



Appendix D:

Cost Analysis

It is difficult to make meaningful cost comparisons of houses with the single metric of cost per square foot. The first problems arise in defining square footage and in establishing items to include in the cost. The next problems come from the individuality of each house and the features included and their quality. In addition, construction costs vary significantly from location to location and year to year.

For establishing the square foot size of Trail Magic, we used the external size of the conditioned space (heated), the method employed by Energy Star and LEED. For Trail Magic we used the number on the Energy Star analysis: 2,494 square feet. This square foot number is different from the 1,309 square feet listed on Trail Magic's tax assessment because the tax form number does not include conditioned space in the basement. This latter method makes a more valid comparison of the quality living space than the conditioned area method, and is also generally used in real estate descriptions.

We consider the cost for the house to include that which we paid the builder plus the cost for items directly paid by us, but not the cost of the barn or the land. We do not include architect and engineer fees, and expenses for appliances, per convention for custom houses.

Many factors go into the choice of a material or item. In building Trail Magic we elected, in most cases, to use materials and items based upon environmentally and economically measured lifecycle costs as Chapter 8 discusses. In many cases, we "upscaled" our choice for aesthetics, durability, ease of maintenance, or environmental importance. Many features and items that we selected had alternatives that would have given similar performance in terms of operating energy efficiency. These upscale elements added significantly to the cost of Trail Magic.

For the house only, Trail Magic cost \$364,200 or \$146 per square foot of conditioned space (Table 1). We asked Mike Strehle to identify the upscale features and items that we could have eliminated or replaced without substantially reducing Trail Magic's energy efficient performance. Without these upscale items, Trail Magic would have cost \$273,200, or \$110 per square foot (Tables 1 and 2).

These numbers for cost per square foot of conditioned space establish that 1) a quality, custom-made house that is high performance and positive energy is no more expensive than a quality, custom-made house that purchases its operating energy and 2) when the upscale features are removed, the cost for making a high performance, positive energy home is similar to that for a development house of equivalent size. We have established, contrary to common belief, it costs nothing extra to build a house that runs on sunshine.

We can estimate ROI (return on investment) for features and particular items in a house for a given time period; ROI is given as a percent = $([\text{gain from investment} - \text{cost of investment}] \div \text{cost of investment}) \times 100$. But, ROIs are fraught with uncertainty because of numerous assumptions. In Sidebar 14, I estimated the 100-year value of making Trail Magic passive solar to be \$50,000 or \$500 per year. We added little expense to Trail Magic by making it passive solar; because costs are essentially in design features, not in material or labor costs—orientation, size and placement of windows, roof overhang. If we assume it cost \$1,000 to make Trail Magic passive solar; the 100 year ROI is 4,900%.

We can estimate ROI for making Trail Magic positive energy by assuming an outlay of \$25,000: superior insulation, \$9,500; PV system, \$12,100; and pond loop for heat pump, \$3,400. If we estimate the annual return to be \$2,200 or the cost to operate an average home in the U.S. (110 million BTUs × \$20/million BTUs) plus the money saved on income taxes not paid on money not earned (\$800), the first year ROI would be -88%, and for 30 years (the anticipated life of PV system), 260%: an average annual ROI of almost 9% or \$2,250.

We can only calculate these and other ROIs imprecisely; however, if we accept the long term ROI is the important number; then the energy conserving and producing features of Trail Magic pay handsome dividends.

We have provided data and analyses here establishing that it costs nothing extra to build a home that provides income in the form of no energy bills.

Table 1: Summary cost for building Trail Magic, with and without upscale features.

Item	Cost	Notes
Original Contract	347,900	Includes barn
Change Orders 1-56	28,200	Includes barn change orders
Finish Work	10,000	Because site wood had to be dried and milled, the shelves, bookcases, beams, pantry counter and second floor flooring were not ready until spring 2009
Custom Lumber	17,100	Site trees cut, dried, and finished by George Ficke
Owner Cost for PV system	9,100	Cost for system in Troy, disassembly, and additional panels and mounting parts minus tax credits
Light Fixtures and Ceiling Fans	2,000	
Miscellaneous	1,000	Estimate of owner small expenses not recorded
Expenses for Barn	-47,100	Included in contract and change orders
Tax Credits	-4,000	Pond loop and heat pump (geothermal), solar hot water system
Total Cost	364,200	\$146 per/ft² for 2,494 ft² of conditioned space
Extra Cost for Upscale Features	91,000	See Table 2 for details
Total Cost without Upscale Features	273,200	\$110 per/ ft² for 2,494 ft² of conditioned space

Table 2: Cost for upscale features of Trail Magic with comparison cost for similar, high performance house without upscale features.

Item	Actual Cost for Upscale Feature	Alternative Item	Approximate Cost for Alternative	Cost Difference between Alternative and Upscale Feature
Custom Grading	3,000	None	0	3,000
Cistern and Rain Collection System	4,000	None	0	4,000
Walkout Patio on Southside	4,000	No patio, retaining wall, or stairs and sidewalks to patio	0	4,000
Landscaping: Sandstone Planters and Sandstones on Sides of Driveway	3,000	None	0	3,000
Central Vacuum System	1,400	None	0	1,400
Pond	8,500	None	0	8,500
Foundation: Reddi-Wall	10,800	Poured wall foundation	9,000	1,800
Framing: Double Wall	28,000	Single 2×6 wall	24,000	4,000
Insulation for double walls	12,900	Insulation for 2×6 walls	7,400	5,500
Roof: 24 gage standing seam	17,000	25 year asphalt shingles	5,500	11,500
Windows: Loewen wood frame and aluminum casing	25,300	Fiberglass or vinyl windows	15,900	9,400
Deck: Tigerwood	9,700	Pressure treated wood	7,200	2,500
HVAC Pond Loop with Heat Pump	15,500	Air to air heat Pump	12,100	3,400
Energy Recovery Ventilation System	1,100	None	0	1,100
Quartz Kitchen Counter Top	4,900	Laminate kitchen counter top	1,200	3,700

Table 2: Continued

Item	Actual Cost for Upscale Feature	Alternative Item	Approximate Cost for Alternative	Cost Difference between Alternative and Upscale Feature
First and Second Floor Flooring: Site Hardwood	8,800	Bamboo flooring	5,500	3,300
Stairway Bookcases: Site Oak, Maple, Ash, and Blackwalnut	5,500	Pine	2,000	3,500
Exterior: Pre-colored Hardiplank	22,500	Vinyl siding	14,800	7,700
Closet and Pantry Shelves: Site Ash	2,800	Pine	1,700	1,100
Custom Tiled Shower	3,500	Fiberglass shower	400	3,100
TOTAL	209,200		118,200	91,000