Executive Summary: Energy Study Helps Homeowners Keep Cooling Costs From Going Through The Roof

Roof and attic thermal performance exert a powerful influence on cooling energy use in Florida homes. Unshaded residential roofs are heated by solar radiation causing high afternoon attic air temperatures. The large influence on cooling is due to increased ceiling heat transfer as well as heat gains to the duct systems which are typically located in the attic space (Figure E-1).

The Florida Solar Energy Center instrumented six side-by-side Habitat homes in Ft. Myers, Florida with identical floor plans and orientation, R-19 ceiling insulation, but with different roofing systems designed to reduce attic heat gain. A seventh house had an un-vented attic with insulation on the underside of the roof deck rather than the ceiling:

(RGS) Standard dark shingles (control home)
(RWB) White "Barrel" S_tile roof
(RWS) Light colored shingles
(RWF) White flat tile roof
(RTB) Terra cotta S_tile roof
(RWM) White metal roof
(RSL) Standard dark shingles with sealed attic and R_19 roof deck insulation

All seven houses were completed by June 26th, 2000 with extensive testing to assure the buildings were similar. Each home was monitored simultaneously from July 8th - 31st in an unoccupied state.

Building thermal conditions and air conditioning power were obtained on a 15-minute basis. Each of the examined alternative constructions exhibited superior performance to dark shingles. Figure E-2 plots the maximum daily air temperature to the maximum recorded at mid-attic in each construction.

The maximum attic temperature during the peak summer hour is 40°F greater than ambient air temperature in the control home while no greater than ambient with highly reflective roofing systems. Light colored shingles and terra cotta roofs show temperatures in between. Table E-1 summarizes the metered data from the unoccupied period.

Table E-1. Cooling Performance During Unoccupied Period July 8th _ 31st, 2000

Site	Total kWh	Savings kWh	Save Percent	Demand kW	Savings kW	Saved Percent
RGS	17.03	0.00	0.0%	1.63	0.00	----
RWS	15.29	1.74	10.2%	1.44	0.19	11.80%
RSL	14.73	2.30	13.5%	1.63	0.01	0.30%
RTB	16.02	1.01	5.9%	1.57	0.06	3.70%
RWB	13.32	3.71	21.8%	1.07	0.56	34.20%
RWF	13.20	3.83	22.5%	1.02	0.61	37.50%
RWM	12.03	5.00	29.4%	0.98	0.65	39.70%

The above results are for the 1,144 square foot homes in the study. Since savings largely scale with ceiling area, the kWh and kW values should be increased by the applicable ratio. For instance, typical FPL homes of 1,770 square feet would have estimated absolute savings 55% greater than above. Also, adjustments were made for slightly different thermostat set points and small variations in the measured performance of individual AC units.

Table E-2. Summary of Normalized Savings and Demand Reductions from Regression Estimates

Case Description	Cooling Savings		Peak Demand Reduction	
	kWh	Percent	kW	Percent
RGS (Control)	0	0%	0	0%
RWS (White Shingle)	300	4%	0.48	17%
RSL (Sealed Attic)	620	9%	0.13	5%
RTB (Terra Cotta Tile)	180	3%	0.36	13%
RWB (White S-Tile)	1,380	20%	0.92	32%
RWF (White Flat Tile)	1,200	17%	0.98	34%
RWM (White Metal)	1,610	23%	0.79	28%

* Percentages relative to typical values for average sized detached S. FL homes detailed in Appendix H.

The results in Table E-2, show essentially two classes of performance: white shingles, terra cotta tile and sealed attic construction which produce energy savings of 200 - 600 kWh/yr and demand reductions of 0.05 - 0.5 kW. Highly reflective roof systems produce energy savings of 1,000 - 1,600 kWh with demand reductions of 0.8 - 1.0 kW. A separate analysis of the data using a special version of the DOE-2.1E simulation verified the magnitude of the measured energy and demand reductions.

Additional monitoring took place over a month long period with the homes occupied, but the thermostat set points were kept exactly the same as in the unoccupied monitoring period.

Although average cooling energy use rose by 36%, analysis indicated no decrease to savings or demand reduction from the highly reflective roofing systems. The added heat gains from appliances and people increase cooling system run-time, with longer periods for the duct system to exchange heat to the often hot attic space.

In summary, this evaluation strongly confirms the energy-saving benefits of using more reflective roofing systems in Florida. Selection of colors with higher solar reflectance will result in tangible cooling energy savings for customers. This is particularly true for roofing materials such as tile and metal which are currently available with solar reflectances of 65%-75%. The selection of reflective roofing systems represents one of the most significant energy-saving options available to homeowners and builders. Such systems also strongly reduce the cooling demand during utility coincident peak periods and may be among the most effective methods for controlling demand.

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FOR IMMEDIATE RELEASE

Energy Study Helps Homeowners Keep Cooling Costs From Going Through The Roof

Juno Beach, Fla ---- Florida Power & Light Company (FPL) announced today the results of a study that confirms what many homeowners living in the Sunbelt have thought for years ---- the whiter, and therefore, more reflective the roof, the lower the electric bill. In the first study of its kind, FPL sponsored a tightly controlled test project that compared commonly used residential roofing materials to evaluate their relationship to home cooling costs.

The four-month study is the first to quantify cooling performance on identical residences during realistic weather conditions. The six roofing materials evaluated were: Dark gray shingles, white shingles, white flat tile, white S-shaped tile, terra cotta S-shaped "Spanish" tile, and white metal.

Study findings indicate energy savings are most strongly influenced by the solar reflectance of roof materials. The study proves dark gray roofs reflect a mere eight percent of the heat associated with sunlight, while white shingle and terra cotta tile roofs reflect 25 and 34 percent, respectively. White metal and cement tile roofs provide the most dramatic results, reflecting 66 to 77 percent of the sun’s energy.

"The results of the study clearly demonstrate that white, galvanized metal roofing material saves the most energy as a result of its high reflectance and superior ability to cool quickly at night. This information, when applied, will not only result in lower energy consumption and cooling costs for the single-family resident in

Florida, but for residents throughout the southern United States," said Craig Muccio, Conservation Program Evaluation Coordinator, for FPL.

A white, galvanized metal roof should save a customer who lives in an average-size 1,770 square foot home approximately $128 or 23 percent annually in cooling costs, compared with a dark gray shingle roof on the same home. For the same size home, white, S-shaped cement tile produces the second-best savings of $110 or 20 percent of annual cooling costs followed by white, flat cement calculated at $96 per year for a 17 percent savings compared to the dark gray shingles. White shingled roofs trim $24 or about four percent off the annual cooling bill, while terra cotta S-shaped cement tiles net a modest $15, or three percent compared to dark gray shingles.

"Choosing a roof for a home, whether it's a new home or a replacement roof, is a major decision for most homeowners. The purpose of this study is to provide homeowners with additional information to help them make the best, most informed decision. Every little bit we do to help our customers stay informed should ultimately conserve energy as well as save them money," Muccio said.

The study, titled "Comparative Evaluation of the Impact of Roofing Systems on Residential Cooling Energy Demand in Florida," was conducted in Fort Myers, Florida by Florida Solar Energy Center for FPL with the cooperation of Habitat for Humanity of Lee County, Florida.

The six identical, side-by-side, newly constructed Habitat for Humanity homes were built using various roofing materials. The homes were operated identically to ensure study accuracy. For example, temperature controls on the air conditioning thermostats of all the houses were set at a constant 77º F. And, all six homes were studied unoccupied and occupied. FPL plans to use the results as a basis for a recommendation to update the energy performance calculations

of the state building code and to examine how to best promote the selection of white and light-colored roofs to help homeowners conserve energy and save money on cooling costs.

FPL Group, with annual revenues of more than $7 billion, is one of the nation's largest providers of electricity-related services. Its principal subsidiary, Florida Power & Light Company, serves 3.9 million customer accounts in Florida. FPL Energy, LLC, FPL Group's independent power production subsidiary, is a leader in generating electricity from clean and renewable fuels. More information is available at www.fpl.com

Photos and b-roll are available by calling Patricia Davis at 561-694-3480.

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Annual Air Conditioning Energy Savings for an Average Size Home *

Average home size for this illustration is 1770 square feet.