

Building Green for the Future

Case Studies of Sustainable Development in Michigan

Green Built Demonstration Home, Grand Rapids



UrbanCatalystAssociates

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This traditional-looking single family home demonstrates what is possible in terms of energy efficiency and the use of green building materials.



Grand Rapids, Michigan

Green Built Demonstration Home

History

For over 35 years, Lee Kitson has been building residential homes in Grand Rapids. In 2003 his company embarked on a project to highlight the benefits of energy efficiency and sustainable materials in residential settings. Kitson's energy efficient demonstration home maximizes the impact of cutting edge energy- and water-conservation technologies as well as environmentally sound materials.

Kitson used the environmentally sound products and services that were provided at promotional prices (see figure below for a comparison of hard costs with and without discounts). He then donated the project's proceeds to Green Built Inc, a non-profit organization that promotes sustainable buildings to the Greater Grand Rapids Home Builders Association. The home is part of a seven-acre development that consists of 15 sites, with homes ranging in size from 1,500 sq. ft. to 2,800 sq. ft., and sale prices from \$240,000 to \$395,000.

Many of the green enhancements came at little-to-no increase in construction costs, and simply relied on early material and design decisions. Some aspects, such as the basement wall construction and energy efficient windows, provide financial savings over the long run, but require a slightly longer time horizon to recover the premium paid. The environmental benefits of the green materials and equipment were also factored into decision making.

Construction Costs

Area	Square Ft	Cost w/o discounts	per sq. ft.	Cost w/ discounts	per sq. ft.
Main Floor	1,682	\$235,500	\$140.01	\$221,500	\$131.69
Lower Level	1,050	\$26,500	\$25.24	\$26,500	\$25.24
Total Hard Cost	2,732	\$262,000	\$95.90	\$248,000	\$90.78
Lot Cost		\$65,000		\$65,000	

Source: Lee Kitson Builders Inc.

Note: Costs do not include marketing and commissions, construction fees, overhead, closing costs, or indirect construction costs.

"Of the \$10.00/sq. ft. premium paid, approximately \$5.00 is added energy savings features and \$5.00 is for ENERGY STAR appliances and other items which we would not include in standard home pricing."

- Lee Kitson

Project type	Residential
Project scale	Building
Construction type	New Construction - Greenfield
Date completed	May 2004
Address	4465 Burton Forest Ct, Grand Rapids MI
Subjects	Development Processes
	Materials Use
	Energy Efficiency
	Water Efficiency
	Cost Benefit Analysis
Building square footage	2,732 (3 Bed, 3 Bath)
Hard cost	\$96/sq. ft.

Development Processes

Developers' design decisions go a long way to protect the environment. For example, in the Demonstration Home project, builders only removed those trees on the property that stood where the structure or driveway would stand; leaving a wooded property that has a dedicated conservation easement from the rear of the building to the rear of the lot. Such decisions may not be entirely feasible on a heavily wooded properties, but builders can work to preserve the existing habitat by making important decisions about tree removal early on in the process.

Kitson avoided additional architectural costs for the project by basing the Demonstration Home plan on other homes he had built. Modifications to the plan included the addition of a retaining wall by the front porch so that a portion of the lower front was exposed to the south. Also, he opened the foyer dormer to the living area with a southern exposure, adding significant daylighting to the main living area.

Materials Use

The Demonstration Home structural framing used finger-jointed studs, manufactured with small pieces of wood and adhesive. The framing is truer, reduces site waste, and does not require lumber from large trees, helping to protect forests. Builders used similar products for floor joists, rim joists, and headers. Kitson employed a "raised heel" design for the roof trusses, allowing the insulation to extend over the exterior walls, and resulting in superior insulation along wall-to-roof joints. The sprayed foam product, Icynene, insulates the walls and ceiling; maintains its seal even with structural shrinkage; is water-based; and contains no CFCs, HCFCs, formaldehyde, or VOCs.

Reducing the use of virgin resources, builders used carpeting made from recycled PET (Poly Ethylene Terephthalate) manufactured from yarn produced from reclaimed 2-liter soda and other bottles. The floors in the kitchen, rear entry, and foyer were manufactured using cork harvested from living trees without harming the trees. Finally, the bathroom flooring is Marmorette linoleum by Armstrong, made from softwood powder, linseed oil, pine tree resins, cork, chalk, and jute backing, all of which are natural and renewable resources.

Outside, the home's deck was constructed with WeatherBest composite materials. WeatherBest products are manufactured with a composite of up to 50%+ wood fiber and thermoplastic polymers. The product's benefits, over using 100% wood-decking materials, include superior durability, fewer maintenance requirements, and decreased use of forest resources.

Water Efficiency



Kitson decided to install Caroma dual-flush toilets, which allow users to choose a small flush (0.8 gallons per flush) or a larger flush (1.6 gallons per flush) based on need. These toilets cost more than traditional toilets, but improved water efficiency covers the increased cost over the life of the toilet.

The dishwasher is an ASKO D3000 and uses less than four gallons of water (a typical dishwasher uses 7-10 gallons) and needs only 1 1/2 tablespoons of detergent per load. ASKO also manufactured the clothes washer and dryer, with an estimated annual utility (electricity and water) cost of \$112 for the pair, compared to \$360 for a traditional residential top-load washer and dryer or between \$170 and \$260 for comparable front load units.

By allowing the user to select a full (1.6 gallon) flush or a half (0.8 gallon) flush, this toilet reduces overall water consumption.

"This is a plan derived from others we have built. We did not have to make any expensive or radical changes to the typical design plan."

- Lee Kitson

This “on demand” system eliminates the need to keep an entire tank of water hot 24 hours a day, 7 days a week. Benefits include lower utility bills and a continuous supply of hot water.



Energy Efficiency

Builders constructed the Demonstration Home’s foundation with a wall system by Great Lakes Superior Walls that uses pre-cast concrete, Styrofoam, and concrete studs. For additional insulation and air sealing, the foundation walls were sprayed with a **bio-based** foam insulation produced by Advanced Insulation Technology LLC. The insulation is soybean-oil based, water blown, and does not contain formaldehyde or emit CFCs or HCFCs, resulting in foundation walls with an insulation **R-value** of R-18.

The windows in the house are Pella Proline wood windows with aluminum exterior cladding. Meeting the highest ENERGY STAR rating, the windows contain insulated **low-E glass**. In addition to their superior insulation properties, Pella windows contain more than 20% recycled content.

Builders chose equipment for the HVAC system based primarily on improving energy efficiency. The Bryant Plus furnace is a two-stage, variable-speed unit with an efficiency rating of 96.6%. The Bryant thermostat allows the owner to control the unit’s fan speed and to establish different temperature profiles for each day of the week. The Bryant SEER (seasonal energy efficiency rating) air-conditioning unit uses Puron, a chlorine-free refrigerant.

The entire HVAC system feeds through a Guardian Plus HEPA filter that filters particles as small as 0.3 microns. Finally, Kitson installed an UltimateAir Energy Recovery Ventilator. With an efficiency of 96%, the ventilator exchanges stale air with fresh filtered air while transferring heat and moisture between the two. The UltimateAir unit filters out 95% of pollens and optimizes lower outdoor air temperatures, reducing the load on the AC unit.

Water is heated using a Rinnai Tankless water heater that heats water as needed rather than heating a tank full of water 24 hours a day, seven days a week. The Rinnai unit easily heats water for the entire house and, saves as much as 50% on hot water heating bills. All the appliances installed in the house are ENERGY STAR rated with the exception of the dryer (ENERGY STAR does not rate dryers).

Estimated Annual Energy Cost*

Use	MMBtu	Cost	Percent of total
Heating	50.2	\$323	28%
Cooling	3.4	\$80	7%
Hot Water	18.2	\$110	10%
Lights/Appliances		\$469	41%
Service Charges		\$150	13%
Total		\$1,132 (\$0.41/sq. ft.)	100%

*Source: Energy Efficient Homes Midwest

biobased - A commercial or industrial product that is composed of biological products or renewable domestic, agricultural, or forestry products.

R-value - A unit of thermal resistance used for comparing insulating values of different materials; the higher the r-value of a material, the greater its insulating properties.

low-E glass - Low-emissivity windows: glazing that has special coatings to permit most of the sun’s light radiation to enter the building, but prevents heat radiation from passing through.

Cost Benefit Analysis

The total cost premium associated with the efficiency and environmental “extras” for this house comes to \$20,475, adding about \$128/month to the owner’s mortgage payments. According to Kitson, if builders installed only the products that deliver superior energy efficiency (96% furnace, advanced thermostat, extra insulation, water heater, Proline windows, and Superior Walls), the cost premium would be \$8,580, adding about \$53/month to mortgage payments. Kitson estimates that these investments alone would result in heating savings of \$449/year, cooling savings of \$120/year, and water heating savings of \$54/year. These savings work out to \$52/month, offsetting the increase in mortgage payments.

Installing all the extras (beyond just the energy efficient investments) listed in the table below would incur an additional premium of \$11,895 (\$20,475 - \$8,580) above that paid for just the energy efficiency investments mentioned above. Additional savings include reduced electricity consumption from the fluorescent lights and ENERGY STAR appliances and water consumption savings from dual flush toilets, dishwasher, washer, and dryer. In fact, the washer and dryer alone would save more than \$248/ yr over a traditional top load pair.

Other investments included in the additional premium may not indicate clear financial benefits, but would provide other benefits. Low-VOC paints and floor coverings provide a healthier indoor environment as does the HEPA filter. The composite materials used for decking offer improved durability and will outlast a deck made of traditional wood. The Energy Recovery Ventilator offers savings by reducing the load on the AC unit and it ensures a fresh air supply for the house.

Following guidelines established by the Home Energy Rating System Council (HERS), Energy Efficient Homes Midwest calculates that the Demonstration Home will significantly reduce emissions to 12,827 lb/yr of CO₂, 17 lb/yr of SO₂, and 22 lb/yr of NO_x. Currently, it is difficult to assign dollar values to these reductions; however, some environmentally conscious consumers understand that these reductions are important, assign their own values to them, and are prepared to pay the extra initial costs for the enhancements.

Cost Analysis

Item	Description	Cost Premium*
Appliances	ENERGY STAR dishwasher, washer, dryer, and refrigerator	\$1,400
Lighting	Fluorescent fixtures and bulbs	\$200
HVAC	High efficiency furnace, AC unit, thermostat, and HEPA filter	\$3,590
Insulation	Icynene and bio-based insulations	\$2,000
Landscaping	Preparation for rain garden installation	\$1,500
Fireplace	Intellifire variable BTU fireplace	\$400
Paints	Low-VOC paints	\$600
Energy Recovery	Stirling Energy Recovery Ventilator (EVR)	\$2,100
Wiring	Wiring for EVR, hot water thermostat, exhaust fans, etc...	\$435
Plumbing	Caroma dual flush toilets and Rinnai tankless hot water heater	\$1,050
Water softener	Braswell water softener	\$2,000
Windows	Pella Proline Insulshield windows	\$800
Deck and frame	Composite decking, TJI joists, finger joint studs	\$900
Walling	Superior insulated concrete basement walls	\$3,500
TOTAL		\$20,475

*Represents the amount that Kitson estimates would be paid over typically installed equipment.

Awards

- ENERGY STAR Rating: 5 Star Plus
- Energy Rating Points: 92.3
- Efficient Home Comparison: 61.5% Better

The Bottom Line

This Demonstration Home project is a clear example of the Green Development Spectrum described on page 16 of this handbook. Many of the investments in energy efficiency pay for themselves very quickly. However, other items, such as all-natural linoleum and energy-recovery ventilators create healthier living environments but the savings are less tangible and vary for each customer.



Energy efficient appliances and lighting as well as sustainable materials in the cabinets, surfaces and flooring all come together in a beautiful state of the art kitchen.

References

Interview: Lee Kitson (1/17/2005)

Energy Rating Report - 4465 Burton Forest Ct., Energy Efficient Homes Midwest

Green Built Demonstration Home - 4465 Burton Forest Ct., Lee Kitson Homes

Contact Information

Developer and Contractor Lee Kitson Builder, Inc.:
www.leekitsonbuilder.com

Lee Kitson Owner, Lee Kitson Builder, Inc.,
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Resources for further information

Icynene Insulation System - www.icynene.com
WeatherBest Composite decking and railings - www.weatherbest.com
Great Lakes Superior Walls - www.greatlakessuperiorwalls.com
Pella Windows - www.pella.com

UltimateAir Energy Recovery Ventilators - www.ultimateair.com
Caroma Toilets - www.caromausa.com
Rinnai Tankless Water Heaters - www.foreverhotwater.com
ASKO Appliances - www.askousa.com
Armstrong Floorings - www.armstrong.com

Urban Catalyst Associates

Urban Catalyst Associates

Urban Catalyst Associates (UCA) is an interdisciplinary team of recent University of Michigan graduate students who have combined their experiences, interests, and educations to create a positive impact on the future of the State of Michigan. The team holds a strong passion for fostering innovative, sustainable development that will shape the evolution of the new urban environment.

In collaboration with the Michigan Department of Environmental Quality, Urban Catalyst Associates developed this handbook to serve as inspiration and ready reference to the development community and other interested groups. As the State furthers its investment in green development, the UCA team hopes that this handbook will encourage developers to infuse elements of environmental sustainability into their planning and development processes.

Urban Catalyst Associates can be contacted via email at uca@uca-michigan.com. See the contact information below for information on contacting individual team members.

Zeb Acuff

Zeb holds Master's degrees from the School of Natural Resources and Environment and the Taubman College of Architecture and Urban Planning, both at the University of Michigan in Ann Arbor. He is also a 2001 graduate of the College of Agriculture and Natural Resources at the University of Delaware. Zeb has extensive experience in farmland preservation and local planning research, as well as familiarity working with demographic and social science media. His professional interests include parks and recreation planning, non-motorized transportation, trails and greenway development, and public transit systems. Zeb and his wife currently reside in Dexter, Michigan. Zeb can be contacted via email at zeb@theacuffs.com.

Bryan Magnus

Bryan graduated from the University of Michigan in April, 2005, with an MBA from the Ross School of Business and a MS from the School of Natural Resources. His undergraduate degree is in Finance and Actuarial Math from Bryant University in Smithfield, Rhode Island. Bryan has extensive knowledge of socially and environmentally responsible business with an emphasis on renewable energy and alternative transportation. He has interned with General Motors' Fuel Cell Activities Group as well as Honeywell's Transportation Systems, and is currently employed by Honeywell TS as a Marketing Analyst. Bryan, his wife Lynn, and their "child" Meadow (dog) live in Ann Arbor, Michigan. Bryan can be contacted via email at magnusb@umich.edu.

Aaron Harris

Aaron will complete his final year at the University of Michigan in spring 2006 with both an MBA from the Ross School of Business and an MS from the School of Natural Resources and Environment. Prior to Michigan, Aaron co-founded Harris Brothers LLC, a real estate development/management company based in Chicago and focused on green building design and environmentally sensitive renovation projects. Upon completion of graduate studies, Aaron plans to return to the real estate field to pursue urban brownfield redevelopment projects. Aaron graduated from the University of Wisconsin-Madison with a BA in Sociology (Honors) and a Certificate in Environmental Studies. Aaron can be contacted via email at aaronmh@umich.edu.

Allyson Pumphrey

Allyson graduated from the School of Natural Resources & Environment with a Master's degree in Landscape Architecture in April 2005. Prior to attending the University of Michigan, she received her BS in Landscape Horticulture & Design from Purdue University in West Lafayette, Indiana. Allyson has experience in residential site design and urban redevelopment projects. Her professional interests include urban trails and greenways, brownfield redevelopment, and urban design. Allyson is employed by InSite Design Studio, Inc. in Ann Arbor, Michigan. Allyson can be contacted via email at apumphrey@insite-studio.com.

Larissa Larsen

Larissa Larsen, Ph.D., is an assistant professor with positions in both the School of Natural Resources and Environment and the Urban Planning Program at the University of Michigan. Larissa has a Master's in Landscape Architecture degree from the University of Guelph in Canada and a Ph.D. in regional planning from the University of Illinois at Urbana-Champaign. Prior to becoming a professor, Larissa practiced landscape architecture and urban planning in Chicago. Her current research investigates the ecological and social impacts of urban settlement patterns. Larissa can be contacted via email at larissal@umich.edu.