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Potential of Energy Efficiency and Renewable Energy Savings To Impact Florida's Projected Energy Use in 2014

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Potential of Energy Efficiency and Renewable Energy Savings To Impact Florida's Projected Energy Use in 2014

Philip Fairey
Deputy Director
January 2006

Introduction

Florida's 2004 electrical energy use was 233 billion kilowatt-hours. Over half (51%) of this energy use went to residential building energy. The state's current 10-year predictions for electrical energy use in 2014 show a requirement for approximately 308 billion kilowatt-hours of electricity, an increase of approximately 75 billion kilowatt-hours. This study presents an example of how Florida can radically alter its 2014 energy use projection by aggressively pursuing residential building energy efficiency improvements and aggressively increasing its use of proven renewable energy resources.

Methods

This study was conducted using EnergyGauge® USA, a detailed, hourly, building energy simulation software based on the U.S. Department of Energy's DOE-2.1E (v.120) simulation engine. EnergyGauge was developed by the Florida Solar Energy Center and has been nationally accredited by the Residential Energy Services Network (RESNET) for use as a home energy rating software tool.[1]

Three typical Florida homes, each with 2000 square feet of conditioned floor area and three bedrooms have been evaluated using EnergyGauge to determine the degree to which they could be improved through off-the-shelf energy efficiency and renewable energy technology. Each home is improved to the point that it will qualify for the new $2,000 federal tax credit for highly efficient new homes. This tax credit, created by the U.S. Energy Policy Act of 2005, requires that the heating and cooling energy use for qualifying homes be 50% or less of the heating and cooling energy use of a reference home, as defined by the minimum requirements of Section 404 of the 2004 Supplement to the International Energy Efficiency Code (IECC). [2]

The three homes were located in Miami, Tampa and Tallahassee in order to represent the variety of Florida climates. Each of the homes was configured in three ways:

1. To represent the current minimum Florida building code standards (2004 baseline home)
2. To represent a home that would qualify for the 2006 IRS tax credit, which also contained a solar hot water heater (EERE home), and
3. The same configuration as number 2 with a 2 kW-peak photovoltaic system added (EERE-PV home).

[1] For a list of RESNET accredited software see http://resnet.us/programs/software/directory.htm
[2] These tax credit qualification criteria are further defined in RESNET Publication 05-001, which may be downloaded at http://www.resnet.us/standards/tax_credits/procedures.pdf

The results from these simulations were then entered in an Excel spreadsheet to perform analysis and expand the results to represent statewide potentials. In addition, the hourly electric energy demand results for the peak summer and peak winter days for each climate were also downloaded to the spreadsheet to examine the impacts on utility load shape.

Results

Results show that significant electrical energy savings in Florida homes are both possible and practical. If the IRS tax credits are augmented by State of Florida rebates, electrical energy savings exceeding 40% of total home energy use are cost-effectively achieved (for the consumer) in all three climates zones.

Summary Results

Results from the individual simulations are broadly extrapolated to the entire state by assuming specific installations per year over the 10 years for each of the various renewable energy and energy efficiency strategies evaluated. The annual installations shown in Table 1 were used to extrapolate the individual results to the statewide totals. It is also important to note that Florida constructs approximately 160,000 new homes each year and has approximately 6.2 million existing homes in place.

Table 1. Assumed Installations for Aggressive Florida Energy Efficiency and Renewable Energy Technologies Program

Measures	Population Base	Installations
High-efficiency new homes	160,000 per year	24,000 per year
Solar hot water (new homes)	160,000 per year	24,000 per year
Improved existing home efficiency (15%)	6,200,000	62,000 per year
Solar hot water (existing homes)	6,200,000	62,000 per year
Photovoltaic systems (2 kWp)	6,200,000	9,300 per year

Using the above assumptions for installations that Florida could achieve by providing additional incentives to those that are provided by IRS tax credits, the statewide savings of such a program can be estimated as shown in Table 2 with costs as shown in Table 3.

Table 2. Savings in Energy Use, Costs and CO_2 for Statewide Program

	Consumer Savings		New Plant Savings		*Fuel Saved*	TRECs Created	Total $ Saved	CO_2 Saved
10-years	**(TWh)**	**($mil)**	**(MW)**	**($mil)**	**($mil)**	**($mil)**	**($mil)**	**(MTons)**
Efficiency	14.68	$1,468	950	$950	$734	n/a	$3,152	21.16
Renewables	10.52	$1,052	681	$681	$526	$421	$2,681	15.17
Total	**25.20**	**$2,520**	**1,631**	**$1,631**	**$1,260**	**$421**	**$5,833**	**36.34**
Annual								
Efficiency	2.67	$267	173	$173	$133	n/a	$573	3.85
Renewables	1.91	$191	124	$124	$96	$77	$487	2.76
Total	**4.58**	**$458**	**297**	**$297**	**$229**	**$77**	**$1,060**	**6.61**

Table 3. Apportioned 10-year Costs and Rebates of Example Statewide Program

Individual Components	Costs ($/unit)	Market ($mil)	IRS ($mil)	Florida ($mil)	Consumer ($mil)	Rebate Total (%)
Solar hot water (new)*	$3,200	$768				
Federal tax credits	$960		$230			
Florida Rebate (1)	$590			$142		
Total rebates	$1,550				$372	48.4%
Net consumer costs	$1,650				$396	
Total units	240,000					
Efficiency - new homes*	$7,000	$1,680				
Federal tax credits	$2,000		$480			
Florida Rebate (1)	$1,453			$349		
Total rebates	$3,453				$829	49.3%
Net consumer costs	$3,547				$851	
Total units	240,000					
Solar hot water (existing)*	$3,600	$2,232				
Federal tax credits	$1,080		$670			
Florida Rebate (1)	$590			$366		
Total rebates	$1,670				$1,035	46.4%
Net consumer costs	$1,930				$1,197	
Total units	620,000					
Efficiency - existing homes*	$4,000	$2,480				
Federal tax credits	$500		$310			
Florida Rebate (1)	$729			$452		
Total rebates	$1,229				$762	30.7%
Net consumer costs	$2,771				$1,718	
Total units	620,000					
Photovoltaic systems*	$14,000	$1,302				
Federal tax credits	$2,000		$186			
Florida Rebate (2)	$5,000			$465		
Total rebates	$7,000				$651	50.0%
Net consumer costs	$7,000				$651	
Total units	93,000					
	Totals:	**$8,462**	**$1,876**	**$1,631**	**$4,813**	**41.4%**

Table Notes:
(1) Rebate = $0.30 per annual kWh saved
(2) Rebate = $2.50 per peak-watt with minimum installation of 2 kWp
***** Typical costs are best available estimates

Table 3 above shows a rebate incentive cost to Florida of $1,631 million over 10 years or $163 million per year. However, such a rebate program cannot be carried out for the cost of the rebates alone. Estimated total costs to operate the program are as follows:

Consumer rebate incentives:		$163.1	million per year
Marketing costs @	7.5%	$12.2	
Verification & assessment costs @	5.0%	$8.2	
Administration costs @	5.0%	$8.2	
Total Costs:		**$192**	**million per year**

While this may appear to be a large expenditure, it should be remembered that the electrical savings are quite large at more than 4,580 gigawatt-hours per year and more than $450 million in consumer savings each year. It should also be remembered that implementation of these measures is being highly leveraged by federal tax credits, which are estimated to add an additional $188 million to the total value of the program. There are also additional economic benefits that accrue from keeping almost $230 million per year in fuel costs from leaving the state, creating more than $75 million in Tradable Renewable Energy Credits each year and saving almost 7 million tons of CO_2 emissions each year. Based on the market expenditures to achieve these results and a simplified estimate of 15 net new jobs per million in expenditures, this program would also create more than 126,000 jobs over the 10-year period.

It is also important to remember that Florida has authorized other programs for the purpose of saving energy with similar annual costs through the Florida Energy-Efficiency and Conservation Act (FEECA). The Florida Public Services Commission (PSC) reports that statewide utility demand side management (DSM) programs operated under FEECA recovered $240 million in costs and saved 239 gigawatt-hours of electricity in 2004. A comparison of this program with the example presented here, as shown in Table 4 below, is helpful.

Table 4. Comparison of Study Results with Florida's Current DSM Programs

Energy Efficiency Program	Annual Costs ($mil)	Annual Savings (GWh)	Cost of Saved Energy (at end of 10th year) ($/kWh)
2004 Florida DSM programs	$240	239	$0.1826
Florida EERE study program	$379	4,582	$0.0150
Florida rebate subtotals	$192		$0.0076
IRS tax credit subtotals	$188		$0.0074

Detailed Simulation Results

The following pages contain detailed information on the three EERE prototypes and results considered in this study. All results are as reported by the EnergyGauge USA home energy rating, code compliance and building energy simulation software tool:

- The detailed improvements that were considered for each of the three EERE prototypes,
- The calculated energy savings potential for each prototype,
- The Home Energy Rating[3] for each prototype, and
- The peak summer and winter day load shapes for each prototype.

[3] The *Florida Building Energy Efficiency Ratings Act of 1993* provides a uniform means for all Florida buildings to be rated for energy efficiency. The Florida Solar Energy Center is a nationally accredited Home Energy Rating System (HERS) Provider in accordance with the national standards for home energy ratings and the software used here for this purpose, EnergyGauge USA, is a nationally accredited HERS software tool.

Table 5. Miami EERE-PV Home (off-the-shelf technology)

Component	**Characteristic**
Windows	Low-e, metal frame, SHGC=0.28 windows
Doors	Insulated (R-5)
Ceilings	Standard truss; R-30 insulation
Walls	Concrete block; R-10 insulation
Floors	Slab-on-grade with 50% tile; R-0 insulation
Roof	Barrel tile, light colored (solar reflectance = 40%)
Attic	Standard vented with radiant barrier system (RBS)
Heating and cooling	SEER-15, HSPF-8.2 heat pump
Air distribution system	Interior ducts & AHU; leakage <= 0.03 cfm25/ft^2
Controls	Programmable thermostat
Ventilation	Mechanically controlled to minimize infiltration
Lighting	50% fluorescent (or CFL) lighting
Refrigerator	Energy Star qualified
Ceiling fans	Energy Star qualified
Dishwasher	Energy Star qualified
Renewable hot water	Open loop solar hot water (30% tax credit)
Renewable power	2.0 kW-peak photovoltaic system (30% tax credit)

Table 5.a. EnergyGauge Predicted Energy Use and Savings for Miami Cases

Energy End Uses	2004 baseline	EERE Home	kWh/kW Savings	% Savings
Cooling	6,918	2,732	4,186	60.5%
Heating	42	8	34	81.0%
Hot water	2,238	322	1,916	85.6%
Ceiling fans	651	329	322	49.5%
Dishwasher	145	115	30	20.7%
Dryer	891	891	0	0.0%
Lighting	2,055	1,522	533	25.9%
Miscellaneous	2,671	2,671	0	0.0%
Range	447	447	0	0.0%
Refrigerator	775	650	125	16.1%
Total kWh	16,756	9,683	7,073	42.2%
Summer peak kW	5.08	2.87	2.21	43.5%
Winter peak kW	3.18	2.17	1.01	31.7%
2 kWp PV kWh	---	-2,366	9,439	56.3%
CO_2 tons/year	17.97	7.61	10.36	57.7%

Projected Rating Based on Plans
Field Performance Tests Required for Rating Confimation

Energy Gauge
Anyplace
Miami, FL

Title: Miami_EERE-PV
CZ1 - New home tax credit qualification example

Design: Miami, FL
TMY: MIAMI, FL

BUILDING ENERGY RATING GUIDE

$0 | **$804** [2] | **Reference $1735**

0 MBtu | **25.0 MBtu** | **54 MBtu**

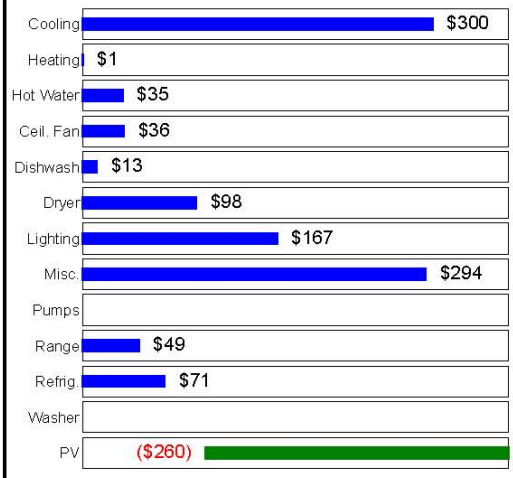
▼ Proposed Home

Savings = $931

Cost Basis:
2006 FPL
2006 Florida Gas
Statewide Prices

Electric Rate: $0.110 /kWh
Gas Rate: $1.400 /Therm
Oil: $1.50/gal LP Gas: $1.75/gal

This Home Qualifies for an Energy Efficient Mortgage (EEM)



HERS Index[1]: 43

NATIONAL MORTGAGE INDUSTRY HERS ACCREDITATION REGISTRY No. 1998-001

Robert Certified	000000
Certified Rater	I.D. Number
Signature	Date

This Rating Guide is provided to you by a Home Energy Rater who is trained and certified to perform Ratings in accordance with the RESNET standard. Questions or complaints regarding this Rating may be directed to the EnergyGauge Program Office, 1679 Clearlake Road, Cocoa, FL 32922-5703, 321-638-1492, or by e-mail to engauge@fsec.ucf.edu.

NOTES:
[1] HERS Index calculated in accordance with 2006 RESNET standard, Section 303.2 (Reference home = 100, Zero energy use = 0).
[2] PV production assumes net metering.

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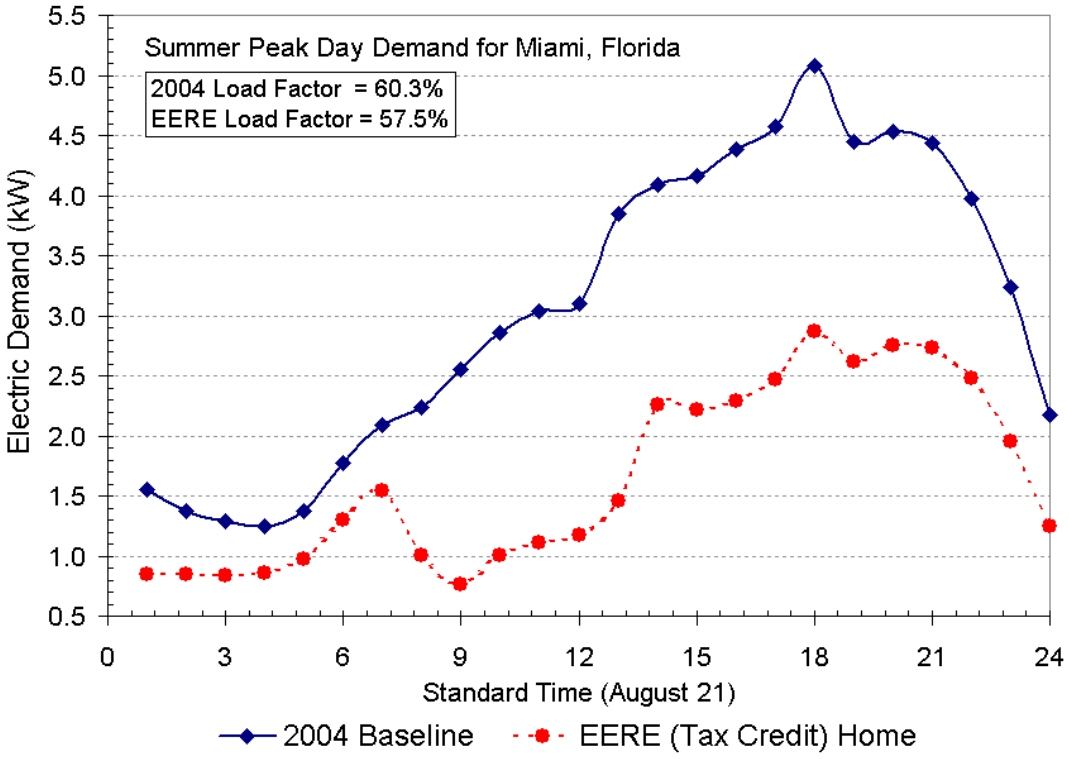
Residential Building Energy Efficiency and Renewable Energy (EERE) Savings Potential Miami Peak Day Plots



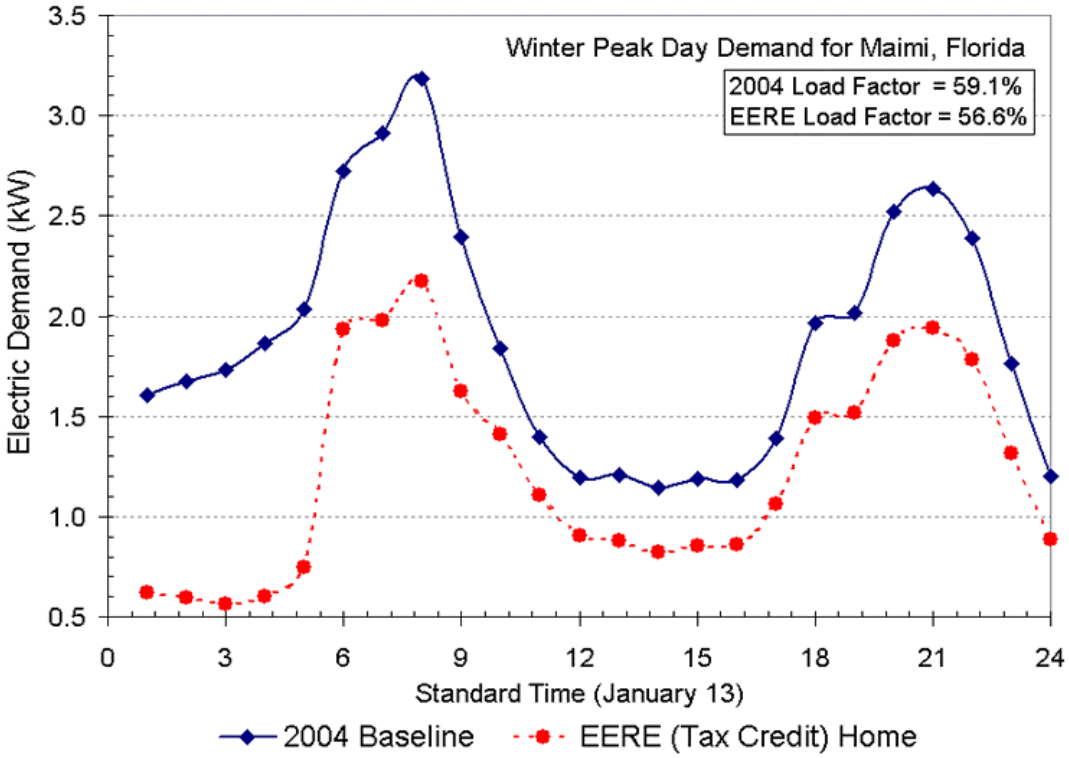


Table 6. Tampa EERE-PV Home (off-the-shelf technology)

Component	**Characteristic**
Windows	Low-e, vinyl frame, SHGC=0.28 windows
Doors	Insulated (R-5)
Ceilings	Standard truss; R-30 insulation
Walls	Concrete block; R-10 insulation
Floors	Slab-on-grade with 50% tile; R-0 insulation
Roof	Barrel tile, light colored (solar reflectance = 40%)
Attic	Standard vented with radiant barrier system (RBS)
Heating and cooling	SEER-15, HSPF-8.2 heat pump
Air distribution system	Interior ducts & AHU; leakage <= 0.03 cfm25/ft^2
Controls	Programmable thermostat
Ventilation	Mechanically controlled to minimize infiltration
Lighting	50% fluorescent (or CFL) lighting
Refrigerator	Energy Star qualified
Ceiling fans	Energy Star qualified
Dishwasher	Energy Star qualified
Renewable hot water	Open loop solar hot water (30% tax credit)
Renewable power	2.0 kW-peak photovoltaic system (30% tax credit)

Table 6.a. EnergyGauge Predicted Energy Use and Savings for Tampa Cases

Energy End Uses	2004 baseline	EERE Home	kWh/kW Savings	% Savings
Cooling	5,052	1,877	3,175	62.8%
Heating	559	146	413	73.9%
Hot water	2,417	427	1,990	82.3%
Ceiling fans	651	329	322	49.5%
Dishwasher	145	115	30	20.7%
Dryer	891	891	0	0.0%
Lighting	2,055	1,522	533	25.9%
Miscellaneous	2,671	2,671	0	0.0%
Range	447	447	0	0.0%
Refrigerator	775	650	125	16.1%
Total kWh	15,663	9,075	6,588	42.1%
Summer peak kW	4.53	2.47	2.06	45.5%
Winter peak kW	4.16	2.63	1.53	36.8%
2 kWp PV kWh	---	-2,416	9,004	57.5%
CO_2 tons/year	16.47	7.04	9.43	57.3%

Projected Rating Based on Plans
Field Performance Tests Required for Rating Confimation

Energy Gauge
Anyplace
Tampa, FL

Title: Tampa_EERE-PV

Design: Tampa, FL
TMY: TAMPA, FL

BUILDING ENERGY RATING GUIDE

$0

$740 [2]

Reference
$1621

0 MBtu

23.0 MBtu

51 MBtu

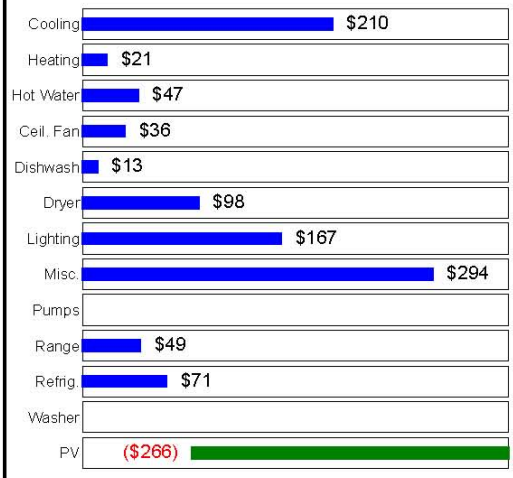
▼ Proposed Home

Savings = $881

Cost Basis:
2006 TECO
2006 Florida Gas
Statewide Prices

Electric Rate: $0.110 /kWh
Gas Rate: $1.400 /Therm
Oil: $1.50/gal LP Gas: $1.75/gal

This Home Qualifies for an Energy Efficient Mortgage (EEM)



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[2] PV production assumes net metering.

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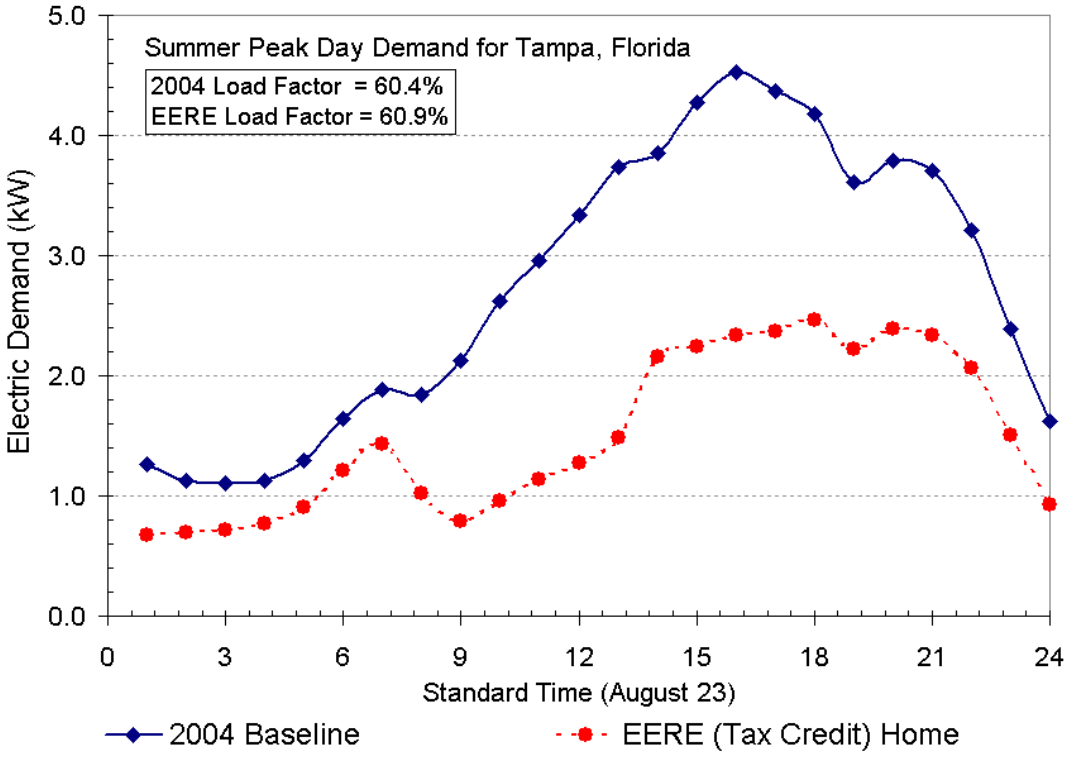
Residential Building Energy Efficiency and Renewable Energy (EERE) Savings Potential Tampa Peak Day Plots



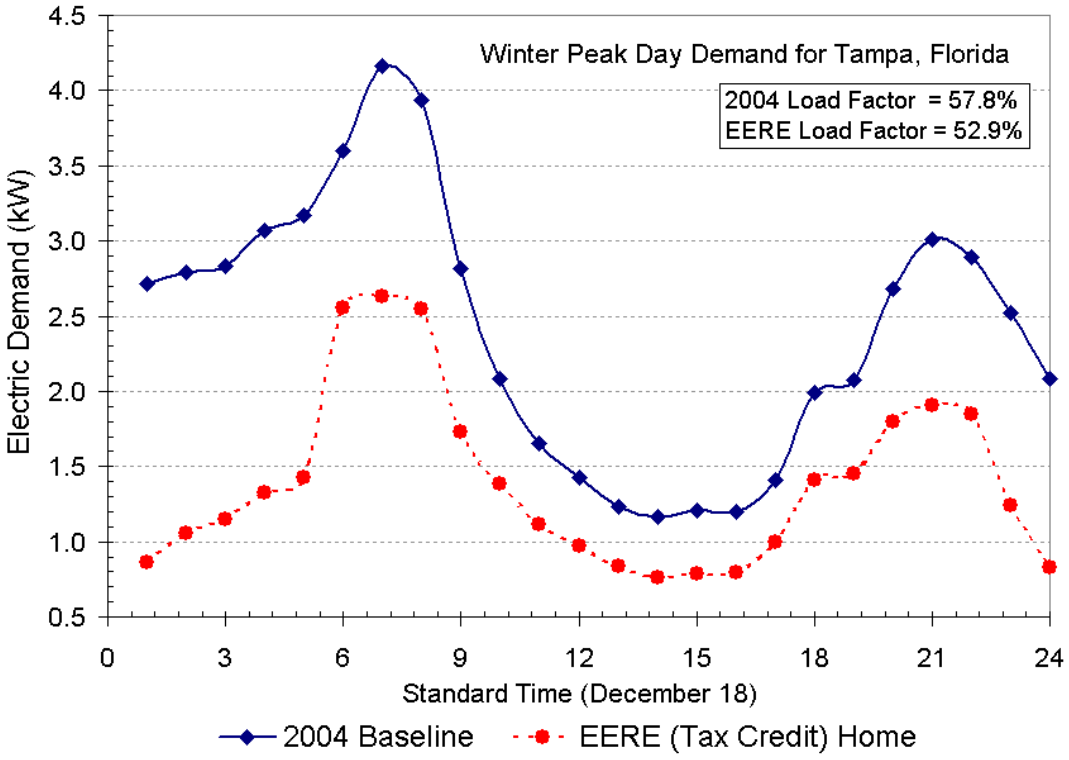


Table 7. Tallahassee EERE-PV Home (off-the-shelf technology)

Component	**Characteristic**
Windows	Low-e, vinyl frame, SHGC=0.40 windows
Doors	Insulated (R-5)
Ceilings	Standard truss; R-30 insulation
Walls	2x4 frame; R-13 insulation
Floors	Slab-on-grade with 50% tile; R-0 insulation
Roof	Barrel tile, light colored (solar reflectance = 40%)
Attic	Standard vented with radiant barrier system (RBS)
Heating and cooling	SEER-15, HSPF-8.2 heat pump
Air distribution system	Interior ducts & AHU; leakage <= 0.03 cfm25/ft^2
Controls	Programmable thermostat
Ventilation	Mechanically controlled to minimize infiltration
Lighting	50% fluorescent (or CFL) lighting
Refrigerator	Energy Star qualified
Ceiling fans	Energy Star qualified
Dishwasher	Energy Star qualified
Renewable hot water	Open loop solar hot water (30% tax credit)
Renewable power	2.0 kW-peak photovoltaic system (30% tax credit)

Table 7.a. EnergyGauge Predicted Energy Use and Savings for Tallahassee Cases

Energy End Uses	2004 baseline	EERE Home	kWh/kW Savings	% Savings
Cooling	3,523	1,389	2,134	60.6%
Heating	2,282	728	1,554	68.1%
Hot water	2,663	669	1,994	74.9%
Ceiling fans	651	329	322	49.5%
Dishwasher	145	115	30	20.7%
Dryer	891	891	0	0.0%
Lighting	2,055	1,522	533	25.9%
Miscellaneous	2,671	2,671	0	0.0%
Range	447	447	0	0.0%
Refrigerator	775	650	125	16.1%
Total kWh	16,103	9,411	6,692	41.6%
Summer peak kW	5.52	3.13	2.39	43.3%
Winter peak kW	9.15	6.15	3.01	32.8%
2 kWp PV kWh	---	-2,386	9,078	56.4%
CO_2 tons/year	16.95	7.29	9.66	57.0%

Projected Rating Based on Plans
Field Performance Tests Required for Rating Confimation

Energy Gauge
Anyplace
Tallahasee, FL

Title: Tallahassee-EERE_PV

Design: Tallahassee, FL
TMY: TALLAHASSEE, FL

BUILDING ENERGY RATING GUIDE

$0 | **$801** [2] | **Reference $1646**

0 MBtu | **24.9 MBtu** | **52 MBtu**

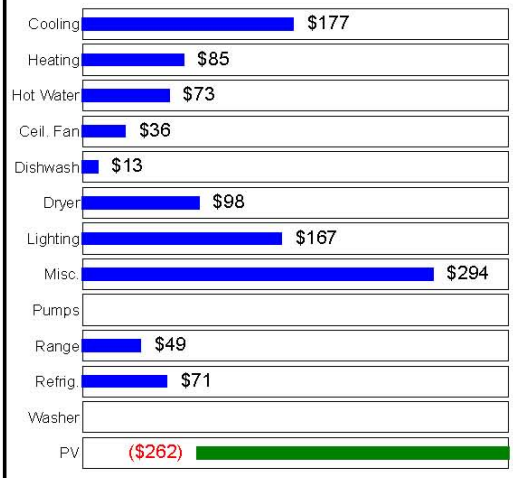
▼ Proposed Home

Savings = $845

Cost Basis:
2006 City of Talley
2006 Florida Gas
Statewide Prices

Electric Rate: $0.110 /kWh
Gas Rate: $1.400 /Therm
Oil: $1.50/gal LP Gas: $1.75/gal

This Home Qualifies for an Energy Efficient Mortgage (EEM)



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Residential Building Energy Efficiency and Renewable Energy (EERE) Savings Potential Tallahassee Peak Day Plots