Executive Summary

This report describes the status of one higher performance building project under construction in Tucson, AZ. The report includes a summary of design objectives for the project, a summary of innovative system design strategies, and a description of the reference house used for analysis of project performance. Additionally, a summary of the construction schedule for the project and a summary of performance test and evaluation plans for the project are included.

Design Objectives

Up to now the fundamental approach has been to concentrate on the building envelope and mechanical systems from the approach of minimal costs or no incremental costs. In essence ignoring the pay back on investment incremental cost approach.

This project uses the lessons previously learned but now coupled with a classic pay back approach (PITE – principle, interest, taxes and energy).

Using current energy prices a typical home consumes approximately $1,500 to $2,000 per year on energy for heating, cooling, domestic hot water, lights, appliances and plug load. Of this total energy, approximately 75 percent is used for heating, cooling and domestic hot water.

The target in previous projects has been a 30 percent reduction in the energy use for heating and cooling with no incremental cost increase in the cost of construction. In essence an instantaneous pay back approach. Using this approach we have obtained energy savings of between $200 to $400 per year for no incremental cost of construction. This is an approximate 20 percent reduction in total energy consumption.

The target for this project is a 50 percent reduction in this total energy consumption.

A 50 percent reduction in total energy consumption will result in a savings of between $750 to $1,000 per year. Using a simple payback analysis over a ten year period, this savings justifies an incremental cost investment of between $7,500 and $10,000.

The objective of this project is to see how much energy can be saved with an investment of $7,500 in additional costs over and above the cost of constructing a house to the building code minimum. This represents an increase in construction and appliance costs of approximately 7.5 percent. Can a reduction of 50 percent or more be achieved using readily available technologies within these cost constraints?

The systems engineering evaluations and cost estimates indicate that the target energy savings are feasible. One test house is currently under construction and will be monitored to verify the objectives.

Discussion

The design team believes that a 50 percent reduction in total energy can be achieved within a simple payback period of 10 years.

Pulte Homes, Tucson, AZ – Ultra Efficient Home

Two homes are under construction. Both homes are the same model (Plan 1749 at La Terraza) and have the same orientation. The first home is being constructed to typical Building America metrics and is designated the reference home. The second home is being constructed with a target reduction of 50 percent of total energy. Both homes will be occupied and both homes will be monitored for total energy consumption as well as energy consumption in the individual categories of heating, cooling, DHW, appliances, lights and plug load.

Construction of the homes began in September, 2001. The homes are expected to be completed by December, 2001.

The ultra efficient home meets the standard Building America performance metrics with the following additional features and incremental costs:

	Incremental Costs
Polaris condensing gas sealed combustion 94 percent efficient water heater	$2,000
Combo fan coil air handler with an ECM motor	$1,000
Savings on gas furnace	($1,000)
14 SEER air conditioner	$ 500
Panasonic exhaust fans	$ 500
Front loading ultra efficient clothes washer	$1,000
Ultra efficient dish washer	$ 350
Ultra efficient refrigerator	$1,000
Compact florescent lighting	$1,500
Slab edge insulation	$ 500
	$7,350

Pulte believes that if the design objectives are met within the proposed cost parameters that these homes are marketable based on their previous experience with Building America in the Tucson area.

Appendix A contains the design and computer simulation work associated with these two homes compared to a standard home.

Performance Testing and Evaluation Plans: SnapShot Performance Testing

The homes constructed are being evaluated against the Building America performance metrics.

As part of the evaluation procedure the following testing will be conducted upon completion of construction prior to closing.

The testing approach outlined below is referred to as SnapShot.

Airtightness

Airtightness testing using the pressurization approach.

Air Pressure Relationships

Determination of air pressure relationships under operating conditions using a multi-channel micromanometer.

Air Distribution Leakage

Determination of air leakage of forced-air thermal distribution systems under operating conditions using a duct blaster.

Air Conditioning Equipment Efficiency

Refrigerant charges and air flows across coils are determined using a micro-computer based "smart system" software package. The software package uses measured superheat and measured air flow temperatures to determine flow rates and refrigerant charges.

Additionally, each of the homes will be instrumented with Campbell CR10X Data Loggers measuring total energy, heating energy, cooling energy, DHW energy, lighting energy, appliance energy, temperature and relative humidity.

An outdoor weather station will also be provided at the site.