life span of 15 years was used. Additionally, regular system maintenance was assumed and system degradation was not factored.

Air Distribution System Leakage

An Air distribution system, or duct system, is a system used to distribute air from the HVAC system throughout the home. For this research, ADS leakage average rates were needed for both building energy models to determine both potential energy savings and outcome energy savings of the Florida ENERGY STAR Residential HVAC Rebate Program.

According to FSEC and Cummings (1990), duct systems in existing home leak between 10% and 30% of the air distribution systems rated flow. Research by Cummings (1990) has shown that sealing ducts reduces duct leakage by 16% to 18%. For research purposes, the typical Florida Home will assume 20% duct leakage before duct repairs, and will assume 3% duct leakage after duct repairs.

Solar Photovoltaic Systems

Photovoltaic systems, or solar cells, as they are often called, are semiconductor devices that convert sunlight into direct current electricity. Photovoltaic systems are generally classified according to their functional and operational requirements, their component configurations, and how the equipment is connected to other power sources and electrical loads. The two principal classifications are grid-connected or utility-interactive systems and stand-alone systems. Photovoltaic systems can be designed to provide DC and/or AC power service, can operate interconnected with or independent of the utility grid, and can be connected with other energy sources and energy storage systems (FSEC 2012).

System Efficiency

For this research, the outcome energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate Program is dependent on calculations of

solar photovoltaic system efficiency. To determine the efficiency of solar photovoltaic systems, a solar calculation worksheet was used. This worksheet was developed by Dr. Charles Kibert, University of Florida. The worksheet was then customized to facilitate the research objective (Table 3-8). The solar calculations worksheet takes into account the degradation, discussed below, of the solar photovoltaic system. To determine the daylight hours available, FSEC's solar calculator (FSEC 2012) was used.System Life Span and Degradation

System Life Span and Degradation

Most solar photovoltaic systems have a life span of 30 to 40 years. While the systems actually last that long, manufacturer warranties and system component failure seem to prove otherwise. According to Dankoff and Shwartz of Home Power Magazine (Dankoff 2007), most manufacturer warranties allow for 20% degradation and a life span of 20 to 25 years. In the report Module 30 Year Life: What does it means and is it predictable/achievable, it is said that the development of a common 30 year pass/fail certification for all PV module types is unexpected. For this research, a 25 year life span for solar photovoltaic systems will be assumed.

According to "Degradation Analysis of Weathered Crystalline Silicon PV Modules" (Osterwald, et el), the average degradation of solar photovoltaic systems is 0.72%per year. For this research, 0.72% degradation per year will be used.

Hot Water Heaters

For this research, hot water heater information is needed for all building energy models created for this research to determine the outcome energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate Program.

Water heaters in homes come in a variety of different packages. For this research, as identified by the US Energy Administration, electric conventional storage water heaters are the most prevalent throughout the state of Florida and will be used for the building energy models.

The Energy Gauge USA determined water heater size of our typical Florida home; a 40 gallon capacity will be used in our building energy models for this research.

System Efficiencies

It is important to understand the efficiencies of electric conventional storage water heaters in order to input accurate information into the building energy models. The National Appliance Energy Conservation Act of 1987 first set standards for water heating systems. According to USDOE, the National Appliance Energy Conservation Act of 1987 and the Energy Policy Act of 1992, the efficiency factor ratings between 82% and 88% (USDOE 2012). For this research an efficiency factor rating of 85% was used.

System Life Span

For this research, the life span of the water heater used in our typical Florida home will not be factored.

Solar Hot Water Heating Systems

In order to calculate the outcome energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate Program, the savings from solar hot water heating systems for both residential and light commercial buildings were estimated. For the purpose of this research, both residential and light commercial solar hot water heating systems will be grouped together.

Moreover, the integral collector storage system will be used as the solar hot water system. To determine the size and type, FSEC's "Simplified Sizing Procedure for Solar Domestic Hot Water Systems" was used. The results of the Sizing Procedure was then cross-referenced with FSEC's list of approved solar hot water systems to determine the system to be used in building energy model 3 (FSEC 2012).

System Efficiencies

For this research, solar hot water system efficiency of the system used in Building Energy Model 3 was determined from FSEC's list of approved solar hot water heaters which was derived from FESC's Simplified Sizing Procedure for Solar Domestic Hot Water Systems. These efficiencies were used in creating Building Energy Model 3.

System Life Span

To determine the potential energy and cost implications for solar hot water systems, the life span of the system was needed. According to FSEC and ENERGY STAR, the average life expectancy of a solar hot water system is 20 years. For this research, a 20 year life span will be used.

Utility Rates

To determine the cost savings of the Florida ENERGY STAR Residential HVAC Rebate Program, utility rates must be determined. For this research, utility rates determined by the building energy modeling software, Energy Gauge USA, was used. A rate of $0.11225 per kWh was used to determine the cost savings of this research.

CHAPTER 2
RESEARCH METHODOLOGY

Overview

The objective of this study is to determine the energy and cost implications of the Florida ENERGY STAR® Residential HVAC Rebate Program by comparing the Program's potential energy and cost implications to the Program's outcome energy and cost implications. The following steps were followed to determine the energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate Program.

Step 1: Typical Florida home

Develop a "typical Florida home" by using data collected from the US Energy Administration, 2010 US Census, and the Shimberg Center. Data from the US Energy Administration was used to determine the house construction characteristics, equipment and appliances, including fuel types, used in the typical Florida home. The 2010 US Census data was used to determine the household size of owner occupied housing in Florida for the typical Florida home. The Shimberg Center's data was used to determine the average Florida home size, according to home sale statistics, for the typical Florida home. This information was used to create the typical Florida homes floor plan, elevations, and building section (Appendix F).

Step 2: Building Energy Models

Create Building Energy Model 1 using Energy Gauge software to calculate the typical Florida home's energy consumption. Create Building Energy Model 2 to represent the typical Florida home's energy consumption after the Florida ENERGY STAR Residential HVAC Rebate Program's HVAC upgrades have been completed

according to the Programs requirements. Create Building Energy Model 3 to represent the typical Florida home's energy consumption after installing a solar hot water system.

Step 3: Potential Energy and Cost Implications

Determine the "potential energy and cost implications," if the original Program had not been interrupted, by comparing the Building Energy Model 1 to Building Energy Model 2 created by Energy Gauge Software to determine the average energy savings in a home when replacing the average existing HVAC system with the Program's proposed new HVAC system and requirements. The energy savings will be multiplied by 10,000 available HVAC rebates, which is $15 M in allocated funds divided by $1,500 rebates available to home owners, to determine the "potential energy and cost implications" of the Program.

Step 4: Outcome Energy and Cost Implications

Determine the "outcome energy and cost implications" of the Program by multiplying the exact number of HVAC rebates paid by the energy savings calculated by comparing Building Energy Model 1 to Building Energy Model 2, plus the average energy savings of solar photovoltaic systems paid for by redirected funds from the Florida ENERGY STAR Residential HVAC Rebate Program, plus the total number solar hot water systems paid for by the redirected funds from the Florida ENERGY STAR Residential HVAC Rebate Program multiplied by the energy savings calculated by comparing Building Energy Model 1 to Building Energy Model 3.

Step 5: Compare Potential Energy and Cost Implications to Outcome Energy and Cost Implications

Compare the Program's potential energy and cost implications to its outcome energy and cost implications to determine the results and develop recommendations for future disbursement of such funds.

CHAPTER 3
RESULTS AND ANALYSIS

Typical Florida Home

The typical Florida home for this research is a 2,051 SF heated and cooled space, detached single family dwelling built in 1985 for 4 occupants. The home features 4 bedrooms, 2 bathrooms, living room, family room, eat-in kitchen and a 2-car garage. The construction characteristics of this home are slab on grade, concrete block construction with unverified insulation, drywall finished walls, 8 foot tall ceilings, composite shingle roofing, and single pane windows. For the purposes of this research, 50% carpet and 50% tile flooring was assumed. The equipment used in the typical Florida house is a central air conditioning system with an electric heat pump and an electric 40 gallon storage water heater. The appliances present in a typical Florida home include a refrigerator with attached freezer, electric cook-top with attached oven (range), microwave, dishwasher, clothes washer and dryer.

For this research, only typical construction drawings were created. These drawings include a floor plan, building elevations and typical wall section (Appendix F). A summary of building characteristics, components, equipment and appliances can be found in the building input summary of building energy model 1 (Appendix G).

Building Energy Modeling

Three building energy models were created for this research. Building Energy Model 1 represents the typical Florida home. Building Energy Model 2 represents the typical Florida home after the HVAC upgrade according to the Florida ENERGY STAR® Residential HVAC Rebate Program requirements. Building Energy Model 3 represents the typical Florida home after installing a solar hot water system.

Building energy model 1 (Appendix G), representing the typical Florida home, showed an annual energy consumption of 15,361 kWh per year (Appendix G). Building energy model 2 (Appendix H), representing the typical Florida home after the HVAC upgrade according to the Florida ENERGY STAR Residential HVAC Rebate Program's requirements, showed an annual energy consumption of 12,581 kWh per year (Appendix H). Building energy model 3 (Appendix I) representing the typical Florida home after installing a solar hot water system (not including the HVAC Rebate), showed an annual energy consumption of 13,042 kWh per year (Appendix I).

Potential Energy and Cost Implications

The findings of potential energy and cost implications of Florida ENERGY STAR Residential HVAC Rebate Program show that, Building Energy Model 1, the existing typical Florida home's energy consumption is 15,361 kWh per year, and Building Energy Model 2, the existing typical Florida home with the HVAC upgrade according to the Florida ENERGY STAR Residential HVAC Rebate Program's requirements had energy consumption of 12,581 kWh per year. This equals in 2,780 kWh of energy savings per year or $312 (Table 3-1).

The energy savings are due to three main factors; Upgrading from an 10 SEER Air Conditioning System to a 16 SEER Air Conditioning System, Upgrading from a 6.8 HSPF electric heat pump to a 9.2 HSPF electric heat pump, and sealing the existing air distribution system, or duct system, reducing duct leakage from approximately 20% leakage to approximately 3% leakage.

To determine the potential energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate program, the energy savings of over the life of the upgraded HVAC system was calculated. For the upgraded HVAC system, a 15 year life

span was assumed with regular maintenance and no deterioration of energy performance.

The potential energy savings of the Florida ENERGY STAR Residential HVAC Rebate Program is the energy savings of the typical Florida home after replacing the HVAC system according to the Program. This is calculated as a product of energy savings of 2,780 kWh, HVAC life span of 15 years, and the total number of homes eligible for the rebate of 10,000. This equals a total potential energy savings of 417,000,000 kWh or $46,808,250 (See Table 3-2).

Outcome Energy and Cost Implications

The following procedure is followed to determine the outcome energy and cost implications of the Florida ENERGY STAR Residential HVAC Rebate Program:

Determine the energy and cost implications of the actual number of HVAC rebates approved and paid out through the Florida ENERGY STAR Residential HVAC Rebate Program.

1. Determine the amount of re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program to pay for outstanding rebates from the Florida Solar System Incentives Program.
2. Determine the energy and cost implications of the solar photovoltaic systems installed from the Solar Energy System Incentives Program that was paid for with the re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program.
3. Determine the energy and cost implications of the solar hot water systems installed from the Solar Energy System Incentives Program that was paid for with the re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program by comparing Building Energy Model 1 to Building Energy Model 3.
4. Add the energy and cost implications of HVAC rebates given with the energy and cost implications of solar photovoltaic systems and solar hot water systems installed under the Solar Energy System Incentives Program and paid for by the Florida ENERGY STAR Residential HVAC Rebate Program to determine the outcome energy savings of the Florida ENERGY STAR Residential HVAC Rebate Program.

Energy and Cost Implications of HVAC Rebates

There are two steps to determine the outcome energy and cost implications from the amount of HVAC Systems replaced from the Florida ENERGY STAR Residential HVAC Rebate Program:

1. Determine the actual number of HVAC Systems replaced.
2. Multiply the actual number of HVAC Systems replaced by the life time energy savings determined in Step 1.

In July 2011, the finaltally of the Florida ENERGY STAR HVAC Rebate Program was released. There were 4,268 rebates approved and paid out due to the Program. In addition to the 4,268 rebates, 1,088 were rejected. For purposes of this research, the rejected rebates were not included for determining total energy savings.

The total outcome energy savings due to the HVAC rebates of program is calculated by the energy savings of the typical Florida home when replacing the HVAC system according to the Program of 2,780 kWh, multiplied by the HVAC life span of 15 years and the total number of homes that received the rebate of 4,268. This equals a total kWh of 177,975,600 kWh or $19,977,761 (Table 3-3).

Re-allocated funds.

According to the November 2010, Florida Legislatures Budget Committee Decision, $24,986,048 was allocated to the outstanding rebates for the Solar Energy System Incentives Program. The original amount designated for the Florida Residential HVAC Rebate program was $15 M. For this research, only the $15 M originally allocated for the Florida ENERGY STAR Residential HVAC Rebate Program will be considered. The total re-allocated funds to pay for the Solar Energy System Incentives Program is the total allocated budget for the Florida ENERGY STAR HVAC Rebate

Program minus the total amount of HVAC rebates paid. In July 2011, the final tally of the Florida ENERGY STAR Residential HVAC Rebate Program showed that 4,268 rebates were given.

The total financial amount used to fund the outstanding rebates for the Florida Solar Energy System Incentives Program is calculated by the total number of rebates approved and paid out of 4,268,multiplied by the rebate amount of $1,500 which equals $6,402,000. This amount is subtracted from original amount allocated to the Program of $15 M. which equals $8,598,000 (Table 3-4).

Solar photovoltaic systems

In order to determine the outcome energy and cost implications from the re-allocated funds for solar photovoltaic systems, supplemental data from the Florida Energy Center's 2011 annual report was used. The supplemental data shows all of the rebates paid for with the re-allocated funds according to the Florida Legislatures House Bill 16B. Because the amount of re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program was the amount of funds available after the Programs rebates had been paid, the data was interpolated to determine the amount of energy savings.

To calculate the energy and cost implications of the solar photovoltaic systems the total dollar amount of rebates paid from the supplemental data from the Florida Energy Office 2011 Annual Report was calculated to be $23,135,927. This dollar amount was then divided by the total amount of re-allocated funds per rule 16B of $24,986,048 in order to calculate the percentage of solar photovoltaic systems installed of 92.6%. This percentage was then multiplied by the total dollar amount re-allocated from the Florida ENERGY STAR Residential HVAC Rebate Program of $8,598,000 to get a total dollar

amount from the re-allocated funds applied to solar photovoltaic system rebates of $7,961,748 (Table 3-5).

The Florida Solar Energy System Incentives Program provided a solar photovoltaic rebates in the amount of $4 per watt based on the total wattage rating of the system; this equals $4,000 per kWh. For research purposes, solar systems exceeding the size for a maximum rebates will not be assumed. Because the outstanding Florida Solar System Incentives Program rebates, as per rule 16B, were only paid at approximately 52% of the original requested amounts, the total dollar amount must be adjusted to reflect the actual rebate amount of $2.08 per watt, or $2,080 per kWh (Table 3-6).

To determine the total kWh of energy savings of solar photovoltaic systems paid for by the re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program we must divide the system specific re-allocated funds of $7,961,748 by the adjusted rebate amount of $2,080 per kWh. This equals 3,828 kWh of solar photovoltaic systems paid for with the re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program (Table 3-7).

To determine the outcome energy and cost implications of solar photovoltaic systems a table to calculate energy production over the lifespan of the systems was created. A 25 year life span of the solar photovoltaic systems was assumed with a 0.72% efficiency loss per year, over the life of the systems, 5.5 sunlight hours per day, 365 days per year to determine the total outcome energy savings of solar photovoltaic systems. Over the 25 year life span of the solar photovoltaic systems, the total energy savings was 176,399,827 kWh or $19,800,880 (Table 3-8).

Solar hot water systems

In order to determine the outcome energy and cost implications from the re-allocated funds for solar hot water systems, supplemental data from the Florida Energy Center's 2011 annual report was used. Because the amount of re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program was the amount of funds available after the Programs rebates had been paid, the data was interpolated to determine the amount of energy savings.

To calculate the energy and cost implications of the solar hot water systems the total dollar amount of rebates paid from the supplemental data from the Florida Energy Office 2011 Annual Report was calculated to be $1,850,121. This dollar amount was then divided by the total amount of re-allocated funds per rule 16B of $24,986,048 in order to calculate the percentage of solar photovoltaic systems installed of 7.4%. This percentage was then multiplied by the total dollar amount re-allocated from the Florida ENERGY STAR Residential HVAC Rebate Program of $8,598,000 to get a total dollar amount from the re-allocated funds applied to solar photovoltaic system rebates of $636,252 (table 3-9).

The Florida Solar System Incentives Program paid $500.00 per solar hot water systems. Because the outstanding Florida Solar System Incentives Program rebates, as per rule 16B, were only paid at approximately 52% of the original requested amounts, the total dollar amount must be adjusted to reflect the actual rebate amount of $260 (Table 3-10).

To determine the kWh of energy savings from solar hot water systems, the total amount of solar hot water systems installed must be determined. To calculate the amount of solar hot water systems installed, the system specific adjusted re-allocated

funds, from the Florida ENERGY STAR Residential HVAC Rebate Program of $636,252 is divided by the adjusted rebate amount of $260. This equals 2,447 solar hot water systems installed with re-allocated funds from the Florida ENERGY STAR Residential HVAC Rebate Program (Table 3-11).

To determine the total kWh of energy savings of solar hot water systems, the total number of solar systems installed of 2,447 is multiplied by the average energy savings of solar hot water systems determined by the difference of building energy model 1 of 15,361 kWh and building energy model 3 of 13,042 kWh equals energy savings of 2,319 kWh per year, multiplied by the life expectancy of solar hot water systems of 20 years. This equals 113,491,860 kWh of energy savings from solar hot water systems or $12,739,461 (Table 3-12).

Outcome Energy and Cost Implications

The findings for the outcome energy savings of the Florida ENERGY STAR Residential HVAC Rebate Program is 467,867,287 kWh of energy savings or $52,518,103 (Table 3-13). These energy savings are due to 177,975,600 kWh of savings from the actual HVAC system replacements from the Florida ENERGY STAR Residential HVAC Rebate Program, 176,399,827 kWh of energy savings from re-allocated funds for solar photovoltaic systems, and 113,491,860 kWh of energy savings from re-allocated funds for solar hot water systems installed from 2009-2010 Florida Solar Energy System Incentives Program.

Compare Potential Energy and Cost Implications to Outcome Energy and Cost Implications

The research found that the potential energy and cost savings of the Florida ENERGY STAR Residential HVAC Rebate Program was 417,000,000 kWh compared

to the outcome energy and cost savings of the Florida ENERGY STAR Residential HVAC Rebate Program of 467,867,287 kWh. This equated to a difference of 50,867,287 kWh or $5,709,853 (Table 3-14).

Table 3-1. Typical Florida Home with HVAC Upgrade Energy and Cost Savings

	Amount	Description
	15,361	kWh Per Year Typical Florida Home
-	12,581	kWh Per Year Typical Florida Home with HVAC Upgrade
=	2,780	kWh Per Year Energy Savings Per Home
x	$0.11225	Cost Per kWh
=	$312	Cost Per Year Energy Savings

Table 3-2. Potential Energy and Cost Savings

	Amount	Description
	2,780	kWh Per Year Energy Savings Per Home
x	15	Year HVAC Life Span
x	10,000	Eligible Homes for HVAC Rebate
=	417,000,000	kWh Total Potential Energy Savings
x	$0.11225	Cost Per kWh
=	$46,808,250	Cost Total Potential Energy Savings

Table 3-3. Actual HVAC Rebates Paid Energy and Cost Savings

	Amount	Description
	2,780	kWh Per Year Energy Savings Per Home
x	15	Year HVAC Life Span
x	4,268	Actual Rebates Paid
=	177,975,600	kWh Total Actual HVAC Rebates Paid Energy Savings
x	$0.11225	Cost Per kWh
=	$19,977,761	Cost Total Actual HVAC Rebates Paid Energy Savings

Table 3-4. Total Reallocated Funds from HVAC Rebate Program

	Amount	Description
	$15,000,000	Total Funds for HVAC Rebate Program
-	4,268	Total HVAC Rebates Paid
x	$1,500	Rebate Amount
=	$8,598,000.00	Total Reallocated Funds from HVAC Rebate Program

Table 3-5. Total Reallocated Funds for Solar Photovoltaic Systems

	Amount	Description
	$23,135,927	Total Spent on Solar Photovoltaic Systems
÷	$24,986,048	Total Spent on all Solar Systems
=	92.6%	Total Percentage Reallocated Funds For Solar Photovoltaics
x	$8,598,000	Total Reallocated Funds from HVAC Rebate Program
=	$7,961,748	Total Reallocated Funds for Photovoltaic Systems

Table 3-6. Adjusted Solar Photovoltaic Rebate Amounts

	Amount	Description
	$4,000	Original Rebate for Solar Photovoltaic System per kWh
x	52%	Of Orignal Rebate Paid Per Rule 15B
=	$2,080	Adjusted Solar Photovoltaic System Rebate Amount Per kWh

Table 3-7. Total kWh Solar Photovoltaic Systems Paid for with Reallocated Funds

	Amount	Description
	$7,961,748	Total Reallocated Funds for Solar Photovoltaic Systems
÷	$2,080	Rebate Amount Per kWh
=	3,828	kWh Solar Photovoltaic Systems

Table 3-8. Outcome Energy and Cost Savings of Photovoltaic Systems

Year	Efficeincy Loss	Total kWh	Sunlight Hours	Days Per Year		Total kWh Per Year
1	0.72%	3,828	5.5	365		7,684,710
2	0.72%	3,800	5.5	365		7,629,380
3	0.72%	3,773	5.5	365		7,574,449
4	0.72%	3,746	5.5	365		7,519,913
5	0.72%	3,719	5.5	365		7,465,769
6	0.72%	3,692	5.5	365		7,412,016
7	0.72%	3,666	5.5	365		7,358,649
8	0.72%	3,639	5.5	365		7,305,667
9	0.72%	3,613	5.5	365		7,253,066
10	0.72%	3,587	5.5	365		7,200,844
11	0.72%	3,561	5.5	365		7,148,998
12	0.72%	3,536	5.5	365		7,097,525
13	0.72%	3,510	5.5	365		7,046,423
14	0.72%	3,485	5.5	365		6,995,689
15	0.72%	3,460	5.5	365		6,945,320
16	0.72%	3,435	5.5	365		6,895,313
17	0.72%	3,410	5.5	365		6,845,667
18	0.72%	3,385	5.5	365		6,796,378
19	0.72%	3,361	5.5	365		6,747,444
20	0.72%	3,337	5.5	365		6,698,863
21	0.72%	3,313	5.5	365		6,650,631
22	0.72%	3,289	5.5	365		6,602,746
23	0.72%	3,265	5.5	365		6,555,207
24	0.72%	3,242	5.5	365		6,508,009
25	0.72%	3,219	5.5	365		6,461,152
		Total kWh Outcome Solar Photovoltaic System Energy Savings				176,399,827
				Cost per kWh	x	$0.11225
		Total Cost Outcome Solar Photovoltaic System Energy Savings				$19,800,880

Table 3-9. Total Reallocated Funds for Solar Hot Water Systems

	Amount	Description
	$1,850,120	Total Spent on Solar Hot Water Systems
÷	$24,986,048	Total Spent on all Solar Systems
=	7.4%	Total Percentage Reallocated Funds For Solar Hot Water
x	$8,598,000	Total Reallocated Funds from HVAC Rebate Program
=	$636,252	Total Reallocated Funds for Hot Water Systems

Table 3-10. Adjusted Solar Hot Water System Rebate Amounts

	Amount	Description
	$500	Original Rebate for Solar Hot Water System Each
x	52%	Of Original Rebate Paid Per Rule 15B
=	$260	Adjusted Solar Hot Water System Rebate Amount Each

Table 3-11. Total kWh Solar Hot Water Systems Paid for with Reallocated Funds

	Amount	Description
	$636,252	Total Reallocated Funds for Solar Hot Water Systems
÷	$260	Rebate Amount
=	2,447	Total Solar Photovoltaic Systems Installed

Table 3-12. Outcome Energy and Cost Savings of Solar Hot Water Systems

	Amount	Description
	15,361	kWh Per Year Typical Florida Home
-	13,042	kWh Per Year Typical Florida Home with SHWS Upgrade
=	2,319	kWh Per Year Energy Savings Per Home
x	2,447	Total Number of Solar Hot Water Systems Installed
x	20	Year Life Span of Solar Hot Water System
=	113,491,860	kWh Outcome Energy Savings of Solar Hot Water Systems
x	$0.11225	Cost per kWh
=	$12,739,461	Cost Outcome Energy Savings of Solar Hot Water Systems

Table 3-13. Total Outcome Energy and Cost Savings

	Amount	Description
	177,975,000	kWh Actual HVAC Rebates Paid
+	176,399,827	kWh Solar Photovoltaic Systems
+	113,491,860	kWh Solar Hot Water Systems
=	467,867,287	kWh Total Outcome Energy Savings
x	$0.11225	Cost Per kWh
=	$52,518,103	Cost Total Outcome Energy Savings

Table 3-14. Compare Potential to Outcome Energy and Cost Savings

	Amount	Description
	417,000,000	kWh Potential Energy Savings
-	467,867,287	kWh Outcome Energy Savings
=	-50,867,287	kWh Difference of Energy Savings
x	$0.11225	Cost Per kWh
=	$5,709,853	Cost Difference of Energy Savings

CHAPTER 4
CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In conclusion, the Florida ENERGY STAR® Residential HVAC Rebate Program's outcome energy and cost savings saved a total of 467,867,287 kWh of energy, or $52,518,103. The Florida ENERGY STAR Residential HVAC Rebate Programs potential energy and cost savings was 417,000,000 kWh of energy, or $46,808,250. This equals a difference of 50,867,287 kWh of energy, or $5,709,853 savings more than the potential energy and cost savings.

This conclusion is due in large part to the relatively low rebate amount for solar hot water systems which made up for approximately 25% of the outcome energy and cost savings, but only used approximately 4% of the total funds. Solar photovoltaic systems accounted for approximately 38% of the outcome energy and cost savings and used approximately 53% of the total funds. The actual HVAC Rebates paid accounted for approximately 37% of the outcome energy and cost savings and used approximately 43% of the total funds.

According to this study, the outcome energy and cost savings performed better than the potential energy and cost savings due to the discounted rebate amounts of 52% of the original rebate amount. If the rebate amounts were paid at 100%, the total outcome energy and cost savings would have been approximately half the outcome energy and cost savings estimated.

This study shows that the final decision by the Florida legislature's budget committee on the Florida ENERGY STAR Residential HVAC Rebate Program did not take into account the energy implications of the Program, but did result in positive

energy and cost savings. The results of this study show that an enormous amount to energy savings was due to the discounted rebate amounts of solar photovoltaic and solar hot water systems.

Research Limitations

This study is an example of how building energy modeling can be used to estimate energy savings for rebate programs. Though building energy modeling is a highly useful and accurate tool for modeling energy use in buildings and homes, for this research, few assumptions were made such as HVAC system efficiencies and the typical Florida home design which were driving factors of the study findings.

The subject home was designed to resemble a typical Florida home. This home plan is typical of homes built from in the 1980's and is prevalent throughout the state. This subject home design was developed to resemble the type of home that would be most likely to be replacing and HVAC system.

The HVAC efficiency of 10 SEER and 6.8 HSPF assumptions for the subject home's energy model was calculated by using the minimum efficiency standards set by the Energy Policy Act of 1992 (USDOE 2012). The duct leakage assumptions for this model of 20% is the average estimated duct leakage of existing homes in Florida according to the Florida Solar Energy Center (FSEC 2012). The HVAC efficiency of 16 SEER and 9.2 HSPF assumptions for the subject home with Program HVAC upgrade was calculated by using the Programs list of approved air conditioning units and using the majority SEER rating from the list. A correlating HSPF rating was assigned. Duct leakage of 3% was used to reflect the performance of personally tested ducts for this Program and the Programs duct leakage requirement.

The results of this study are only an estimate of potential energy and cost savings and the outcome energy and cost savings of the Florida ENERGY STAR Residential HVAC Rebate Program. Further research is required to determine the measured, or "actual energy savings" of the Program.

Recommendations

Though the Florida ENERGY STAR Residential HVAC Rebate Program outcome energy and cost savings was due to a combination of HVAC rebates and re-allocated funds to pay outstanding solar photovoltaic system and solar hot water system rebates, it is not recommended that future HVAC rebate programs be split to pay rebates for both. Based on the above research, the following lists some of the recommendations for future Rebate Programs.

Building Energy Modeling

Building energy modeling is a proven tool to develop energy savings potential of different building HVAC systems. Using Building Energy Modeling, the cost effective energy saving solution for any building can be estimated.

- It is recommended that Building Energy Modeling be used to estimate potential energy savings before Program implementation.
- Building Energy Modeling should be included in the rebate requirements for individual homes.
- A building energy model performed by a Third Party Verifier may be used for both ensuring that energy savings are achievable and to provide documentation to calculate the actual energy savings of the Program upon completion.

HVAC Rebates

Future HVAC Rebate Programs should ensure that the maximum energy saving potential of the Program is realized. One key factor in ensuring maximum energy savings of future HVAC Rebate Programs is to require Air Distribution System testing.

- Future HVAC Rebate Programs should include Air distribution System tests by qualified Third Party Verifiers and should require leakage of less than 5%.

Solar Photovoltaic Rebates

Recently, the price solar photovoltaic systems have reduced significantly. With lower prices for solar photovoltaic systems, future solar Rebate Program should reduce the amount of the rebate to reflect this reduction in up-front costs to the consumer. This may potentially make solar rebates more competitive with other Rebate Programs concerning energy and cost savings.

- Future solar Rebate Programs should evaluate the cost and benefits of these systems to determine their viability to rebate programs.

Solar Hot Water System Rebates

Future solar hot water system Rebate Programs should also be considered for future Rebate Programs concerning energy savings. As discussed in this research, the rebate amount paid for solar hot water systems was directly responsible for the outcome energy savings outperforming the potential energy savings.

- Future solar hot water system rebates should keep the rebate amount low in order to maximize the number of systems installed.

State Funded Revolving Rebate Program

Another way to accomplish a successful rebate program aimed at energy efficient systems for residential homes is to have a State funded revolving Rebate Program that may be used for new construction. The best time to install energy efficient system, whether it is an HVAC system, solar photovoltaic system or solar hot water system, is during construction phase. This will offer owners and builders a financial incentive to install energy efficient systems.

Energy efficiency rebates are an excellent way to save energy, money and spur economic growth. Further research into the feasibility of different energy efficient technologies is required to ensure future rebate programs and both financially sound and energy saving programs.

APPENDIX A
HVAC REBATE PROGRAM FINAL TOTALS

FINAL TOTALS
THE FLORIDA ENERGY STAR HVAC REBATE PROGRAM
July 25, 2011

The Florida ENERGY STAR HVAC Rebate program was held in September of 2010. The program launched on August 30, 2010, and closed on September 14, 2010. To qualify for the program a Floridian had to purchase a new ENERGY STAR qualifying HVAC or geothermal unit between August 30, 2011 and September 14, 2011. Florida consumers received rebates on ENERGY STAR central air conditioners, air source heat pumps, and geothermal heat pumps if their installed systems met the Federal Energy Tax Credits standard and with a system duct test resulting in no more than 15% leakage to the outside. These actions qualified customers for a rebate of $1,500. Floridians had to mail in: an application, a new system purchase receipt, a Manual J form that indicated the appropriate sized unit, a copy of the local building permit, and a copy of their duct test results before November 30, 2010 to qualify. In addition to Florida's rebate, customers would also qualify for the Federal Energy Tax Credits on those same HVAC or geothermal units

Number of Appliances
There were 4,268 Floridians that received ENERGY STAR HVAC rebates. Of the Floridians that purchased new HVAC systems, the most frequent system purchased were central air conditioners (57%), followed by air source heat pumps (42%), and last geothermal heat pumps at just under one percent. The low take rate of geothermal systems is not surprising because the technology is still very expensive as compared to air cooled systems. In addition, to be effective, geothermal systems require a large differential between the air temperature and ground temperature and those conditions occur primarily in the northern part of the state.

TABLE 1
APPLIANCE CATEGORIES PURCHASED IN
FLORIDA'S ENERGY STAR HVAC REBATE PROGRAM

ENERGY STAR HVAC Type	Number of Rebate Payments
Central Air Conditioners	2461
Air Source Heat Pumps	1776
Geothermal Heat Pumps	31
TOTAL	**4268**

Economic Stimulus

Based on the application receipt price of the 4,268 HVAC and geothermal systems purchased in order to receive a rebate, the economic stimulus to the Florida economy was $26,745,889. In addition, assuming each Floridian only paid $300 per required duct test that was another $1.28 million invested in green jobs through energy efficiency testing. The results are for every one dollar spent by the state, on this rebate program, consumers invested approximately five dollars into the economy.

Energy Savings

Based on the energy savings calculator provided by the USDOE, through participation in the ENERGY STAR HVAC Rebate program Florida consumers are estimated to save 4,312,367 kWh per year off their electric bills.

Rejected Rebates

Of those consumers that mailed in applications, 1088 had their HVAC rebate rejected. Approximately 75% of those rejected were because the purchase date was outside the August 30 through September 14, 2010 purchase range. The other 25% were rejected for one of the following reasons: they mailed in their applications after November 30, 2010, they failed to provide one of the required documents, or they purchased a system that did not meet the Federal Energy Tax Credits standards.

Participation in the ENERGY STAR Program by Florida County

Individuals in 49 counties participated in the Florida ENERGY STAR HVAC Rebate program. The top five counties with consumers participating in the rebate program are in order: (1) Palm Beach, (2) Broward, (3) Alachua, (4) Sarasota, and (5) Miami-Dade. In comparison, the five most populous Florida counties, according to the 2000 census, are (1) Miami-Dade, (2) Broward, (3) Palm Beach, (4) Hillsborough, and (5) Pinellas. It is not surprising to see the City of Gainesville or Sarasota in the top five list because both have aggressive energy conservation programs.

TABLE 2
Rebate Payments Mailed by Florida County and ENERGY STAR HVAC Type
July 8, 2011

County	Central Air Conditioners	Air Source Heat Pumps	Geothermal Heat Pumps	Totals
Alachua	140	126	2	268
Bay	3	11		14
Brevard	73	102		175
Broward	603	65	7	675
Charlotte	29	7		36
Citrus	64	6		70
Clay	2	17		19
Collier	43	10	1	54
Columbia		5		5
Duval	9	112		121
Escambia	11	14	2	27

Flagler	6	47		53
Gilchrist	1			1
Hamilton	1			1
Hernando	2	14	1	17
Highlands	8	14	1	23
Hillsborough	30	94		124
Indian River	43	29		72
Jackson		7		7
Jefferson		2		2
Lake	18	33	1	52
Lee	108	15	2	125
Leon	5	16	2	23
Levy		3		3
Manatee	31	87	1	119
Marion	6	38		44
Martin	78	11		89
Miami Dade	179	26	1	206
Monroe	5			5
Nassau	2	17		19
Okaloosa	5	7		12
Okeechobee	23	1		24
Orange	35	143	1	179
Osceola	3	14	1	18
Palm Beach	666	88		754
Pasco	4	57		61
Pinellas	30	96		126
Polk	16	52	1	69
Putnam	1	2		3
Saint Johns	5	31		36
Saint Lucie	69	28		97
Santa Rosa	3	6		9
Sarasota	55	147	6	208
Seminole	21	96		117
Sumter	13	1		14
Suwannee	1			1
Union	1	1		2
Volusia	10	77	1	88
Walton		1		1
TOTAL	**2461**	**1776**	**31**	**4,268**

APPENDIX B
AIR DISTRIBUTION TEST PROCEDURE

1. The duct inspector will make a visual inspection of the home and locate all supply and return vents.

2. The duct inspector will remove the air filter for the HVAC system.

3. The duct inspector will isolate the duct system by taping off all supply and return vents with duct mask tape.

4. The duct inspector will set up a duct blaster in the main return duct, and depressurize the duct system to -25 Pascals and record the flow in cubic feet per minute at -25 Pascals (CFM25).

5. Pressure and Flow calculations are determined using a manometer that reads 2 channels of pressure, each measuring two different pressures. The first channel will measure the duct pressure with respect to the inside pressure allowing one to measure a difference in pressure (i.e. -25 Pascals). One pressure tube will be placed within the duct system (inside a supply vent) and the second pressure tube will be exposed to the inside pressure of the home. The second channel will record pressure at two different locations on the duct fan (a calibrated fan). One pressure tube will take a pressure reading on the fan inlet and the other will take a pressure reading of the air entering the fan allowing one to record the pressure difference of the air moving through the fan. Because the fan is calibrated, the pressure at the fan inlet is constant, and the pressure is determined by air pressure caused by the fan only. The pressure of the air entering the fan is not constant; it is being pulled through the duct system by the calibrated fan. If the air pressure entering the fan equals the air pressure at the fan inlet, there is zero leakage; any difference in air pressure between the two points is leakage. This pressure is then turned to air flow by using a formula calculated by the manometer.

6. If the HVAC system has a dedicated return system (not a single return), the duct inspector will repeat the process with the pressure tube in a return duct and record the flow in CFM25. These two CFM25 numbers will then be averaged to get a total CFM25.

7. The duct inspector will divide the total CFM25 by the home square footage (SF) and get the Normalized air distribution system leakage area (Qn).

8. If Qn of .10 is not achieved, the duct inspector will install a blower door and blower door fan. A pressure tube will be placed outside the home in order to determine the pressure difference from the outside of the home from the inside of the home

9. The duct inspector will depressurize the home to -25 Pascals. This will keep the home under a constant depressurization.

10. Pressure and Flow calculations are determined using a manometer that reads 2 channels of pressure, each measuring two different pressures. The first channel will measure the outside pressure with respect to the inside pressure allowing one to measure a difference in pressure (i.e. -25 Pascals). One pressure tube will be placed outside the home to take the pressure of outside the home. The second pressure tube will be placed inside the home to take the pressure inside the home. The second channel will record pressure of the blower door fan (a calibrated fan) with respect to the indoor pressure. One pressure tube will take a pressure reading on the fan inlet and the other will take a pressure reading of the air entering the fan, or inside the home, allowing one to record the pressure difference of the air moving through the fan. Because the fan is calibrated, the pressure at the fan inlet is constant, and the pressure is determined by air pressure caused by the fan only. The pressure of the air entering the fan is not constant; it is being pulled through the home by the calibrated fan. If the air pressure entering the fan equals the air pressure at the fan inlet, there is zero leakage; any difference in air pressure between the two points is leakage. This pressure is then turned to air flow by using a formula calculated by the manometer.

11. The duct inspector will then repeat steps 4 and 5, but instead of depressurizing the duct system to -25 Pascals, the duct inspector will balance the pressure between the duct system and home, reaching a pressure difference of 0 Pascals. This allows the duct inspector to Qn.out, or leakage of the duct system outside of conditioned space.

12. The duct inspector will then divide the CFM25out by the homes SF and get the Qn.out.

13. If Qn.out is above .10, the duct inspector will then calculate the leakage percentage of the total rated air flow of the HVAC system. This is done by dividing Qn.out by the total rated air flow of the HVAC system. The total rated air flow of an HVAC system is determined by multiplying the HVAC system tonnage by 400 CFM.

14. The duct inspector will the fill out the Air Distribution test report for the homeowner.

    (Moyer 2010)

APPENDIX C
RULE 16B

I. Summary:

The bill appropriates $31,369,867 to the Florida Energy and Climate Commission (FECC) and directs that the money be used to pay approved HVAC rebates and a portion of approved solar energy rebates. The bill makes two appropriations. The first appropriation, $2,467,244 in nonrecurring funds from the Grants and Donations Trust Fund, is to be used exclusively for HVAC rebates. The second, $28,902,623 from the Grants and Donations Trust Fund, from Specific Appropriation 2561A, Chapter 2009-81, Laws of Florida, is to be used first to pay any remaining approved HVAC rebates, and second to pay a percentage of each unpaid and approved solar energy system rebate. The percentage is to be derived by dividing the remaining appropriation by the total dollar value of the backlog of final approved solar rebates.

The bill makes it theft for anyone to obtain a rebate based on the submission of information that the applicant knows to be false.

The bill takes effect upon becoming a law.

II. Present Situation:

HVAC rebates

The FECC approved the Florida ENERGY STAR Residential HVAC Rebate Program during a May 21, 2010 FECC meeting. The program was to begin on August 30, 2010 and end on December 31, 2010 or when funds were depleted. The program was intended to provide $1,500 rebates for the purchase and installation of eligible HVAC systems.

The Governor publicly announced the program on August 20, 2010. On August 31, 2010, the FECC submitted a budget amendment for the September 14, 2010, Legislative Budget Commission (LBC) meeting to transfer approximately $17.5 million in federal 2009 American Recovery and Reinvestment Act (ARRA) funds ($15 million of which were from a Fixed Capital Outlay (FCO) appropriation) to a suitable operating category to fund the program. However, the LBC does not have authority to approve transfers from an FCO category. Section 216.292, F.S., provides that an FCO appropriation may not be expended for another purpose. Accordingly, the amendments were not placed on the LBC agenda. Due to the lack of authorized funding, the FECC removed the application from their web page and announced on September 14, 2010, that all rebates filed under the program were pending legislative action, thus suspending the program.

According to FECC support staff, approximately 2,700 applications have been submitted as of October 25, 2010. However, as processing of the applications was terminated when the program was suspended, it is unknown at this time how many of these applications are qualified for the rebate.

Solar rebates

Section 377.806, F.S., was enacted in 2006 to create the Solar Energy System Incentives Program (program). The program is administered by the FECC. The purpose of the program is to provide financial incentives (rebates on a portion of the purchase price) for the purchase and installation of solar energy systems that meet specified requirements. Rebates are available for both solar photovoltaic systems that produce electricity and solar thermal systems that produce heat.

The amounts of the rebates are as follows:

For a photovoltaic system, the rebate amount is $4 per watt based on the total wattage rating of the system, with the maximum amount per system installation of:

Twenty thousand dollars for a residence and

One hundred thousand dollars for a place of business, a publicly owned or operated facility, or a facility owned or operated by a private, not-for-profit organization, including condominiums or apartment buildings.

For a solar thermal system:

Five hundred dollars for a residence and

Fifteen dollars per 1,000 Btu up to a maximum of $5,000 for a place of business, a publicly owned or operated facility, or a facility owned or operated by a private, not-for-profit organization, including condominiums or apartment buildings.

For a solar thermal pool heater, $100 per installation.

The rebate is available only for the purchase and installation, between July 1, 2006, and June 30, 2010, inclusive, of a new solar energy system of 2 kilowatts or larger for a solar photovoltaic system, a solar energy system that provides at least 50 percent of a building’s hot water consumption for a solar thermal system, or a solar thermal pool heater. Application for a rebate must be made within 120 days after the purchase of the solar energy equipment.

The FECC is to determine and publish on a regular basis the amount of rebate funds remaining in each fiscal year. The total dollar amount of all rebates issued is subject to the total amount of appropriations in any fiscal year for this program. If funds are insufficient during the current fiscal year, any requests for rebates received during that fiscal year may be processed during the following fiscal year. Requests for rebates received in a fiscal year that are processed during the following fiscal year must be given priority over requests for rebates received during the following fiscal year.

The Legislature provided annual funding for the program, as follows:

FY 2006-07 $2.5 million in General Revenue

FY 2007-08 $3.5 million in General Revenue

FY 2008-09 $5.0 million in General Revenue

FY 2009-10 $14.4 million in federal ARRA 2009 funds

FY 2010-11 No funding was provided.

The program proved much more popular than anticipated. Additionally, the FECC did not announce that funds for the program had been depleted until several months after the fact. These factors contributed to a backlog of over 13,000 applications and over $52 million dollars being accumulated as of October 2010. The rebate applications date as far back as June 2009.

III. Effect of Proposed Changes:

The bill appropriates $31,369,867 and directs how this money is to be spent. Section 3 provides that for Fiscal Year 2010-11, and exclusively to implement the provisions of section 1 of the bill on HVAC rebates, $2,467,244 in nonrecurring funds is appropriated from the Grants and Donations Trust Fund to the FECC. In addition, $28,902,623 from the Grants and Donations Trust Fund, from Specific Appropriation 2561A, Chapter 2009-81, Laws of Florida, is immediately reverted and reappropriated to the FECC for Fiscal Year 2010-11. The money is to be used first to implement the provisions of section 1 on HVAC rebates, if actual rebates paid exceed $2,467,244; the remainder of the money is to be used to implement the provisions of section 2 of the bill on Solar Energy System Incentives Program rebates.

Section 1 directs the FECC to pay rebates to eligible applicants who submit an application pursuant to the Florida ENERGY STAR Residential HVAC Rebate Program. The FECC is directed to pay a $1,500 rebate to each

consumer whose application is approved by the FECC. An applicant is eligible for a rebate under this section if:

A complete application is submitted to the FECC on or before November 30, 2010.

The HVAC/geothermal unit replacement for which the applicant is seeking a rebate was purchased or contracted for after August 29, 2010, but before September 15, 2010, by a contractor licensed in the State of Florida, and fully installed prior to submission of the application for a rebate.

The FECC determines that the application complies with this section and any existing agreement with the U.S. Department of Energy governing the Florida ENERGY STAR Residential HVAC Rebate Program.

On or before November 30, 2010, the applicant provides to the commission required information including:

a copy of either the sales receipt or the purchase and installation contract that indicates compliance with the date of purchase requirements and contains the make and model number and the name and address of the HVAC/geothermal installer;

a copy of the county/city mechanical building permit pulled by the HVAC/geothermal installer for the residence;

a copy of the Air Distribution System Leakage Test Report results from either a Class 1 Florida Energy Gauge Certified Energy Rater, a State of Florida Mechanical Contractor, or a recognized Test and Balance agent, which indicate the home has no more than 15 percent leakage to the outside as measured by 0.10 Qn. out or less; and

A copy of the summary of the Manual J completed for the residence to indicate that the proper methodology for sizing the new HVAC/geothermal unit was completed.

Section 2 directs the FECC to utilize up to $28,902,623, less any amount in excess of $2,467,244 used to pay HVAC rebates, to pay a percentage of each unpaid and approved rebate application pursuant to the Solar Energy System Incentives Program. The percentage of each approved rebate to be paid must be derived by dividing the remaining appropriation by the total dollar value of the backlog of final approved solar rebates.

Section 4 makes obtaining a rebate pursuant to this act based on the submission of information that the applicant knows to be false a theft, punishable as provided in s. 812.014, F.S. Under this section, the degree of the felony and the corresponding penalties depend on the amount stolen.

Section 5 provides that the bill takes effect upon becoming a law.

IV. Constitutional Issues:

A. Municipality/County Mandates Restrictions:

None.

B. Public Records/Open Meetings Issues:

None.

C. Trust Funds Restrictions:

None.

V. Fiscal Impact Statement:

A. Tax/Fee Issues:

None.

APPENDIX D
FEDERAL RECOVERY AND REINVESTMENT ACT TITLE XVI, SECTION 1607

ADDITIONAL FUNDING DISTRIBUTION AND ASSURANCE OF APPROPRIATE USE OF FUNDS

SEC. 1607.

(a) CERTIFICATION BY GOVERNOR.—Not later than 45 days after the date of enactment of this Act, for funds provided to any State or agency thereof, the Governor of the State shall certify that:

(1) The State will request and use funds provided by this Act; and

(2) The funds will be used to create jobs and promote economic growth.

(b) ACCEPTANCE BY STATE LEGISLATURE.—if funds provided to any State in any division of this Act are not accepted for use by the Governor, then acceptance by the State legislature, by means of the adoption of a concurrent resolution, shall be sufficient to provide funding to such State.

(c) DISTRIBUTION.—after the adoption of a State legislature's concurrent resolution, funding to the State will be for distribution to local governments, councils of government, public entities, and public-private entities within the State either by formula or at the State's discretion.

APPENDIX E
FLORIDA STATE STATUTE CHAPTER 216.212

216.212

Budgets for federal funds; restrictions on expenditure of federal funds.

—

(1)

The Executive Office of the Governor and the office of the Chief Financial Officer shall develop and implement procedures for accelerating the drawdown of, and minimizing the payment of interest on, federal funds. The Executive Office of the Governor shall establish a clearinghouse for federal programs and activities. The clearinghouse shall develop the capacity to respond to federal grant opportunities and to coordinate the use of federal funds in the state.

(a)

Every state agency, when making a request or preparing a budget to be submitted to the Federal Government for funds, equipment, material, or services, shall submit such request or budget to the Executive Office of the Governor for review before submitting it to the proper federal authority. However, the Executive Office of the Governor may specifically authorize any agency to submit specific types of grant proposals directly to the Federal Government.

(b)

Every office or court of the judicial branch, when making a request or preparing a budget to be submitted to the Federal Government for funds, equipment, material, or services, shall submit such request or budget to the Chief Justice of the Supreme Court for approval before submitting it to the proper federal authority. However, the Chief Justice may specifically authorize any court to submit specific types of grant proposals directly to the Federal Government.

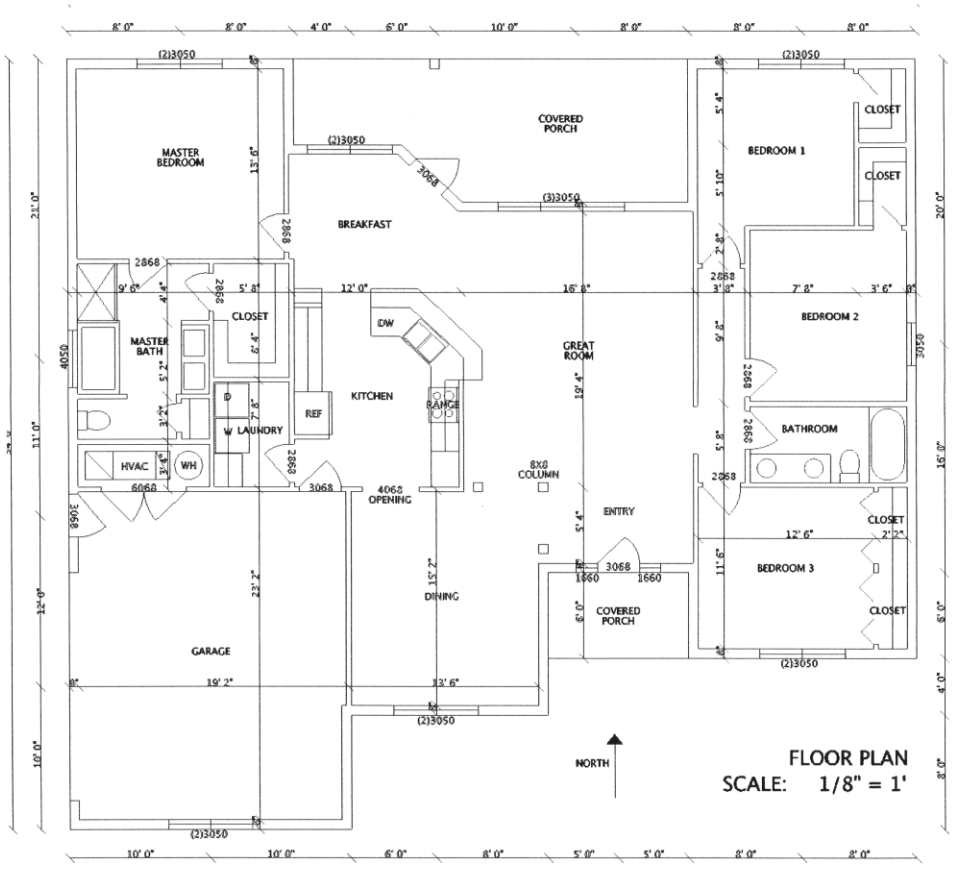
(2)

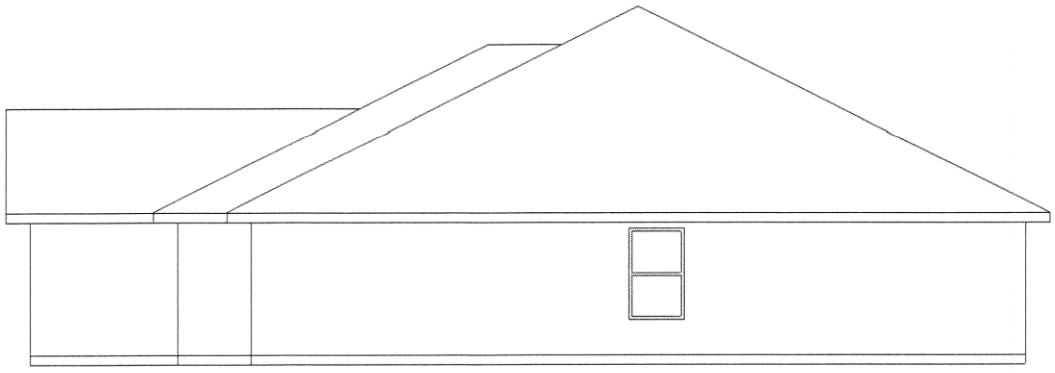
When such federal authority has approved the request or budget, the state agency or the judicial branch shall submit to the Executive Office of the Governor such documentation showing approval as that office prescribes. The Executive Office of the Governor must acknowledge each approved request or budget by entering that approval into an Automated Grant Management System developed in consultation with the chairs of the House of Representatives and Senate appropriations committees.

(3)

Federal money appropriated by Congress or received from court settlements to be used for state purposes, whether by itself or in conjunction with moneys appropriated by the Legislature, may not be expended unless appropriated by the Legislature. However, the Executive Office of the Governor or the Chief Justice of the Supreme Court may, after consultation with the legislative appropriations committees, approve the receipt and expenditure of funds from federal sources by state agencies or by the judicial branch. Any federal programs requiring state matching funds which funds were eliminated, or were requested and were not approved, by the Legislature may not be implemented during the interim. However, federal and other fund sources for the State University System which do not carry a continuing commitment on future appropriations are hereby appropriated for the purpose received.

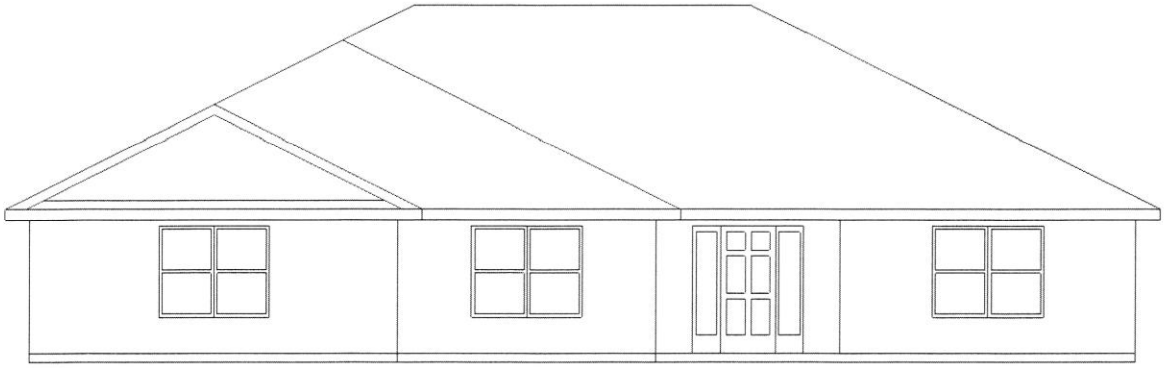
APPENDIX F
TYPICAL FLORIDA HOME PLANS



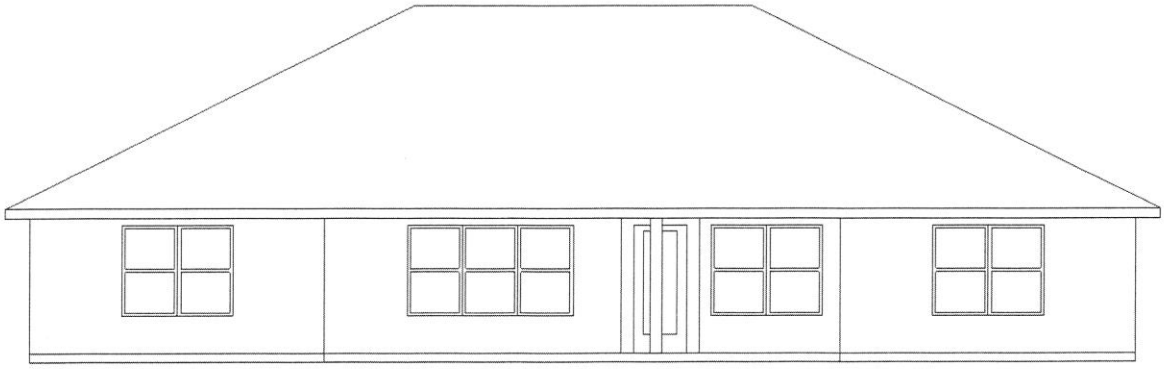


SIDE ELEVATION (EAST)
SCALE: 1/8" = 1'

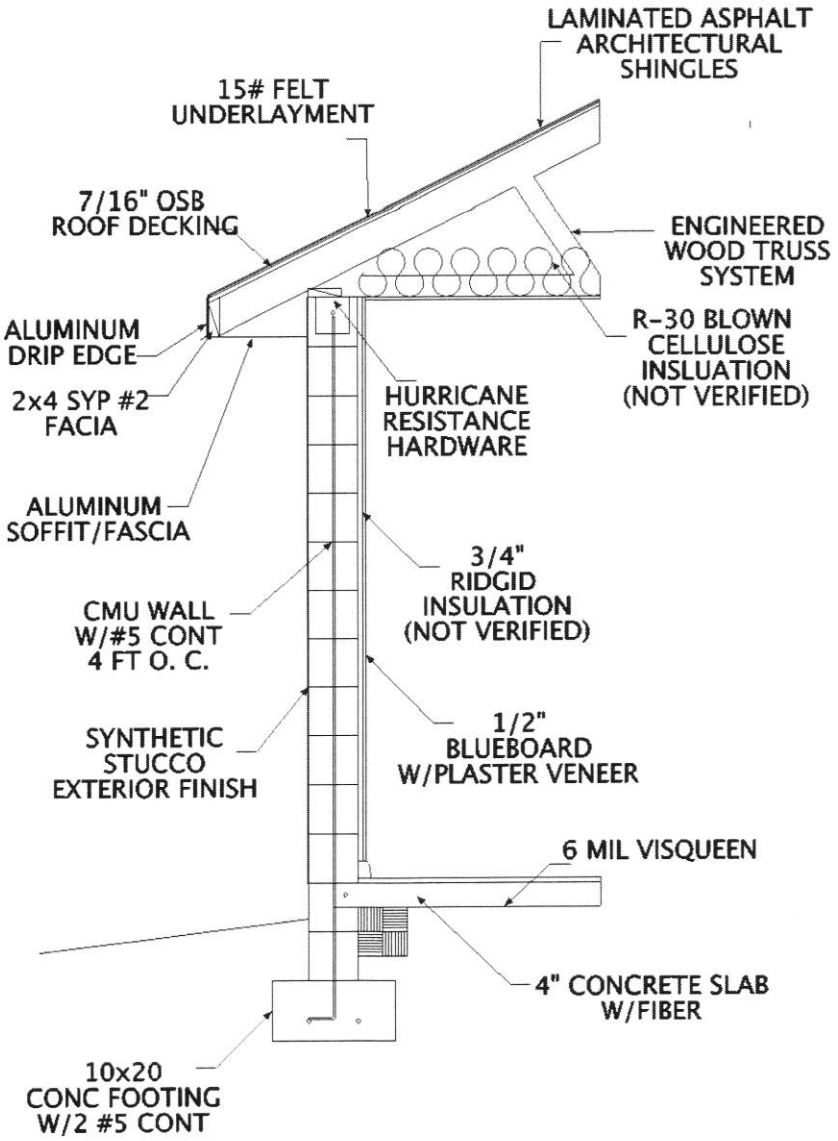
SIDE ELEVATION (WEST)
SCALE: 1/8" = 1'



FRONT ELEVATION (SOUTH)
SCALE: 1/8" = 1'



REAR ELEVATION (NORTH)
SCALE: 1/8" = 1'



WALL SECTION
SCALE: 1/4" = 1'

APPENDIX G
BUILDING ENERGY MODEL 1

Building Input Summary Report

PROJECT

Title:	Typical Floirda Home	Bedrooms:	0	Adress Type:	Street Address
Building Type:	User	Bathrooms:	0	Lot #	
Owner:		Conditioned Area:	2051	Block/SubDivision:	
# of Units:	1	Total Stories:	1	PlatBook:	
Builder Name:		Worst Case:	No	Street:	NA
Permit Office:		Rotate Angle:	0	County:	Alachua
Jurisdiction:		Cross Ventilation:		City, State, Zip:	Gainesville , FL , 32609-
Family Type:	Single-family	Whole House Fan:			
New/Existing:	New (From Plans)				
Comment:	Building Energy Model for Thesis				

CLIMATE

Design Location	Tmy Site	Design Temp 97.5 %	Design Temp 2.5 %	Int Design Temp Winter	Int Design Temp Summer	Heating Degree Days	Design Moisture	Daily Temp Range
FL, Gainesville	FL_GAINESVILLE_REGIONAL_AP	32	92	70	75	1305.5	51	Medium

UTILITY RATES

Fuel	Unit	Utility Name	Monthly Fixed Cost	$/Unit
Electricity	kWh	EnergyGauge Default	0	0.1126
Natural Gas	Therm	EnergyGauge Default	0	1.72
Fuel Oil	Gallon	EnergyGauge Default	0	1.1
Propane	Gallon	EnergyGauge Default	0	1.4

SURROUNDINGS

Ornt	Type	Shade Trees Height	Shade Trees Width	Shade Trees Distance	Adjacent Buildings Exist	Adjacent Buildings Height	Adjacent Buildings Width	Adjacent Buildings Distance
N	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
NE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
E	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
SE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
S	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
SW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
W	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
NW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft

FLOORS

#	Floor Type	Perimeter	R-Value	Area	Tile	Wood	Carpet
1	Slab-On-Grade Edge Insulation	228 ft	0	2051 ft²	0.5	0	0.5

ROOF

#	Type	Materials	Roof Area	Gable Area	Roof Color	Solar Absor.	Tested	Deck Insul.	Pitch
1	Hip	Composition shingles	2294 ft²	0 ft²	Medium	0.85	No	0	26.6 deg

ATTIC

#	Type	Ventilation	Vent Ratio (1 in)	Area	RBS	IRCC
1	Full attic	Vented	300	2051 ft²	N	N

Building Input Summary Report

CEILING

#	Ceiling Type	R-Value	Area	Framing Fraction	Truss Type
1	Under Attic ()	30	2051 ft²	0.11	Wood

WALLS

Wall orientation below is as entered. Actual orientation is modified by rotate angle shown in "Project" section above.

#	Ornt	Adjacent To	Wall Type	Cavity R-Value	Width Ft	Width In	Height Ft	Height In	Area	Sheathing R-Value	Framing Fraction	Solar Absor.
1	N	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
2	E	Exterior	Concrete Block - Int Insul	6	4	0	8		32 ft²		0	0.75
3	N	Exterior	Concrete Block - Int Insul	6	18		8		144 ft²		0	0.75
4	W	Exterior	Concrete Block - Int Insul	6	8		8		64 ft²	0	0	0.75
5	N	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
6	E	Exterior	Concrete Block - Int Insul	6	42		8		336 ft²		0	0.75
7	S	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
8	W	Exterior	Concrete Block - Int Insul	6	6		8		48 ft²		0	0.75
9	S	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75
10	E	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75
11	S	Exterior	Concrete Block - Int Insul	6	14		8		112 ft²		0	0.75
12	W	Garage	Frame - Wood	13	16		8		128 ft²		0.23	0.75
13	S	Garage	Frame - Wood	13	20		8		160 ft²		0.23	0.75
14	W	Exterior	Concrete Block - Int Insul	6	32		8		256 ft²		0	0.75
15	N	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75

DOORS

#	Ornt	Door Type	Storms	U-Value	Width Ft	Width In	Height Ft	Height In	Area
1	N	Insulated	None	0.46	1		1	6	1.5 ft²
2	S	Insulated	None	0.46	3		6	8	20 ft²
3	S	Wood	None	0.46	3		6	8	20 ft²
4	S	Wood	None	0.46	6		6	8	40 ft²

WINDOWS

#	Ornt	Frame	Panes	NFRC	U-Factor	SHGC	Storm	Area	Overhang Depth	Overhang Separation	Interior Shade	Screening
1	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
2	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	5 ft 4 in	1 ft 0 in	Drapes/blinds	None
3	N	Wood	Single (Clear)	No	0.95	0.8	N	10.33 ft²	5 ft 4 in	1 ft 8 in	Drapes/blinds	None
4	N	Metal	Single (Clear)	No	1.2	0.8	N	45 ft²	9 ft 4 in	1 ft 0 in	Drapes/blinds	None
5	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
6	E	Metal	Single (Clear)	No	1.2	0.8	N	15 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
7	S	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
8	S	Wood	Single (Clear)	No	0.95	0.8	N	15.5 ft²	7 ft 4 in	1 ft 8 in	Drapes/blinds	None
9	S	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
10	W	None	Glazed Block	No	0.6	0.6	N	16 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None

Building Input Summary Report

INFILTRATION & VENTING

Method	SLA	CFM 50	ELA	EqLA	ACH	ACH 50	---- Forced Ventilation ---- Supply	Exhaust	Run Time	Terrain/Wind Shielding
Best Guess	0.00050	2690	147.7	277.7	0.385	9.84	0	0	0	Suburban / Suburban

GARAGE

#	Floor Area	Roof Area	Exposed Wall Perimeter	Avg. Wall Height	Exposed Wall Insulation
1	460 ft²	0 ft²	52 ft	8 ft	(invalid)

MASS

Mass Type	Area	Thickness	Furniture Fraction
No Added Mass	0 ft²	0 ft	0.3

COOLING SYSTEM

#	System Type	Subtype	Efficiency	Capacity	Air Flow	SHR	Ductless
1	Central Unit	None	SEER: 10	48 kBtu/hr	1440 cfm	0.75	False

HEATING SYSTEM

#	System Type	Subtype	Efficiency	Capacity	Ductless
1	Electric Heat Pump	None	HSPF: 6.2	48 kBtu/hr	False

HOT WATER SYSTEM

#	System Type	EF	Cap	Use	SetPnt	Credits
1	Electric	0.85	40 gal	60 gal	120 deg	None

SOLAR HOT WATER

Collector Type	Collector Tilt	Azimuth	Surface Area	Loss Coef.	Absorp. Prod.	Trans Corr.	Tank Volume	Tank U-Value	Tank Surf Area	Heat Exch Eff	PV Pumped	Pump Energy

DUCTS

#	---- Supply ---- Location	R-Value	Area	---- Return ---- Location	Area	Number	Leakage Type	Air Handler	CFM 25	Percent Leakage	QN	RLF
1	Attic	6	410.2 ft²	Attic	102.55 ft²	(invalid)	Proposed Qn	Garage	289.19 cf	20.08 %	0.14	0.60

TEMPERATURES

Programable Thermostat: None Ceiling Fans: Y

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cooling	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]	[X]	[X]	[ ]	[ ]	[ ]
Heating	[X]	[X]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]
Venting	[ ]	[ ]	[X]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]	[ ]

Thermostat Schedule: HERS 2006 Reference

Schedule Type		Hours 1	2	3	4	5	6	7	8	9	10	11	12
Cooling (WD)	AM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
	PM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
Cooling (WEH)	AM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
	PM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
Heating (WD)	AM	68	68	68	68	68	68	68	68	68	68	68	68
	PM	68	68	68	68	68	68	68	68	68	68	68	68
Heating (WEH)	AM	68	68	68	68	68	68	68	68	68	68	68	68
	PM	68	68	68	68	68	68	68	68	68	68	68	68

Building Input Summary Report

APPLIANCES & LIGHTING

Appliance Schedule: HERS 2006 Reference Schedule Type		Hours 1	2	3	4	5	6	7	8	9	10	11	12
Ceiling Fans (Summer)	AM	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.33	0.33	0.33	0.33	0.33
% Released: 100	PM	0.33	0.33	0.33	0.33	0.33	1	0.9	0.9	0.9	0.9	0.9	0.65
Annual Use: 652 kWh/Yr		Peak Value: 128 Watts											
Clothes Washer	AM	0.105	0.081	0.047	0.047	0.081	0.128	0.256	0.57	0.849	1	0.977	0.872
% Released: 60	PM	0.779	0.698	0.605	0.57	0.581	0.57	0.57	0.57	0.57	0.488	0.43	0.198
Annual Use: 53 kWh/Yr		Peak Value: 12 Watts											
Dishwasher	AM	0.139	0.05	0.028	0.024	0.029	0.09	0.169	0.303	0.541	0.594	0.502	0.443
% Released: 60	PM	0.377	0.396	0.335	0.323	0.344	0.448	0.791	1	0.8	0.597	0.383	0.281
Annual Use: 78 kWh/Yr		Peak Value: 24 Watts											
Dryer	AM	0.2	0.1	0.05	0.05	0.05	0.075	0.2	0.375	0.5	0.8	0.95	1
% Released: 10	PM	0.875	0.85	0.8	0.625	0.625	0.6	0.575	0.55	0.625	0.7	0.65	0.375
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											
Lighting	AM	0.16	0.15	0.16	0.18	0.23	0.45	0.4	0.26	0.19	0.16	0.12	0.11
% Released: 90	PM	0.16	0.17	0.25	0.27	0.34	0.55	0.55	0.88	1	0.86	0.51	0.28
Annual Use: 566 kWh/Yr		Peak Value: 185 Watts											
Miscellaneous	AM	0.48	0.47	0.47	0.47	0.47	0.47	0.64	0.71	0.67	0.61	0.55	0.53
% Released: 90	PM	0.52	0.5	0.5	0.5	0.59	0.73	0.79	0.99	1	0.96	0.77	0.55
Annual Use: 4105 kWh/Yr		Peak Value: 753 Watts											
Pool Pump	AM	0	0	0	0	0	0	0	0	0	1	1	1
% Released: 0	PM	1	1	1	1	0	0	0	0	0	0	0	0
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											
Range	AM	0.057	0.057	0.057	0.057	0.057	0.114	0.171	0.286	0.343	0.343	0.343	0.4
% Released: 100	PM	0.457	0.343	0.286	0.4	0.571	1	0.857	0.429	0.286	0.229	0.171	0.114
Annual Use: 447 kWh/Yr		Peak Value: 165 Watts											
Refrigeration	AM	0.85	0.78	0.75	0.73	0.73	0.73	0.75	0.75	0.8	0.8	0.8	0.8
% Released: 100	PM	0.88	0.85	0.85	0.83	0.88	0.95	1	0.98	0.95	0.93	0.9	0.85
Annual Use: 775 kWh/Yr		Peak Value: 106 Watts											
Well Pump	AM	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1
% Released: 0	PM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											

Annual Energy Summary

NA
Gainesville, FL, 32609-
Registration #:

Title: Typical Floirda Home
User

TMY City: FL_GAINESVILLE_R
Elec Util: EnergyGauge Default
Gas Util: EnergyGauge Default
Run Date: 04/27/2012 13:19:59

Building Energy Model for Thesis

End-Use	Energy Consumption	Annual Cost
Cooling (48 kBtu/hr)	3176 kWh	$358
Cooling Fan	513 kWh	$58
Mechanical Vent Fan	0 kWh	$ 0
Total Cooling	**3689 kWh**	**$416**
Heating (48 kBtu/hr)	1985 kWh	$224
Heating Fan/Pump	278 kWh	$31
Mechanical Vent Fan	0 kWh	$ 0
Total Heating	**2263 kWh**	**$255**
Hot Water	2947 kWh	$332
Hot Water Pump	0 kWh	$0
Total Hot Water	**2947 kWh**	**$332**
Ceiling Fans	438 kWh	$49
Clothes Washer	52 kWh	$6
Dishwasher	78 kWh	$9
Dryer	0 kWh	$0
Lighting	567 kWh	$64
Miscellaneous	4105 kWh	$462
Pool Pump	0 kWh	$0
Range	447 kWh	$50
Refrigerator	775 kWh	$87
Total (kWh)	15361 kWh	$1730
Total (Therms)	0 Therms	$0
Total (Oil Gallons)	0 Gallons	$0
Total (Propane Gallons)	0 Gallons	$0
PV Produced (kWh)*	0 kWh	$0
* Assumes net metering		
Total Cost		$1730

Emissions (Calculated as Total - PV Produced)

SO2	61 Lbs.
NOX	35.83 Lbs.
CO2	10.35 Tons

APPENDIX H
BUILDING ENERGY MODEL 2

Building Input Summary Report

PROJECT

Title:	Typical Floirda Home Rebate	Bedrooms:	0	Adress Type:	Street Address
Building Type:	User	Bathrooms:	0	Lot #	
Owner:		Conditioned Area:	2051	Block/SubDivision:	
# of Units:	1	Total Stories:	1	PlatBook:	
Builder Name:		Worst Case:	No	Street:	NA
Permit Office:		Rotate Angle:	0	County:	Alachua
Jurisdiction:		Cross Ventilation:		City, State, Zip:	Gainesville , FL , 32609-
Family Type:	Single-family	Whole House Fan:			
New/Existing:	New (From Plans)				
Comment:	Building Energy Model for Thesis				

CLIMATE

Design Location	Tmy Site	Design Temp 97.5 %	Design Temp 2.5 %	Int Design Temp Winter	Int Design Temp Summer	Heating Degree Days	Design Moisture	Daily Temp Range
FL, Gainesville	FL_GAINESVILLE_REGIONAL_AP	32	92	70	75	1305.5	51	Medium

UTILITY RATES

Fuel	Unit	Utility Name	Monthly Fixed Cost	$/Unit
Electricity	kWh	EnergyGauge Default	0	0.1126
Natural Gas	Therm	EnergyGauge Default	0	1.72
Fuel Oil	Gallon	EnergyGauge Default	0	1.1
Propane	Gallon	EnergyGauge Default	0	1.4

SURROUNDINGS

Ornt	Type	Shade Trees Height	Shade Trees Width	Shade Trees Distance	Exist	Adjacent Buildings Height	Adjacent Buildings Width	Adjacent Buildings Distance
N	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
NE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
E	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
SE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
S	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
SW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
W	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
NW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft

FLOORS

#	Floor Type	Perimeter	R-Value	Area	Tile	Wood	Carpet
1	Slab-On-Grade Edge Insulation	228 ft	0	2051 ft²	0.5	0	0.5

ROOF

#	Type	Materials	Roof Area	Gable Area	Roof Color	Solar Absor.	Tested	Deck Insul.	Pitch
1	Hip	Composition shingles	2294 ft²	0 ft²	Medium	0.85	No	0	26.6 deg

ATTIC

#	Type	Ventilation	Vent Ratio (1 in)	Area	RBS	IRCC
1	Full attic	Vented	300	2051 ft²	N	N

Building Input Summary Report

CEILING

#	Ceiling Type	R-Value	Area	Framing Fraction	Truss Type
1	Under Attic ()	30	2051 ft²	0.11	Wood

WALLS

Wall orientation below is as entered. Actual orientation is modified by rotate angle shown in "Project" section above.

#	Ornt	Adjacent To	Wall Type	Cavity R-Value	Width Ft	Width In	Height Ft	Height In	Area	Sheathing R-Value	Framing Fraction	Solar Absor.
1	N	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
2	E	Exterior	Concrete Block - Int Insul	6	4	0	8		32 ft²		0	0.75
3	N	Exterior	Concrete Block - Int Insul	6	18		8		144 ft²		0	0.75
4	W	Exterior	Concrete Block - Int Insul	6	8		8		64 ft²	0	0	0.75
5	N	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
6	E	Exterior	Concrete Block - Int Insul	6	42		8		336 ft²		0	0.75
7	S	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
8	W	Exterior	Concrete Block - Int Insul	6	6		8		48 ft²		0	0.75
9	S	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75
10	E	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75
11	S	Exterior	Concrete Block - Int Insul	6	14		8		112 ft²		0	0.75
12	W	Garage	Frame - Wood	13	16		8		128 ft²		0.23	0.75
13	S	Garage	Frame - Wood	13	20		8		160 ft²		0.23	0.75
14	W	Exterior	Concrete Block - Int Insul	6	32		8		256 ft²		0	0.75
15	N	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75

DOORS

#	Ornt	Door Type	Storms	U-Value	Width Ft	Width In	Height Ft	Height In	Area
1	N	Insulated	None	0.46	1		1	6	1.5 ft²
2	S	Insulated	None	0.46	3		6	8	20 ft²
3	S	Wood	None	0.46	3		6	8	20 ft²
4	S	Wood	None	0.46	6		6	8	40 ft²

WINDOWS

#	Ornt	Frame	Panes	NFRC	U-Factor	SHGC	Storm	Area	Overhang Depth	Overhang Separation	Interior Shade	Screening
1	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
2	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	5 ft 4 in	1 ft 0 in	Drapes/blinds	None
3	N	Wood	Single (Clear)	No	0.95	0.8	N	10.33 ft²	5 ft 4 in	1 ft 8 in	Drapes/blinds	None
4	N	Metal	Single (Clear)	No	1.2	0.8	N	45 ft²	9 ft 4 in	1 ft 0 in	Drapes/blinds	None
5	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
6	E	Metal	Single (Clear)	No	1.2	0.8	N	15 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
7	S	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
8	S	Wood	Single (Clear)	No	0.95	0.8	N	15.5 ft²	7 ft 4 in	1 ft 8 in	Drapes/blinds	None
9	S	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
10	W	None	Glazed Block	No	0.6	0.6	N	16 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None

Building Input Summary Report

INFILTRATION & VENTING

Method	SLA	CFM 50	ELA	EqLA	ACH	ACH 50	---- Forced Ventilation ---- Supply	Exhaust	Run Time	Terrain/Wind Shielding
Best Guess	0.00050	2690	147.7	277.7	0.385	9.84	0	0	0	Suburban / Suburban

GARAGE

#	Floor Area	Roof Area	Exposed Wall Perimeter	Avg. Wall Height	Exposed Wall Insulation
1	460 ft²	0 ft²	52 ft	8 ft	(invalid)

MASS

Mass Type	Area	Thickness	Furniture Fraction
No Added Mass	0 ft²	0 ft	0.3

COOLING SYSTEM

#	System Type	Subtype	Efficiency	Capacity	Air Flow	SHR	Ductless
1	Central Unit	None	SEER: 16	48 kBtu/hr	1440 cfm	0.75	False

HEATING SYSTEM

#	System Type	Subtype	Efficiency	Capacity	Ductless
1	Electric Heat Pump	None	HSPF: 9.2	48 kBtu/hr	False

HOT WATER SYSTEM

#	System Type	EF	Cap	Use	SetPnt	Credits
1	Electric	0.85	40 gal	60 gal	120 deg	None

SOLAR HOT WATER

Collector Type	Collector Tilt	Azimuth	Surface Area	Loss Coef.	Absorp. Prod.	Trans Corr.	Tank Volume	Tank U-Value	Tank Surf Area	Heat Exch Eff	PV Pumped	Pump Energy

DUCTS

#	---- Supply ---- Location	R-Value	Area	---- Return ---- Location	Area	Number	Leakage Type	Air Handler	CFM 25	Percent Leakage	QN	RLF
1	Attic	6	410.2 ft²	Attic	102.55 ft²	(invalid)	Proposed Qn	Garage	43.58 cfm	3.03 %	0.02	0.60

TEMPERATURES

Programable Thermostat: None Ceiling Fans: Y

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cooling	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]	[X]	[X]	[ ]	[ ]	[ ]
Heating	[X]	[X]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]
Venting	[ ]	[ ]	[X]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]	[ ]

Thermostat Schedule: HERS 2006 Reference

Schedule Type		Hours 1	2	3	4	5	6	7	8	9	10	11	12
Cooling (WD)	AM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
	PM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
Cooling (WEH)	AM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
	PM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
Heating (WD)	AM	68	68	68	68	68	68	68	68	68	68	68	68
	PM	68	68	68	68	68	68	68	68	68	68	68	68
Heating (WEH)	AM	68	68	68	68	68	68	68	68	68	68	68	68
	PM	68	68	68	68	68	68	68	68	68	68	68	68

Building Input Summary Report

APPLIANCES & LIGHTING

Appliance Schedule: HERS 2006 Reference Schedule Type		Hours 1	2	3	4	5	6	7	8	9	10	11	12
Ceiling Fans (Summer)	AM	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.33	0.33	0.33	0.33	0.33
% Released: 100	PM	0.33	0.33	0.33	0.33	0.33	1	0.9	0.9	0.9	0.9	0.9	0.65
Annual Use: 652 kWh/Yr		Peak Value: 128 Watts											
Clothes Washer	AM	0.105	0.081	0.046	0.046	0.081	0.128	0.256	0.57	0.849	1	0.977	0.872
% Released: 60	PM	0.779	0.698	0.605	0.57	0.581	0.57	0.57	0.57	0.57	0.488	0.43	0.198
Annual Use: 53 kWh/Yr		Peak Value: 12 Watts											
Dishwasher	AM	0.139	0.05	0.028	0.024	0.029	0.09	0.169	0.303	0.541	0.594	0.502	0.443
% Released: 60	PM	0.377	0.396	0.335	0.323	0.344	0.448	0.791	1	0.8	0.597	0.383	0.281
Annual Use: 78 kWh/Yr		Peak Value: 24 Watts											
Dryer	AM	0.2	0.1	0.05	0.05	0.05	0.075	0.2	0.375	0.5	0.8	0.95	1
% Released: 10	PM	0.875	0.85	0.8	0.625	0.625	0.6	0.575	0.55	0.625	0.7	0.65	0.375
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											
Lighting	AM	0.16	0.15	0.16	0.18	0.23	0.45	0.4	0.26	0.19	0.16	0.12	0.11
% Released: 90	PM	0.16	0.17	0.25	0.27	0.34	0.55	0.55	0.88	1	0.86	0.51	0.28
Annual Use: 566 kWh/Yr		Peak Value: 185 Watts											
Miscellaneous	AM	0.48	0.47	0.47	0.47	0.47	0.47	0.64	0.71	0.67	0.61	0.55	0.53
% Released: 90	PM	0.52	0.5	0.5	0.5	0.59	0.73	0.79	0.99	1	0.96	0.77	0.55
Annual Use: 4105 kWh/Yr		Peak Value: 753 Watts											
Pool Pump	AM	0	0	0	0	0	0	0	0	0	1	1	1
% Released: 0	PM	1	1	1	1	0	0	0	0	0	0	0	0
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											
Range	AM	0.057	0.057	0.057	0.057	0.057	0.114	0.171	0.286	0.343	0.343	0.343	0.4
% Released: 100	PM	0.457	0.343	0.286	0.4	0.571	1	0.857	0.429	0.286	0.229	0.171	0.114
Annual Use: 447 kWh/Yr		Peak Value: 165 Watts											
Refrigeration	AM	0.85	0.78	0.75	0.73	0.73	0.73	0.75	0.75	0.8	0.8	0.8	0.8
% Released: 100	PM	0.88	0.85	0.85	0.83	0.88	0.95	1	0.98	0.95	0.93	0.9	0.85
Annual Use: 775 kWh/Yr		Peak Value: 106 Watts											
Well Pump	AM	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1
% Released: 0	PM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											

Annual Energy Summary

NA
Gainesville, FL, 32609-
Registration #:

Title: Typical Floirda Home Rebate
User

Building Energy Model for Thesis

TMY City: FL_GAINESVILLE_R
Elec Util: EnergyGauge Default
Gas Util: EnergyGauge Default
Run Date: 04/27/2012 13:17:41

End-Use	Energy Consumption	Annual Cost
Cooling (48 kBtu/hr)	1584 kWh	$178
Cooling Fan	299 kWh	$34
Mechanical Vent Fan	0 kWh	$ 0
Total Cooling	**1883 kWh**	**$212**
Heating (48 kBtu/hr)	1119 kWh	$126
Heating Fan/Pump	170 kWh	$19
Mechanical Vent Fan	0 kWh	$ 0
Total Heating	**1289 kWh**	**$145**
Hot Water	2947 kWh	$332
Hot Water Pump	0 kWh	$0
Total Hot Water	**2947 kWh**	**$332**
Ceiling Fans	438 kWh	$49
Clothes Washer	52 kWh	$6
Dishwasher	78 kWh	$9
Dryer	0 kWh	$0
Lighting	567 kWh	$64
Miscellaneous	4105 kWh	$462
Pool Pump	0 kWh	$0
Range	447 kWh	$50
Refrigerator	775 kWh	$87
Total (kWh)	12581 kWh	$1416
Total (Therms)	0 Therms	$0
Total (Oil Gallons)	0 Gallons	$0
Total (Propane Gallons)	0 Gallons	$0
PV Produced (kWh)*	0 kWh	$0
* Assumes net metering		
Total Cost		$1416

Emissions (Calculated as Total - PV Produced)

SO2	49.96 Lbs.
NOX	29.35 Lbs.
CO2	8.48 Tons

APPENDIX I
BUILDING ENERGY MODEL 3

Building Input Summary Report

PROJECT

Title:	Typical Floirda Home SHWS	Bedrooms:	0	Adress Type:	Street Address
Building Type:	User	Bathrooms:	0	Lot #	
Owner:		Conditioned Area:	2051	Block/SubDivision:	
# of Units:	1	Total Stories:	1	PlatBook:	
Builder Name:		Worst Case:	No	Street:	NA
Permit Office:		Rotate Angle:	0	County:	Alachua
Jurisdiction:		Cross Ventilation:		City, State, Zip:	Gainesville , FL , 32609-
Family Type:	Single-family	Whole House Fan:			
New/Existing:	New (From Plans)				
Comment:	Building Energy Model for Thesis				

CLIMATE

Design Location	Tmy Site	Design Temp 97.5 %	Design Temp 2.5 %	Int Design Temp Winter	Int Design Temp Summer	Heating Degree Days	Design Moisture	Daily Temp Range
FL, Gainesville	FL_GAINESVILLE_REGIONAL_AP	32	92	70	75	1305.5	51	Medium

UTILITY RATES

Fuel	Unit	Utility Name	Monthly Fixed Cost	$/Unit
Electricity	kWh	EnergyGauge Default	0	0.1126
Natural Gas	Therm	EnergyGauge Default	0	1.72
Fuel Oil	Gallon	EnergyGauge Default	0	1.1
Propane	Gallon	EnergyGauge Default	0	1.4

SURROUNDINGS

Ornt	Type	Shade Trees Height	Shade Trees Width	Shade Trees Distance	Exist	Adjacent Buildings Height	Adjacent Buildings Width	Adjacent Buildings Distance
N	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
NE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
E	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
SE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
S	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
SW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
W	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft
NW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft

FLOORS

#	Floor Type	Perimeter	R-Value	Area	Tile	Wood	Carpet
1	Slab-On-Grade Edge Insulation	228 ft	0	2051 ft²	0.5	0	0.5

ROOF

#	Type	Materials	Roof Area	Gable Area	Roof Color	Solar Absor.	Tested	Deck Insul.	Pitch
1	Hip	Composition shingles	2294 ft²	0 ft²	Medium	0.85	No	0	26.6 deg

ATTIC

#	Type	Ventilation	Vent Ratio (1 in)	Area	RBS	IRCC
1	Full attic	Vented	300	2051 ft²	N	N

Building Input Summary Report

CEILING

#	Ceiling Type	R-Value	Area	Framing Fraction	Truss Type
1	Under Attic ()	30	2051 ft²	0.11	Wood

WALLS

Wall orientation below is as entered. Actual orientation is modified by rotate angle shown in "Project" section above.

#	Ornt	Adjacent To	Wall Type	Cavity R-Value	Width Ft	Width In	Height Ft	Height In	Area	Sheathing R-Value	Framing Fraction	Solar Absor.
1	N	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
2	E	Exterior	Concrete Block - Int Insul	6	4	0	8		32 ft²		0	0.75
3	N	Exterior	Concrete Block - Int Insul	6	18		8		144 ft²		0	0.75
4	W	Exterior	Concrete Block - Int Insul	6	8		8		64 ft²	0	0	0.75
5	N	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
6	E	Exterior	Concrete Block - Int Insul	6	42		8		336 ft²		0	0.75
7	S	Exterior	Concrete Block - Int Insul	6	16		8		128 ft²		0	0.75
8	W	Exterior	Concrete Block - Int Insul	6	6		8		48 ft²		0	0.75
9	S	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75
10	E	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75
11	S	Exterior	Concrete Block - Int Insul	6	14		8		112 ft²		0	0.75
12	W	Garage	Frame - Wood	13	16		8		128 ft²		0.23	0.75
13	S	Garage	Frame - Wood	13	20		8		160 ft²		0.23	0.75
14	W	Exterior	Concrete Block - Int Insul	6	32		8		256 ft²		0	0.75
15	N	Exterior	Concrete Block - Int Insul	6	10		8		80 ft²		0	0.75

DOORS

#	Ornt	Door Type	Storms	U-Value	Width Ft	Width In	Height Ft	Height In	Area
1	N	Insulated	None	0.46	1		1	6	1.5 ft²
2	S	Insulated	None	0.46	3		6	8	20 ft²
3	S	Wood	None	0.46	3		6	8	20 ft²
4	S	Wood	None	0.46	6		6	8	40 ft²

WINDOWS

#	Ornt	Frame	Panes	NFRC	U-Factor	SHGC	Storm	Area	Overhang Depth	Overhang Separation	Interior Shade	Screening
1	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
2	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	5 ft 4 in	1 ft 0 in	Drapes/blinds	None
3	N	Wood	Single (Clear)	No	0.95	0.8	N	10.33 ft²	5 ft 4 in	1 ft 8 in	Drapes/blinds	None
4	N	Metal	Single (Clear)	No	1.2	0.8	N	45 ft²	9 ft 4 in	1 ft 0 in	Drapes/blinds	None
5	N	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
6	E	Metal	Single (Clear)	No	1.2	0.8	N	15 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
7	S	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
8	S	Wood	Single (Clear)	No	0.95	0.8	N	15.5 ft²	7 ft 4 in	1 ft 8 in	Drapes/blinds	None
9	S	Metal	Single (Clear)	No	1.2	0.8	N	30 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None
10	W	None	Glazed Block	No	0.6	0.6	N	16 ft²	1 ft 4 in	1 ft 0 in	Drapes/blinds	None

Building Input Summary Report

INFILTRATION & VENTING

Method	SLA	CFM 50	ELA	EqLA	ACH	ACH 50	---- Forced Ventilation ---- Supply	Exhaust	Run Time	Terrain/Wind Shielding
Best Guess	0.00050	2690	147.7	277.7	0.385	9.84	0	0	0	Suburban / Suburban

GARAGE

#	Floor Area	Roof Area	Exposed Wall Perimeter	Avg. Wall Height	Exposed Wall Insulation
1	460 ft²	0 ft²	52 ft	8 ft	(invalid)

MASS

Mass Type	Area	Thickness	Furniture Fraction
No Added Mass	0 ft²	0 ft	0.3

COOLING SYSTEM

#	System Type	Subtype	Efficiency	Capacity	Air Flow	SHR	Ductless
1	Central Unit	None	SEER: 10	48 kBtu/hr	1440 cfm	0.75	False

HEATING SYSTEM

#	System Type	Subtype	Efficiency	Capacity	Ductless
1	Electric Heat Pump	None	HSPF: 6.2	48 kBtu/hr	False

HOT WATER SYSTEM

#	System Type	EF	Cap	Use	SetPnt	Credits
1	Electric	0.85	40 gal	60 gal	120 deg	Solar System

SOLAR HOT WATER

Collector Type	Collector Tilt	Azimuth	Cover Area	Tank Loss Coef.	Trans Prod.	Volume Cap
Integrated Collector Storage	26.6	180	4.65 m²	9.00 W/C	0.82	302.8

DUCTS

#	---- Supply ---- Location	R-Value	Area	---- Return ---- Location	Area	Number	Leakage Type	Air Handler	CFM 25	Percent Leakage	QN	RLF
1	Attic	6	410.2 ft²	Attic	102.55 ft²	(invalid)	Default Leakage	Garage	(Default)	(Default)		

TEMPERATURES

Programable Thermostat: None Ceiling Fans: Y

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cooling	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]	[X]	[X]	[ ]	[ ]	[ ]
Heating	[X]	[X]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]
Venting	[ ]	[ ]	[X]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[X]	[ ]

Thermostat Schedule: HERS 2006 Reference

Schedule Type		Hours 1	2	3	4	5	6	7	8	9	10	11	12
Cooling (WD)	AM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
	PM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
Cooling (WEH)	AM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
	PM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5
Heating (WD)	AM	68	68	68	68	68	68	68	68	68	68	68	68
	PM	68	68	68	68	68	68	68	68	68	68	68	68
Heating (WEH)	AM	68	68	68	68	68	68	68	68	68	68	68	68
	PM	68	68	68	68	68	68	68	68	68	68	68	68

Building Input Summary Report

APPLIANCES & LIGHTING

Appliance Schedule: HERS 2006 Reference Schedule Type		Hours 1	2	3	4	5	6	7	8	9	10	11	12
Ceiling Fans (Summer)	AM	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.33	0.33	0.33	0.33	0.33
% Released: 100	PM	0.33	0.33	0.33	0.33	0.33	1	0.9	0.9	0.9	0.9	0.9	0.65
Annual Use: 652 kWh/Yr		Peak Value: 128 Watts											
Clothes Washer	AM	0.105	0.081	0.046	0.046	0.081	0.128	0.256	0.57	0.849	1	0.977	0.872
% Released: 60	PM	0.779	0.698	0.605	0.57	0.581	0.57	0.57	0.57	0.57	0.488	0.43	0.198
Annual Use: 53 kWh/Yr		Peak Value: 12 Watts											
Dishwasher	AM	0.139	0.05	0.028	0.024	0.029	0.09	0.169	0.303	0.541	0.594	0.502	0.443
% Released: 60	PM	0.377	0.396	0.335	0.323	0.344	0.448	0.791	1	0.8	0.597	0.383	0.281
Annual Use: 78 kWh/Yr		Peak Value: 24 Watts											
Dryer	AM	0.2	0.1	0.05	0.05	0.05	0.075	0.2	0.375	0.5	0.8	0.95	1
% Released: 10	PM	0.875	0.85	0.8	0.625	0.625	0.6	0.575	0.55	0.625	0.7	0.65	0.375
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											
Lighting	AM	0.16	0.15	0.16	0.18	0.23	0.45	0.4	0.26	0.19	0.16	0.12	0.11
% Released: 90	PM	0.16	0.17	0.25	0.27	0.34	0.55	0.55	0.88	1	0.86	0.51	0.28
Annual Use: 566 kWh/Yr		Peak Value: 185 Watts											
Miscellaneous	AM	0.48	0.47	0.47	0.47	0.47	0.47	0.64	0.71	0.67	0.61	0.55	0.53
% Released: 90	PM	0.52	0.5	0.5	0.5	0.59	0.73	0.79	0.99	1	0.96	0.77	0.55
Annual Use: 4105 kWh/Yr		Peak Value: 753 Watts											
Pool Pump	AM	0	0	0	0	0	0	0	0	0	1	1	1
% Released: 0	PM	1	1	1	1	0	0	0	0	0	0	0	0
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											
Range	AM	0.057	0.057	0.057	0.057	0.057	0.114	0.171	0.286	0.343	0.343	0.343	0.4
% Released: 100	PM	0.457	0.343	0.286	0.4	0.571	1	0.857	0.429	0.286	0.229	0.171	0.114
Annual Use: 447 kWh/Yr		Peak Value: 165 Watts											
Refrigeration	AM	0.85	0.78	0.75	0.73	0.73	0.73	0.75	0.75	0.8	0.8	0.8	0.8
% Released: 100	PM	0.88	0.85	0.85	0.83	0.88	0.95	1	0.98	0.95	0.93	0.9	0.85
Annual Use: 775 kWh/Yr		Peak Value: 106 Watts											
Well Pump	AM	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1
% Released: 0	PM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Annual Use: 0 kWh/Yr		Peak Value: 0 Watts											

Annual Energy Summary

NA
Gainesville, FL, 32609-
Registration #:

Title: Typical Floirda Home SHWS
User

Building Energy Model for Thesis

TMY City: FL_GAINESVILLE_R
Elec Util: EnergyGauge Default
Gas Util: EnergyGauge Default
Run Date: 04/27/2012 14:54:59

End-Use	Energy Consumption	Annual Cost
Cooling (48 kBtu/hr)	2825 kWh	$318
Cooling Fan	444 kWh	$50
Mechanical Vent Fan	0 kWh	$ 0
Total Cooling	**3269 kWh**	**$368**
Heating (48 kBtu/hr)	1799 kWh	$203
Heating Fan/Pump	245 kWh	$28
Mechanical Vent Fan	0 kWh	$ 0
Total Heating	**2044 kWh**	**$231**
Hot Water	1267 kWh	$143
Hot Water Pump	0 kWh	$0
Total Hot Water	**1267 kWh**	**$143**
Ceiling Fans	438 kWh	$49
Clothes Washer	52 kWh	$6
Dishwasher	78 kWh	$9
Dryer	0 kWh	$0
Lighting	567 kWh	$64
Miscellaneous	4105 kWh	$462
Pool Pump	0 kWh	$0
Range	447 kWh	$50
Refrigerator	775 kWh	$87
Total (kWh)	13042 kWh	$1469
Total (Therms)	0 Therms	$0
Total (Oil Gallons)	0 Gallons	$0
Total (Propane Gallons)	0 Gallons	$0
PV Produced (kWh)*	0 kWh	$0
* Assumes net metering		
Total Cost		$1469

Emissions (Calculated as Total - PV Produced)

SO2	51.79 Lbs.
NOX	30.42 Lbs.
CO2	8.79 Tons

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BIOGRAPHICAL SKETCH

Kurt Strauss is a Master of Science in Building Construction student at the M.E. Rinker, Sr. School of Building Construction at the University of Florida. Kurt received his Associate of Art (AA) in General Education and Associate of Applied Science (AAS) in Building Construction Technology from Santa Fe College. Kurt also received his Bachelor of Science (BS) from the M.E. Rinker, Sr. School of Building Construction at the University of Florida. Kurt Strauss is also a State of Florida Certified Building Contractor, State of Florida Certified Class 1 Energy Rater, National Certified RESNET Energy Rater, and State of Florida Certified Real Estate Sales Person.