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Living homes

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Abstract

Steve Glenn, a successful internet start-up entrepreneur, returned to his love of architecture and commitment to sustainability by creating a company that would provide signature, green, prefabricated homes to the "cultural creative" market. The case outlines the state of both the housing industry and the green building industry in 2007. Students will learn about the environmental impacts of buildings, the certification programs to build green buildings, and the critical elements of creating a sound business that capitalizes on the green building industry.

Some general case questions that might be used by students to prepare for the lecture include:

- Would you invest in Steve Glenn's new company?
- Would you buy one of his products (assuming you had the capital)?
- Glenn says he has a six month window to perfect his business plan. What do you think are his critical challenges in the three legs of his business model?
- What are the immediate threats and opportunities to his business model?
- Where should he position the company for long term growth?

The case can be used in an environmental business, competitive strategy, entrepreneurship, marketing, or green building class.

livinghomes.

"Now comes the hard part, which is creating a sustainable business." [1]

Steve Glenn
Founder and CEO, LivingHomes

In March 2007, Steve Glenn put down the phone and stared outside at his thirsty yard. He was still living under a temporary occupancy permit after eight months, and the new plants had to be hand-watered daily. Los Angeles County officials said they couldn't find a "mountain or rural inspector" to review the design of his gray-water system for permit approval and system startup.[2] If he was having these problems in a progressive city like Santa Monica, what would happen to his customers across the country? Would they encounter the same delays and barriers? Would these challenges discourage them from buying his prefabricated green homes? Would the homes' green features be disabled because of inexperienced zoning and building code inspectors? This was no small issue. Even before construction, Santa Monica's zoning laws and height limits reduced the size of the modules of the home and required a split-level foundation.[3] And these were just a few of the concerns when tapping into the emerging green building market. Glenn wanted to revolutionize the home building industry in the United States by merging product attributes of high–end style and green design with process attributes of home prefabrication and delivery. While each of these may have had independent market representation, few companies linked them all in one offering. He wanted the process of home construction to be not only quicker and less expensive, but also green and beautiful.

LivingHomes' target market included people who "drive Priuses, buy Bosch appliances and Design Within Reach furniture, shop at Whole Foods, and give money to the [Natural Resources Defense Council]."[4] To serve these customers, LivingHomes selected brand-name architects who specialized in a modern aesthetic. The homes' luxury provided every convenience for the high-end consumer. The homes' "green" attributes provided higher

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[1] Anderton, F. (2006). "LEEDing the way." *Dwell*, November: 99-104.

[2] Yoshihara, N. (2007). "Drought-busters hit a hurdle." *Los Angeles Times*. March 29. A gray-water system typically irrigates landscape with waste water from baths and sinks.

[3] Newman, M. (2006). "Green-Fab House." *The Architect's Newspaper*, June 7. 18.

[4] Clifford Public Relations (2006). *Innovative, Start-Up Home Builder Makes Green Living a Reality with a New Line of Architectural Prefab Homes*. Press release. April 27.

performance, less waste, a healthier environment to live in, and greater energy efficiency than normal construction. And prefabrication embraces mass-production and scale benefits through the notion that customers should be able to buy a house no differently than the way they buy a car—in choosing a product that matches their market segment.

Glenn's thoughts were interrupted by the doorbell and another prospective customer tour of his modern, Ray Kappe-designed home; the first LivingHomes structure that was "installed" in an astonishing eight hours.[5] This 2,480 square foot house received the very first Platinum Level LEED® for Homes Certification by the US Green Building Council (USGBC), which is the highest possible level of certification in the LEED system.[6] Glenn loved showing off both the modern, luxurious design and sustainable features, from the photovoltaic panels on the roof to the recycled denim insulation (See **Exhibit 1**). He was sure that a better environment could be achieved through building low-energy, non-toxic, healthy homes like his, and to his pleasure, others agreed. His home was featured in dozens of newspapers and magazines in recent months—*Business Week*, *Forbes Life*, *Los Angeles Times*, *House & Garden*, *Vogue Mens*, *TreeHugger*, *Inhabitat*, *Environmental Design and Construction*, *Residential Architect*, *Dwell*, *Wired*, *The Times* and *Financial Times in London*, and even France's *Le Monde*. *Men's Journal* designated the house as one of "97 Perfect Things" in 2007.[7]

But despite this acclaim, he struggled with code inspectors, costs that were hard to keep under control, an uncertain housing market, and a more affluent target consumer that might not see prefabrication, high-end luxury, and "green" as a consistent value proposition. Not only was he trying to build sustainable homes, he needed to build a sustainable business that carved out its own niche in the U.S. housing market.

The Housing Industry

In the United States, the American Dream is epitomized by home ownership.[8] In 1999, 70% of Americans lived in a single-family home. Though most people live in "used" homes, the market for new, single-family, detached homes has increased through both population growth and consumers' desire for newness itself.[9]

In 2006, almost 1.5 million new homes were built in the United States. As **Exhibit 2** shows, the market has historically gone through cycles of increasing and decreasing volumes. The 2006 average sales price of new single-family homes sold (including land) was $305,900 (an 84% increase from $166,400 in 1996). With an average new home size in 2006 of 2,469 square feet, the critical number for calculating home value—the price per square foot—was

[5] Ibid.

[6] Clifford Public Relations (2006). *The USGBC LEED for Homes Program Awards Livinghomes the First-Ever Platinum Rating in Residential Sustainable Design*. Press release. August 16.

[7] Scanlon, J. (2007). "Objects of Desire. The prefab luxury home." *Men's Journal*. September. 16(8). p. 116-7.

[8] U.S. Department of Housing and Urban Development [HUD]. (n.d.). *American Dream Downpayment Initiative*. Retrieved August 28, 2007, from http://www.hud.gov/offices/cpd/affordablehousing/programs/home/addi/

[9] Cohen, L. (2003). *A Consumers' Republic: The Politics of Mass Consumption in Postwar America*. New York: Random House.

$91.99 in the US. Regionally, it was most expensive to build in the West[10] at $120.66 and least expensive to build in the South[11] at $80.32.[12] **Exhibit 3** highlights additional characteristics of new housing in 2006.

Housing Market Segments

The purchase of a home is "one of the most difficult economic decisions of a whole domestic life-cycle, a decision fraught with enormous consequences."[13] The three main tasks involved in building a new home—property selection, home design, and home construction—are rarely taken on solely by the homeowner. Instead, delivery systems have evolved to meet the demand of different consumers, with each system having different levels of price, quality, and speed (or delay).

Homes can be entirely "manufactured," and are primarily purchased by **lower-income buyers**. After purchase, they are typically delivered and placed on rented lots in clusters fittingly termed "parks." Traditionally, **middle-income homeowners** who are interested in a new home can either buy a finished speculative (or "spec") home or "customize" pre-purchased construction plans for an individual lot. Generally, the level of customization is limited to a choice of colors, materials, finishes and a pre-selected list of options for cabinets and appliances. Within this market, one could work with either a small-scale home-builder who completes as few as five houses per year, or a large-scale developer who creates large scale developments in the hundreds or thousands of units per year. **Affluent consumers** who are not content with a standardized home can hire an architect to provide a thoroughly original, unique design. These are *truly custom* homes, where wealthy clients typically find their own property and hire an architect and contractor separately. LivingHomes wanted to provide the better aesthetic qualities of this latter "affluent" segment to the upper financial end of the "middle-income" market. The two major players in this arena were large-scale developers and small-scale custom home builders.

Homes Built by Developers

KB Homes and Toll Brothers, two of the largest homebuilding development companies in the United States, offered a turnkey product within narrowly stratified communities—residents often share economic, aesthetic, and even generational similarities.[14] These and other large

[10] Washington, Oregon, California, Idaho, Montana, Wyoming, Utah, Colorado, New Mexico, Arizona.

[11] Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Tennessee, Kentucky, West Virginia, Virginia, Maryland, Delaware, North Carolina, South Carolina, Georgia, and Florida.

[12] U.S. Census Bureau. (2006). *Highlights of Annual 2006 Characteristics of New Housing*. Retrieved August 28, 2007, from http://www.census.gov/const/www/highanncharac2006.html

[13] Bourdieu, P. (2005). *The Social Structures of the Economy*. Malden, MA: Polity, p. 19.

[14] KB Home. (n.d.). *Hampton Oaks*. Retrieved August 28, 2007, from http://www.kbhome.com/martha/neighborhood~CommID~01160246.aspx

scale developers wielded increasing control over the home building industry in the early 00's. In 1986 they provided 65% of new homes; by 2006 that figure rose to 78%.[15] See **Exhibit 4**.

Since one of the most significant considerations in choosing a home is the neighborhood into which one moves and lives, developers ensure uniformity within the neighborhoods they create by purchasing large "greenfield" sites (usually farmland, but almost always previously undeveloped property) on the edge of more urban areas.[16] They then hire a planning consultant to determine individual lot sizes, median home prices (based on local marketing studies), standard floor plans, options, and styles of homes to be built. Once approved by local zoning officials, the developers begin to market the homes. Customers then simply mix-and-match plans and building sites.

Developers also craft a set of restrictive property-use agreements regarding what future owners may or may not do with their property and homes. These neighborhood agreements historically included limitations such as paint colors, material choices for additions, fencing types and configurations, garden ornaments, vehicle parking, yard maintenance, mailbox styles, solar panels, and even approved outdoor activities. While some homeowners balk at this level of control, the neighborhood's homogeneity entices many buyers. Perceived property values are protected by eliminating neighbors with dilapidated recreational vehicles on blocks, or a yard full of garden gnomes. Depending on the location and market, home prices in one of these developments ranged from $125,000 to $1,000,000 and higher in the mid 2000s.

These builders are able to keep costs low (and profits high) because volume production of homes (often called "tract homes") resembles an assembly line, with houses so similar that crews are able to stay in a predictable sequence. Further, the use of 'prefabricated' parts of homes (such as roof trusses and wall panels, as well as windows, doors and cabinetry) produces major cost savings through shorter production times, reduced weather delays and damage to homes under construction, and simplified scheduling of labor. This standardized method of house production successfully limits the variables that could otherwise slow the construction of a unique home—such as compliance with zoning laws and building codes, as well as ease of product acquisition since most pre-selected products (appliances, doors, hardware, etc.) are already in stock at the local supply companies.

Additionally, larger development firms provide home financing, thus offering a total solution to potential buyers. In 2006, 90% of all new single-family homes sold were financed by a mortgage, up from 55% in 1986.[17] However, constraining consequences of buying a developer's home result in accepting both the limited aesthetic styles and typically forgotten environmental concerns in the home's creation.

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[15] This percentage represents homes "built for sale" (i.e. "the builder is offering the house and the developed lot for sale as one transaction") completed in 2006.

U.S. Census Bureau. (2006). *Comparing New Home Sales and New Residential Construction*. Retrieved August 28, 2007, from http://www.census.gov/const/www/salesvsstarts.html

U.S. Census Bureau. (2006). *Highlights of Annual 2006 Characteristics of New Housing*. Retrieved August 28, 2007, from http://www.census.gov/const/www/highanncharac2006.html

[16] Jacovino, E. J. (2007). "From open farmland to 1,500 units?" *Courant.Com*. August 13.

[17] U.S. Census Bureau. (2006). *Highlights*. op cit.

Toll Brothers considered themselves "America's Luxury Home Builder" and in 2007, offered homes well above $1 million. Their average delivered home price was $690,000 in 2006.[18] KB Homes teamed up with Martha Stewart in 2005, and Disney in 2007 to create "branded" communities, and began to offer a green product to their consumers by integrating their "myEarth" program.[19] Customers of these homebuilders buy a *product* instead of a *process*: they need not deal with zoning, codes, or outside mortgage lenders or designers. While architects may dismiss developers' "custom homes" as "McMansions" that display "architectural and historical malapropisms,"[20] developers successfully market the homes with titles reminiscent of the "Old World" of Europe, such as Essex, Stratford, Vienna, and Windsor—regardless of whether their location is Texas, Michigan, or Pennsylvania.

Custom Designed Homes

A custom home designed by an architect is typically an expensive proposition, representing only 3-5% of new homes in the United States in 2006. Designing a home from scratch can require at least one year of full-time attention from an architect. Architectural fees typically range from 10-20% of the home's total construction cost. This total cost can be an intimidating financial prospect for one family—especially since the total fee is often unknown until the design work is complete, the bids for construction are received, or even until the house is complete. Additionally, a unique design introduces variables that are purposely avoided by developers. Having "the perfect" granite for a kitchen countertop could delay installation for weeks, and owner requested design changes in the middle of the process could grind construction to a halt. Numerous aspects of architectural homes hold this possibility, since these homes are, by most definitions, unique creations—essentially building a prototype with every home design. Economies of scale are not available to provide financial savings.

However, the value of architecture may lie more in its cultural capital, and in some cases, the quality of its structure or spatial environment. For example, the Frank Gehry brand carries certain cachet—what homeowner would not impress her friends by hiring the same architect who designed the Guggenheim Museum in Bilbao and the Disney Concert Hall in Los Angeles? The clients of Frank Lloyd Wright, a well-known American architect, were known as "patrons," as in the art world, rather than simply "homeowners." The term "starchitect," a combination of "star" and "architect" has emerged, as a few personalities have become coveted brands.[21] The stylistic range of these personalized creations is as divergent as the people who sponsor them—from the radical forms of Herzog and de Meuron to the "superbly

[18] Toll Brothers. (2006). *Annual report.* Retrieved on October 1, 2007, from http://www.tollbrothers.com/homesearch/servlet/HomeSearch?app=IRannual

[19] "KB Homes to feature Disney designs" (2007). *The Wall Street Journal.* September 26. B3. It is also worth noting that KB Homes' stock price tripled from 2001 to 2006: KB Homes. (2006). *Annual report.* Retrieved November 19, 2007, from http://phx.corporate-ir.net/phoenix.zhtml?c=111266&p=irol-reportsAnnual

[20] Huxtable, A. L. (1997). *The Unreal America: Architecture and Illusion.* New York: The New Press.

[21] Deamer, P. (2005). "Branding the architectural author." *Perspecta 37: Famous.* 37.

wrought wood structures"[22] of Bill Gates' family compound by James Cutler and Bohlin Cywinski Jackson. These homes, often without wide cultural precedent, stand in stark contrast to the more mass-produced options of a developer.

Green Buildings

Buildings and the Environment

Commercial and residential buildings leave a very large footprint on the environment in the United States. According to the Center for Sustainable Systems, "urbanized land consumes natural space and agricultural land at a rate 2.6 times the population growth in the United States" as of 2007.[23] Further, buildings consume 40% of the world's materials; use 55% of the wood cut for non-fuel use;[24] use 12.2% of the total water consumed, consume 40% of the world's energy; and create 36% of the carbon dioxide emissions that cause global warming.[25]

When one focuses specifically on the housing sector, there is evidence for even greater environmental concern. For example, the average size of a single-family home in the United States *increased* from 983 square feet in 1950, to 2,492 square feet in 2006 (more than 2.5 times larger), while the average number of occupants per household *decreased* from 3.37 to 2.62 over the same period (a 22% reduction). This equates to significantly more material and energy used per person living apart. In 1950, 9% of housing units were occupied by only one person. By 2005, that number increased to 27%. As a result, total residential CO_2 emissions increased by 26% from 1990 to 2006, while the population increased only 20%.[26] **Exhibit 5** details more of the environmental impacts of the residential sector.

Beyond the external environmental impacts of homes, the interior environment also merits consideration. As of 2007, Americans spent 90% of their time indoors, and the EPA reported that indoor air often contained pollutant levels two to five times higher than outdoor air.[27] These pollutants come from well-known sources such as radon and tobacco smoke, but also emanate from less well known sources such as formaldehyde in exterior wall sheathing, furniture, or fiberglass in insulation. Dust particles from vinyl floors, wallpaper, fire retardant fabrics, and vinyl siding can give off other pollutants such as phthalates. Further complicating matters, efforts towards sealing a home for energy efficiency trap these pollutants inside. Responsibilities to the environment and human health, as well as greater

[22] Ivy, R. (2007). "Genius loci: Jim Cutler's design embraces Northwest place and culture." *Architectural Record*. Retrieved August 16, 2007, from http://archrecord.construction.com/people/interviews/archives/0502JimCutler-1.asp

[23] Center for Sustainable Systems. (2007). *Fact Sheet: Residential Buildings* (Ann Arbor, MI: University of Michigan) from http://css.snre.umich.edu/css_doc/CSS01-08.pdf

[24] Roodman, D. M., Lenssen, N. K. & Peterson, J. A. (1995). *A Building Revolution: How Ecology and Health Concerns Are Transforming Construction*. Washington, DC: Worldwatch Institute.

[25] Kulman, J. & Schurke, J. (2001). *Sustainable Design*. Washington, DC: National Council of Architectural Registration Boards.

[26] Center for Sustainable Systems, op. cit.

[27] U.S. Environmental Protection Agency [EPA]. (2007). *The Inside Story: A Guide to Indoor Air Quality*. Report No. 402-K-93-007. Retrieved August 30, 2007, from http://www.epa.gov/iaq/pubs/insidest.html

mainstream acceptance of "green," prompted some members of the construction industry to pursue green buildings.

Green Buildings

Green building is a term encompassing strategies, techniques, and construction products that are less resource-intensive or pollution-producing than "regular" construction. In some cases, this involves merely "doing without" extra space, finishes, or appliances. In others, it simply substitutes a less polluting product for more polluting ones (e.g., low-VOC paint).[28] More integrated strategies actually configure the shape of a space to take advantage of unique site attributes (e.g., facing glass towards the sun path to use natural or "passive" solar heat gain instead of using natural gas or electricity to heat a space). Experimentation of more unusual techniques caused green building to be seen by some as a fringe activity (e.g. rammed earth or straw bale house construction, composing toilets, and "cheese wedge" house forms where homes tilted towards the sun for passive solar gain.)[29]

While the flush 1980's and low energy costs pushed many "green" approaches from mainstream interests, the early 2000's saw a resurgence. With concern for climate change, the American "addiction to oil," and terrorism in the oil-producing regions, environmental concerns hit an all time high in the mid-2000s. And one area where this concern yielded the greatest change was green construction, which emerged to become a more mainstream topic. "Green" was becoming fashionable with *Elle, Vogue, Vanity Fair*, and others featuring green issues, while new magazines as *Natural Home*, *Plenty*, and *Organic Style* gained in popularity. By 2006, *Energy Star*, the US government-backed energy performance rating system which designates homes that are at least 15% more energy efficient than standard homes, had reached a national market penetration of 12% for site-built, single-family new homes.[30] Nearly 200,000 new homes earned the *Energy Star* in 2006, bringing the total number of qualified homes across the nation to almost 750,000, though this penetration was not uniform (see **Exhibit 6)**.

With this rush of excitement, accusations of "greenwashing" were not always unfounded, as every company wanted to join the marketing hype. In response to these charges, a few organizations created third-party-verified rating systems for green buildings. These systems codified environmental goals, and provided a measurement system for each. To achieve "certification," one must meet a minimum number of the stated goals.

[28] VOC is an abbreviation for volatile organic compounds, which are harmful pollutants. Depending on the specific formulation, VOCs can include carcinogens, greenhouse gases, or ground-level ozone reactants.

[29] Rybczynski, W. (2007). "Green Unseen: Environmentally friendly buildings don't need to look like cheese wedges." *Slate* July 16. Retrieved November 19, 2007 from http://www.slate.com/id/2170511/

[30] U.S. EPA. (2007). *ENERGY STAR Qualified New Homes Market Indices for States*. Retrieved October 1, 2007, from http://www.energystar.gov/index.cfm?fuseaction=qhmi.showHomesMarketIndex

Green Building Rating Systems

US Green Building Council

In 1998, the United States Green Building Council (USGBC) introduced the LEED (Leadership in Energy and Environmental Design) rating system for new institutional and commercial construction (NC). In this system, adhering to environmental goals earned points toward four certification levels: Certified, Silver, Gold, and Platinum. The goals for new construction (NC) were grouped into six categories: sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor air quality, and innovation & design process. LEED-NC Certified projects, like Energy Star homes, enjoyed variable popularity in states around the country (see **Exhibit 7**). LEED was the dominant standard for green building certification as of 2007, and attendance at USGBC's annual conference, Greenbuild, rose from 4,200 in 2002 to 20,500 in 2007—a five fold increase in five years.[31] Subsequent to the success of LEED-NC adoption, the USGBC offered specialized rating systems for existing buildings, commercial interiors, core and shell, schools, retail, healthcare, neighborhood development and homes.

LEED for Homes

LEED for Homes began as a pilot study in August 2005. Unlike other LEED projects, which had to be certified by the USGBC office in Washington, DC, locally based LEED for Homes Providers certify residential projects.[32] This diffusion of responsibility was a welcome change from the LEED-NC backlogs that were encountered as LEED's popularity grew much faster than expected. The LEED for Homes rating system expanded its list of resource categories from six to eight to measure the overall performance of a home.[33] **Exhibit 8** is a sample scoring sheet for LEED Homes certification. The USGBC also launched *The Green Home Guide* website in November 2007 to educate the target market (see **Exhibit 9**).[34]

Green Building Initiative

In 2005 the Green Building Initiative (GBI) launched a competing system called Green Globes for all building types.[35] The GBI was "originally conceived as a way to bring green building into the mainstream by helping local Home Builder Associations develop green building programs modeled after the National Association of Home Builders' Green Home

[31] Southface. (2005). "Greenbuild 2005: Is Georgia on your mind?" Retrieved November 19, 2007, from http://www.southface.org/web/resources&services/publications/journal/sfjv105/sfjv105-greenbuild.htm

Floor Daily. (2007). "Greenbuild Sets Attendance Record." Retrieved November 19, 2007, from http://www.floordaily.net/NewsArticle.aspx?article=11684

[32] U.S. Green Building Council (2007). *LEED for Homes*. Retrieved August 28, 2007, from http://www.usgbc.org/DisplayPage.aspx?CMSPageID=147

[33] U.S. Green Building Council. (2007). *LEED for Homes Program Pilot Rating System Version 1.11a*. January.

[34] USGBC. (2007). *The Green Home Guide*. Retrieved November 19, 2007, from http://www.greenhomeguide.org/index.html

[35] Smith, T. M., Fischlein, M., *et al.* (2006). *Green Building Rating Systems: A Comparison of the LEED and Green Globes Systems in the US.* Carpenters Industry Council.

Building Guidelines."[36] The organization also provided a Green Globes rating system for commercial projects, which appealed to those frustrated with the difficult and protracted LEED process.[37] GBI's advantage over LEED was in its "simpler methodology, employing a user-friendly interactive guide for assessing and integrating green design principles."[38] The point system also differed in allocation emphasis; GBI gave more credit than LEED to energy saving efforts.

The Economics of Green Buildings

Overall, the full cost-benefit analysis of green building is a moving target. Some argue that adopting LEED forces the project to add expensive "features" (green roofs, photovoltaics, gray water systems) to meet LEED criteria. Indeed, a 2004 study by the US General Services Administration found that the anticipated construction premium for new federal courthouses would range from negative 0.4% for a "low cost" LEED Certified facility, to a high of 8.1% for a "high cost" LEED Gold Certified courthouse. The GSA also cited additional "soft" costs ranging from $0.41-0.80 per square foot for LEED-related requirements that went beyond GSA's standard project scope. A 2006 study by Building Design+Construction sites perceptions of higher up front costs as the top barriers to incorporating green design into building projects.[39] But a 2006 report by Davis Langdon compared the cost of 83 LEED certified buildings with 138 conventional buildings and found that "many projects achieve sustainable design within their initial budget, or with very small supplemental funding ...the costs per square foot for buildings seeking LEED certification fall into the existing range of costs for buildings of similar program type."[40] **Exhibit 10** presents the results of several studies on the cost premiums for building green.

The reality is that some green building strategies may require increased up-front costs. High-efficiency equipment or low-VOC paints and adhesives often cost higher than their standard counterparts. Additionally, the costs of certifying your building can include application fees from $1,500 to $7,000, additional paperwork preparation, building commissioning,[41] and energy modeling. But such strategies can result in long-term financial savings. **Exhibit 10** also presents the results of studies on the economic benefits of building green. These can include "hard" financial savings through reduced energy and water consumption,

[36] Green Building Initiative (2005). *Origin and Status*. Retrieved August 28, 2007, from http://www.thegbi.org/gbi/originandstatus.asp

[37] Podkul, C. (2007). "Green Globes certification rises as alternative to LEED." *Philadelphia Business Journal*. August 17. Retrieved August 28, 2007, from http://philadelphia.bizjournals.com/philadelphia/stories/2007/08/20/focus5.html

[38] Smith, T. M., Fischlein, M., *et al.*. (2006). *Green Building Rating Systems: A Comparison of the LEED and Green Globes Systems in the US*. p. 3.

[39] Building Design+Construction (2006) *Green Buildings and the Bottom-Line* (Oakbrook, IL: Building Design+Construction).

[40] Matthiessen, L.F., & Morris, P. (2007). *The Cost of Green Revisited*, Davis Langdon. retrieved November 21, 2007, from http://www.davislangdon.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-Revisited/

[41] Building commissioning is the systematic process of ensuring that a building's complex array of systems is designed, installed, and tested to perform according to the design intent and the building owner's operational needs. This process is rewarded in the LEED point system. Definition retrieved November 21, 2007 from http://www.energydesignresources.com/category/commissioning/

construction waste disposal costs, and more efficient or smaller mechanical equipment. A waterless urinal, for example, may cost more to purchase, but it costs less to install, and saves as much as $161-$192 per year in water/wastewater costs (at 2006 prices). Green buildings may also result in "soft" financial benefits through more rapid leasing of space, easier employee recruiting, reduced employee turnover, and reduced liability risk.[42] There are also suggestions that green buildings improve human performance for their occupants. Studies claim that students in schools with more natural light perform significantly better on exams;[43] retail sales are higher in day-lit stores;[44] office workers perform better when their workspace includes a view out a window;[45] and improved ventilation and views to the outdoors speed patient healing in hospitals.[46]

By analyzing the entire life of the building in light of these hard and soft benefits, long-term financial savings can cover initial costs at varying payback rates. In a case study of a 60,000 square foot building containing 40 apartments in New York,[47] costs and benefits in 2006 were found to be:

- Install solar panels: cost $19,000; payback 15 years
- Install fluorescent bulbs: cost $1,120; payback 3 years
- Install motion sensors: cost $11,000; payback $2 years
- Replace an old boiler with the most efficient gas unit: cost $50,000; payback 8 years

Clearly, as the prices of energy and water vary in both time and locale, these payback periods will be shorter or longer. See **Exhibit 11** for nationwide variances.

LivingHomes

Steve Glenn created LivingHomes in Santa Monica, California, 16 miles west of Los Angeles. He is no stranger to starting companies—his first was started as an undergraduate at Brown University, and was quickly sold to Apple. But after thirteen years of founding successful internet technology companies such as the highly successful PeopleSoft, Glenn wanted to return to a longstanding fascination—architecture. He had given the profession a try in college, attending a summer Career Discovery program at Harvard's Graduate School of Design. However, he had left there with the realization that he "lacked both the talent and

[42] Wilson, A. (2005). Making the Case for Green Building. *Environmental Building News*. 14(4).

[43] Heschong Mahone Group. (1999). *Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance*. August 20. Fair Oaks, CA: Pacific Gas and Electric Company.

[44] Heschong, L. (2003). *Daylight and Retail Sales*. October. (Publication No. P500-03-082-A-5) Fair Oaks, CA: California Energy Commission.

[45] Heschong, L. (2003). *Windows and Offices: A Study of Office Worker Performance and the Indoor Environment*. October. (Publication No. P500-03-082-A-9) Fair Oaks, CA: California Energy Commission.

[46] Wilson, op cit.

[47] Tarquinio, J. (2007) "The cost of saving energy," *New York Times*, July 15: 11-1, 9.

temperament to be an architect."[48] Still, this did not diminish his interest or fascination, which he had developed as a child while playing with Legos and reading books on Frank Lloyd Wright. Glenn quickly realized that a developer held more control in the building process. He could hire his favorite architects to "do some good in the world," just as his hero Jim Rouse had done with the revitalizations of Faneuil Hall Marketplace in Boston and South Street Seaport in New York City. Regardless, Glenn's official title on the LivingHomes' website is "Wannabe Architect." See **Exhibit 12** for Glenn's bio.

Glenn approached LivingHomes in the same way he approached his other startups; plain and simple, he "loved developing products."[49] He wanted to make a "portfolio play" with a *product line* that met a range of customers' needs. After a long look into the sustainable real estate market, he decided that the time was ripe for this product in this market sector. Just like developing consumer products, his business plan outlined the target customer needs, and matched them to his proposed product strategies and features.

Product Differentiation

The business plan for LivingHomes rested on three central pillars. The first pillar was to create a **signature home**. Glenn recognized that he did not posses the "starchitect" cachet to make LivingHomes a coveted brand, so he developed working relationships with a few well-known architects.[50] At the end of 2007, his company was working with two architects, Ray Kappe and David Hertz, with stirrings of working with a third, Kieran Timberlake. Each architect was to hit a different price point to provide customers with a suite of options. See **Exhibit 13** for Kappe's profile from the LivingHomes' website. Kappe created four designs for LivingHomes, ranging from 2,000 to 4,000 square feet with a *base price* between $350,000 and $650,000[51] and LivingHomes' first, 2,650 square foot model. The homes' aesthetic style has been described as "environmental modernism," combining "the light, volume and linear forms... [of] a modern space" with the "warmth and detail" found in a more traditional home. The design has been called fun, functional, flexible and practical.[52] Glenn felt that the success of the first home lay in "not screwing up" Kappe's design. In short, his approach was to "get great architects and get the hell out of the way."[53]

The second pillar was the use of **prefabrication** techniques to build the house in a controlled environment, and deliver it to the site as complete as possible. This was not a new idea. In 2006, 40,000 new single-family homes were built in a modular fashion.[54] But connecting prefabrication to high end green homes was new. It was prodded by the kind of

[48] LivingHomes. (n.d.). *Steve Glenn.* Retrieved August 30, 2007, from http://www.livinghomes.net/viewPerson.html?id=1

[49] Glenn, S. (2007). Personal Communication. November 8.

[50] LivingHomes. (n.d.). *FAQ.* Retrieved August 30, 2007, from http://www.livinghomes.net/faq.html

[51] Newman,op. cit.

[52] LivingHomes. (n.d.). *Environmental Modernism: Form, Function, and Ecological Fidelity*. Retrieved August 28, 2007, from http://www.livinghomes.net/formFunction.html

[53] Glenn, S. (2007). Presentation at Greenbuild. November 7.

[54] U.S. Census Bureau. (2006). *Quarterly Starts and Completions*. Retrieved August 30, 2007 from http://www.census.gov/const/quarterly_starts_completions_cust.xls

thinking that asks, "Why can't you produce houses the same way Apple produces iPods?"[55] The idea is that a house should be stylish, sexy, easy to use, and mass produced. LivingHomes models comprised prefabricated steel frames "pre-stuffed" with electrical systems, heating and cooling ducts, and insulation, could weigh as much as 25,000 pounds and were stacked much like Legos to provide quick assembly. Further, homeowners could buy additional modules for home expansion after the home was complete and lived in.

LivingHomes claimed that modular prefabrication produced "higher quality homes faster and for less money than traditional, 'stick-built' (site built) methods." The next step involved using a flat-pack system, were wall panels instead of whole modules were shipped to the site. This innovation could create a more compact delivery system and faster fit-out, which would be important for scaling the business. As John Quale, an assistant professor at the University of Virginia School of Architecture said, "It doesn't make sense to ship air."[56] LivingHomes began talking with Kieran Timberlake, the architects who developed this system, about integrating this system into LivingHomes. [57]

The third pillar was **environmental sustainability**. The company felt that this goal was synergistic with prefabrication as "modular fabrication supports sustainable building practices," creating only 4-5% material waste in construction, compared with the 30-40% material waste of site built homes.[58] Exterior walls were made from sustainable wood siding and metal-framed glass doors and windows. The standard-order homes were guaranteed to reach a minimum of LEED Silver rating, though they had the capability to build to the Platinum level, as shown in their prototype.

Glenn's goal with LivingHomes was to build with "as close to zero negative impact on your health and on the environment."[59] The company strove to meet what they termed the "6Zs," or "Six Zeros of Sustainability: Zero Water, Zero Energy, Zero Waste, Zero Emissions, Zero Carbon, and Zero Ignorance." These were inspired by McDonough and Brungart's *Cradle-to-Cradle* ethic, where "less bad" does not mean "good."[60] Each of these six categories delineated a green strategy that could then be counted in the LEED for Homes Certification process. "Zero Ignorance" involved education of the homeowner and a "dashboard" in the kitchen that displayed real-time energy and water use. Glenn confessed to "playing" the dashboard like a videogame, trying to get a better "score" every day by using less energy and water. He compared this to hybrid car owners trying to get better gas mileage with their real-

[55] Yudelson, J. (2006). "Green Buildings and iPods." *Environmental Design + Construction*. April.

[56] Wendt, A. (2007). "Prefabricating Green: Building Environmentally Friendly Houses Off Site." *Environmental Building News*. 16(10).

[57] Blum, op cit.; Saffron, I. (2007). "Green, clean, and pretty prefab." *The Philadelphia Inquirer*. June 15. Retrieved August 19, 2007, from 3http://www.philly.com/inquirer/columnists/inga_saffron/20070615_Changing_Skyline___Green__clean__and_pretty_prefab.html

[58] LivingHomes. (n.d.). *Building for Superior Quality, Lower Cost and Less Waste*. Retrieved August 30, 2007, from http://www.livinghomes.net/modularConstruction.html

[59] LivingHomes. (n.d.). *Six Zeros of Sustainability*. Retrieved August 30, 2007, from http://www.livinghomes.net/zeros.html

[60] McDonough & Braungart (2002). *Cradle to Cradle: Remaking the Way We Make Things*. New York: North Point Press.

time dashboard readout.[61] Similarly, each home came with a Sustainability Scorecard of LEED Points, just like a nutritional label for food. LivingHomes wanted to be sure that their commitment to sustainability was both transparent and rigorous, and they believed that despite their "Six Zeros" goals, LEED certification was still necessary to give credibility to their green efforts and "keep [them] honest." But for the prototype home with the "6Z" goals, Glenn was the first to admit, "We're not quite zero on anything. ...The point was to minimize these as much as possible, and we came extremely close."[62]

The company has also created a list of partners—companies that pass LivingHomes' internal review for alignment with the core values of the company ("building warm, functional, modern homes that strive to achieve minimal negative impact on the health of homeowners and their communities")—and can therefore be considered for possible inclusion in the homes. The list included mainstream companies like Best Buy, Bosch, GE Security, Herman Miller, HP, Jacuzzi, Klipsch, Kohler and Panasonic as well as lesser known companies like 3Form,[63] Ecosmart Fire[64] and EnviroGLAS Products Inc.[65] For the second LivingHome, one could visit a *Wired* magazine website[66] and see a video of the installation, "Shop the Home" by purchasing items that the home contained (bath fixtures, lighting, furniture, salad bowls, clothing, and even the vodka), or sign up for events and lectures.

Putting these three pillars together raises the costs of the LivingHomes product, something that Steve Glenn is acutely aware of. Estimates put the price between $280[67] and $300[68] per square foot (excluding foundation and transportation), which is far above the average of $120.66 in the western United States. At the current price point, a 2,500 square foot house (similar in size to Steve Glenn's own LivingHome) would run more than $700,000 plus the cost for transportation, foundation, design modification (10-15% of the budget), and permitting (estimated at $70-$90 per square foot excluding design for a flat lot). Transportation costs were an estimated $20/square foot in Los Angeles ($50,000) and foundations could cost upwards of an additional $50,000, leading to a total cost of over $1,000,000. This was for an "off the shelf" home. One could further customize the house ("constrained custom"), for additional hourly fees. Some reports suggest that in Steve Glenn's house, "green features added an estimated 20 percent over a comparable prefab place, but resulted in a house that makes its own power, automatically irrigates plants using gray water (wastewater from the showers and sinks), and leaves almost no carbon footprint."[69] Glenn's first LivingHome was estimated to cost about $1 million. In June 2007 *Wired* magazine, with a reader base of cultured tech-savvy consumers, announced a joint venture with LivingHomes to build a 4,057 square foot, LEED Gold, "*Wired* LivingHome" co-sponsored by

[61] Glenn, Presentation, op. cit.

[62] Blum, A. (2007). "Plug+Play Construction." *Wired.* January. 15(1).

[63] http://www.3-form.com/

[64] http://www.ecosmartfire.com/USA/home.php

[65] http://www.enviroglasproducts.com/index.html

[66] http://www.wired.com/promo/wiredlivinghome/index.html

[67] Scanlon, op. cit.

[68] Lawrence, R. G. (2007). "Living in L.A." *Natural Home,* July/August. 34-41.

[69] Scanlon, op. cit.

BMW CleanEnergy.[70] The home opened for ten days of limited tours in November 2007, and was offered for sale for $4 million. This was clearly a home for the upper-income and discerning green client. However, Glenn's goal was to bring down the LivingHomes price to $150-$200 per square foot (not including land costs, designer fees, etc.).

Product Acquisition

Innovatively, consumers could visit the company website (www.livinghomes.net) and configure their own home based on five standard models, then select finishes and options to produce a total estimated budget. See **Exhibit 14** for a configuration example. Though customers could customize their homes online as they could a computer, the overall process was still very personalized. After initial conversations, the company completed a site feasibility study to determine whether the client's site met logistical and legal criteria. Once confirmed, LivingHomes staff could proceed to customize the home based on site zoning and customer specifications. This customization included engineering and design modifications, all based on the prefabricated modules. Clients were charged an additional hourly fee for customization services.

LivingHomes initially purchased its Lego-like prefabricated steel modules from Profile Structures, Inc. of Santa Fe Springs, California (roughly 10 miles southeast of Los Angeles). This required careful coordination to maintain high standards of quality. Ray Kappe's design, for example, encountered "a fair amount of compromise and change" to conform to the "usual techniques and materials"[71] of Profile Structures' steel models. The internal staff at LivingHomes would then coordinate the orders for all equipment, cabinetry, lighting, etc. Foundation work was required before frame delivery. Clients could hire LivingHomes to manage foundation construction, or hire a contractor on their own. After installation day, LivingHomes committed that it could complete the installation of all equipment and finishes (kitchen cabinets, plumbing fixtures, etc.) in four weeks or less. For customers who wanted a more turnkey solution, Glenn was also taking a play from the book of larger developers, and building a community of homes to take advantage of the neighborhood qualities of like-minded customers. He acquired a plot in Joshua Tree National Park, and began pre-selling homes there.

Due to the expected learning curve associated with developing a new product and process, in 2007 LivingHomes was only delivering homes to the lucrative, yet competitive area of California.[72] Further, the nature of prefabricated homes requires that home delivery be within an economical range of the manufacturing site. The company also committed to working only with clients who were looking to have a LivingHome within 12 months of the initial inquiry.

[70] Clifford Public Relations (2007). *LivingHomes and* Wired *magazine announce the first-ever* Wired *LivingHome*. Press Release. June 18.

[71] Newman, op cit.

[72] LivingHomes. (2007). *FAQ*. Retrieved August 30, 2007, from http://www.livinghomes.net/faq.html

LivingHomes Organization

LivingHomes employed a small team of himself, four architects or architectural interns, one project manager, and one office manager. See **Exhibit 15** for the Team Profiles. The company described the team as nimble, the atmosphere as creative, and the skill sets as being drawn from "the worlds of technology, design, and construction management." A key value that they tried to instill in their work force is a desire to "marry profit and purpose," and "co-opt capitalism to be a positive agent of change."[73] They also stressed that the work environment was fun and laid-back. According to the company, "if you met [our employees] on the street, they'd probably talk to you about snowboarding, dogs, or some chair they're making... Plus we're near the beach, so we like morning runs, bike rides and surf sessions (when the waves are good). Two other things of note: ours is a dog-friendly environment and Steve Glenn's grandmother brings lots of baked goodies."

Product Market Segment

A survey by McGraw Hill identifies green homeowners by the following attributes: Seventy-one percent are female; two-thirds have an annual income over $50,000; the average age is 45; more likely married and highly educated.[74] While this is, in part, the target of LivingHomes product, Glenn wanted to go further. LivingHomes was targeting America's growing class of "cultural creatives" – people who value design, health and ecological sustainability in the products they purchase. Glenn maintained that a mass-produced, prefabricated green home would give people like himself and his friends—this "creative class"—a home to match their lifestyle. This class, unlike their parent's generation, did not want to sacrifice space and comfort for ecological performance. The LivingHome products were designed with this in mind, blending attributes such as high-end audio and theatre equipment into the home.

Members of the cultural creative class not only differ from hippies, but they were also strikingly different from the "moderns" (or yuppies) of the 1980s. While the moderns valued achievement, style, and economic progress, cultural creatives valued authenticity, nature, and community. However, this ostensibly diminished focus on success does not mean that they are not affluent. The creative class was estimated to have an average income between $25,000 - $75,000 (1995 figures).[75]

This group's marketplace was also described as LOHAS—Lifestyles of Health and Sustainability. In 2000, this represented an estimated $230 billion U.S. industry "for goods and services focused on health, the environment, social justice, personal development and sustainable living."[76] Figures also showed that this class was growing. In 2001, it was estimated that this class represented 50 million, approximately 25% of American adults, and

[73] Glenn, Presentation, op. cit.

[74] McGraw Hill Construction (2007) *The Green Homeowner: Attributes & Preferences for Remodeling and Buying Green Homes* (Bedford, MA: McGraw Hill Construction Research & Analytics)

[75] Ray, P. H. & Anderson, S. R. (2000). *The Cultural Creatives: How 50 Million People Are Changing the World*. New York: Harmony Books.

[76] LOHAS. (2007). *About LOHAS*. Retrieved October 1, 2007, from http://www.lohas.com/about.htm

by 2003 that figure had grown to 68 million Americans, or about 33% of the adult population.[77]

The cultural creatives were "careful consumers" who preferred their home to be located "far away from tract houses in treeless suburbs." They rejected "fake, imitation, poorly made, throwaway, cliché style or high fashion." In terms of décor, status display happened inside the house not outside. They wanted the building to fit "into its proper place on the land," and they were conscious consumers who wanted to know "where a product came from, how it was made, who made it, and what will happen to it when they are done with it." [78] As Glenn pointed out, "our customers make uneconomic decisions in this space."[79]

LivingHomes Financials

For LivingHomes, capital was necessary to set up his office, develop marketing materials, pay salaries and develop contractual relationships with architects, suppliers, contractors and prefabricators. Glenn's model of pre-selling homes mirrors that of larger developers, where construction (or fabrication) does not start until the client agreement is completed. Glenn started the company with his own funds, but was soon working with venture capitalist Vinod Khosla, founding CEO of Sun Microsystems, and former partner of the "greentech" venture capital firm Kleiner Perkins. Still, Glenn retained significant ownership and control, and was confident of his expertise at raising significant investment to assure a successful product launch.[80]

Other Niche Players in the Green Building Industry

Marmol Radziner Prefab

The architectural firm Marmol Radziner, started by California idealists Leo Marmol and Ron Radziner, recently established a separate design/build practice in Los Angeles for their prefabricated products. The firm produced their first sustainable prefabricated prototype home in 2005, titled *The Desert House*, in Palm Springs, California. The company's construction crew numbered over 40 people, and the associated architecture firm, established in 1989, employed more than 60 architects, landscape designers, and fabricators. Clients could either order a custom prefab home, or select one of five base models and customize the fixtures and finishes. The homes were "designed to achieve LEED Certification." In 2007, they were also constructing a subdivision-like development in Joshua Tree National Park.

Marmol Radziner was unusual among architects in that it already had a vertically-integrated factory doing millwork and detailing, so it was a natural step to expand to completely

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[77] Cortese, A. (2003). "Business; They Care About the World (and they shop, too)." *The New York Times*. July 20. Retrieved October 1, 2007, from http://query.nytimes.com/gst/fullpage.html?res=9E01E3D8103CF933A15754C0A9659C8B63

[78] Ray, P.H. and Anderson, S. R. (n.d.) *Lifestyles of the Cultural Creatives*. Retrieved October 1, 2007, from http://culturalcreatives.org/lifestyles.html

[79] Glenn, Presentation, op. cit.

[80] Glenn, Personal, op. cit.

prefabricated houses. Green aspects of their buildings included responsible wood choices, structural insulated panels, solar panels, natural cooling, recycled steel construction, and of course, efficient factory built construction.[81] In 2007, the founders were spreading the word of their new product offering. They spoke at both the *Dwell on Design* conference and the Design Within Reach's showrooms in Pasadena, California.[82] See **Exhibit 16** for images of Marmol Radziner's designs.

MKD (Michelle Kaufmann Designs)

MKD, founded by Michelle Kaufmann, debuted in 2004 with the *Glidehouse* (Shown in **Exhibit 17**). The *Glidehouse* was prefabricated in a factory, using modern and environmentally-friendly building methods and materials. The Oakland, California company offered five models and custom homes in 2007. As of July 2007, Kaufmann had built 17 prefab homes and had an additional 75 moving through the pipeline. She bought her own factory near Seattle, a location she chose because it was close to the mills that produced her framing, cabinetry, and flooring. The factory could complete a *Glidehouse* in a month. Kaufmann's houses cost between $185 and $250 per square foot, depending on the model and location, and she wanted them to be even cheaper. Her goal was to reach the middle-class market. MKD was featured in *Sierra* magazine and described as "The Henry Ford of Green Homes." The article compared the process of ordering one of MKD's "solar-ready, sustainably built, water- and energy-efficient modular homes" to ordering a pair of customized Nike shoes online.[83] So far, MKD had been able to convince some middle and high-income customers that prefabrication could be used to produce a desirable and eco-conscious home.

Next Steps

As Glenn finished the latest tour of his green home, the group followed Glenn to the roof, chattering excitedly about the features of the home. Their interest was palpable, and Glenn felt a surge of renewed optimism. A young couple approached him, gushing about the house. "We're getting married in two months and this is exactly the sort of place where we want to raise a family. If you offered a more affordable model, we would sign a contract today. Do you have something a bit less lavish, but still just as progressive?" Another couple intimated that cost was not a problem. However, the woman also commented that she could not bring herself to live in such a fishbowl, and her husband wanted a wood-burning fireplace—one that Glenn warned could cause indoor air pollutants, unlike the denatured alcohol fireplace installed in the LivingHome. As he led the group out the door, he turned around and saw his beautiful home. Could he really merge the pillars of high-end style and price, prefabrication and green?

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[81] Alter, Lloyd, CA Boom Prefab: Marmol Radziner, Retrieved October 12th 2007, from http://www.treehugger.com/files/2007/03/ca_boom_prefab.php

[82] Marmol Radziner Prefab. (n.d.). *News and Events.* Retrieved August 30, 2007, from http://www.marmolradzinerprefab.com/main.html

[83] Slater, D. (2007). "Innovators: The Henry Ford of green homes." *Sierra.* July/August. Retrieved August 30, 2007, from http://www.sierraclub.org/sierra/200707/innovators.asp

Sales were starting to come in. By November 2007, LivingHomes had sold thirteen homes, and scheduled to install four of those within 4-9 months.[84] Glenn was confident about this market, and noted that even if the "niche" were a "rounding error" in new homes, he would have adequate sales. He hoped to learn more to perfect his home delivery process with these homes coming on-line. Still, the high "installed price" was a genuine concern and he was "absolutely committed to aggressively reducing our costs."[85] But he also defended the costs as providing a better product to his customers:

> "We're currently at the higher end of the range of modern, prefab homes - and certainly those of us at this range are expensive vis-à-vis typical construction in many parts of the country - but it's important to do a fair comparison. We believe our homes represent a 20-40% reduction in the cost of similarly constructed, stick-built home. By "similarly constructed," we mean a steel-framed home, designed by a world-class architect that features substantial amounts of floor-to-ceiling glass, decking, and environmental finishes and energy systems. We will introduce homes in the future that have lower per square foot costs."[86]

Beyond getting costs down, Glenn faced other difficult questions.

- Was his target market large enough to really provide the economies of scale necessary to reap the benefits of prefabrication?
- Would prefabrication and mass production reduce the signature brand value of the LivingHome?
- Should he contract with more architects to create a more diverse product offering?
- How could he control transportation costs?
- Should he branch out geographically and develop relationships with other fabricators around the country? Should he acquire his own prefabrication plant?
- Would competitors emerge that could provide a similar product better, faster, or cheaper?
- And then, of course, how could he deal with the building inspectors and zoning laws that were unfamiliar with the innovations he was introducing?

In the long run, eventually Glenn wanted to get rid of the fabrication part of the business. He was more interested in providing the brand with product specifications. "Our focus, ultimately, is on builders... We want to sell this [LivingHomes concept] to builders and developers. They'll be able to buy these from us."[87] Making this transition could prove to be

[84] Scanlon, op. cit. ; Glenn, Personal, op. cit.

[85] Glenn, S. (2006). "Letter to LA Times Editor on LivingHomes" [Letter to the editor]. *Curbed Los Angeles*. August 7. Retrieved August 30, 2007, from http://la.curbed.com/archives/2006/08/letter_to_la_ti.php

LivingHomes. (n.d.) *Tour*. Retrieved August 30, 2007, from http://www.livinghomes.net/tour.html

[86] LivingHomes. (n.d.). *FAQ*. op cit.

[87] Crouch, A. (2006). "Making a Living" *Innovative Homes*, 34.

the biggest challenge. Merging his short and long term concerns, Glenn wondered, could he create a sustainable business by building sustainable homes?

Exhibit 1: Images of the first LivingHome
Retrieved August 30, 2007, from http://www.livinghomes.net/gallery.html

Exhibit 1: Images of the first LivingHome, *continued*

Exhibit 2: Annual Housing Starts

National Association of Home Builders, retrieved November 24, 2007 from
http://www.nahb.org/generic.aspx?centionID=130&genericContentID=554&print=true

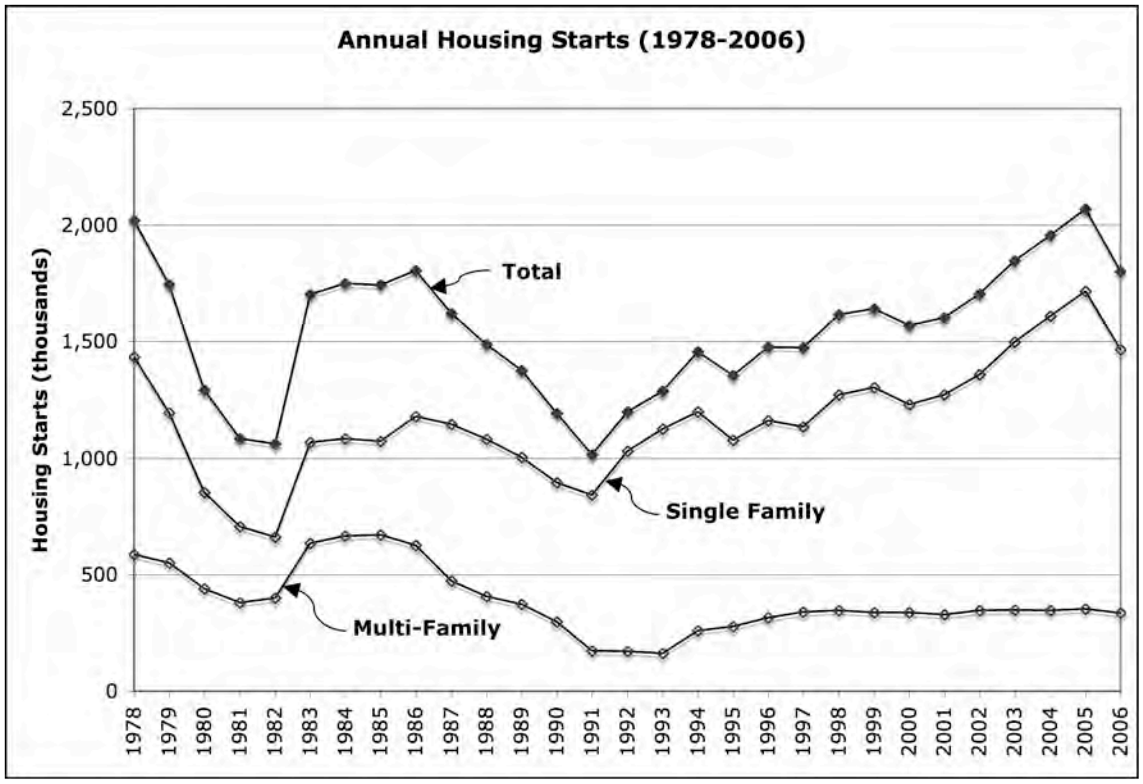


Exhibit 3: Highlights of Annual 2006 Characteristics of New Housing

Retrieved November 24, 2007, from http://www.census.gov/const/www/highanncharac2006.html

Please note that the estimates shown here are based on sample surveys and subject to sampling variability as well as nonsampling error.

In 2006:

- The average single-family house completed had 2,469 square feet, 769 more square feet than in 1976.
- 78% of all new single-family homes completed were speculatively-built (house and land are sold together as part of the same transaction), up from 65% in 1986.
- 39% of new single-family homes completed have four or more bedrooms, almost double the rate of just 20 years ago.
- 26% of new single-family homes sold have 3 or more bathrooms, almost triple the rate from 1986.
- Half of all single-family homes were completed in the South region, up 10 percentage points from 1976.
- Approximately 90% of all single-family homes completed have air conditioning!
- Approximately 95% of new single-family homes sold have at least a 1-car garage or carport.
- In the Northeast and Midwest (75%) of the homes completed have a basement, but in the West only 20% have a basement and that drops to 10% in the South.
- Across the country, over half (53%) of all single-family homes sold have at least 1 fireplace.
- 25% of new single-family homes completed have a deck, down from 34% in 1996.
- Almost 70% of all new single-family homes sold use gas as the primary source of heating fuel and approximately 30% use electricity as the primary source.
- Attached single-family homes account for nearly 15% of all new single-family homes sold, up from 11% in 1996.
- Currently vinyl siding is the most common principal exterior material at 30% of new single-family homes sold. In 1996 wood was 22% of the share. It has now reduced to 5% in 2006. Regionally the exterior wall material of preference is: Vinyl - Northeast (86%), and Midwest (67%); Brick - South (41%) and Stucco - West (62%).
- 90% of all new single-family homes sold were financed by a conventional loan, up from 55% in 1986.
- The average sales price of new single-family homes sold (including land) was $305,900. In 1996, the average sales price was $166,400. This is an increase of over 84%!
- The average price per square foot for new single-family homes sold was $91.99, up from $64.38 in 1996. Regionally, it is most expensive to build in the West at $120.66 and least expensive to build in the South at $80.32.
- Over a tenth (12%) of all new single-family homes sold were built on lots of at least 22,000 square feet (approximately a half an acre); this is virtually unchanged from 1986 and 1996.
- 40,000 new single-family homes were modular homes, up 3,000 units from 1996. This represents about 2 percent of all homes completed; however, this method of construction is most prevalent in the Northeast, with nearly 10% of its units built this way.
- For more than 3/4 of all new single-family homes sold, closing costs were excluded from the sales price. This estimate has remained relatively stable over the past 20 years.
- Multi-family construction has decreased dramatically over the last 20 years from 636,000 units, in 1986 to 153,000 units in 1993. It rebounded 325,000 units in 2006.
- The average multi-family unit completed had 1,533 square feet, 173 more square feet than in 1999.
- The percentage of apartments completed being built to be sold was 39.2. This is second only to the record 39.6% set in 1982.

Exhibit 4: New Housing Units Completed, by type
U.S. Census Bureau, retrieved August 30, 2007 from
http://www.census.gov/const/quarterly_starts_completions_cust.xls

	Total (000)	Built for sale (000)	Contractor built (000)	Owner built (000)	Median square footage	Average square footage
2000	1,242	883	192	126	2,057	2,266
2001	1,256	906	189	122	2,103	2,324
2002	1,325	967	195	123	2,114	2,320
2003	1,386	1,038	185	119	2,137	2,330
2004	1,532	1,170	191	125	2,140	2,349
2005	1,636	1,288	190	118	2,227	2,434
2006	1,654	1,293	198	124	2,248	2,469

Exhibit 5: Residential Building Factsheet

Center for Sustainable Systems, University of Michigan
Retrieved November 24, 2007 from http://css.snre.umich.edu/css_doc/CSS01-08.pdf

University of Michigan
440 Church Street, Ann Arbor, MI 48109-1041
phone: 734-764-1412 fax: 734-647-5841
email: css.info@umich.edu
http://css.snre.umich.edu

Center for Sustainable Systems

factsheets

Residential Buildings

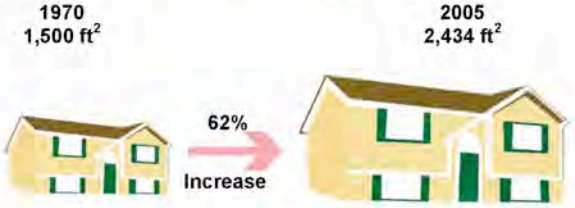
Patterns of Use

Proven climate-specific, resource-efficient house design strategies exist, but due to lack of market incentives and political will, per capita materials and energy consumption continue to increase. Likewise, between 1950 and 1990, urbanized land expansion grew at a rate 3 times the rate of population growth.[1]

Size and Occupancy[2]

A majority of Americans live in single-family houses – in 2005, 64% of the 109 million U.S. households were single-family. Some unsustainable residential building trends to consider:

Average Size of a New U.S. Single-Family House



Average size of a new U.S. single-family house:
- 1950 983 ft²
- 1970 1,500 ft²
- 2000 2,200 ft²
- 2005 2,434 ft² **a 148% increase from 1950**

Average area per person in a new U.S. single-family house:
- 1950 292 ft² per person
- 1970 478 ft² per person
- 2000 840 ft² per person **a 188% increase from 1950**

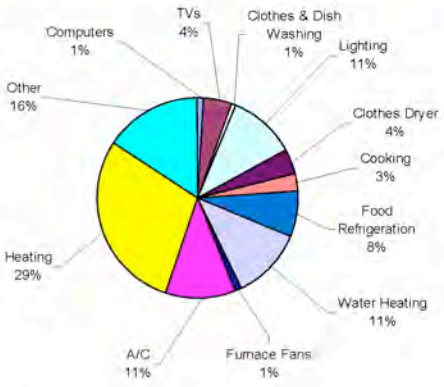
Average number of occupants per U.S. household:
- 1950 3.37
- 1970 3.14
- 2000 2.62 **a 22% decrease from 1950**

- In 1950, 9% of housing units were occupied by only one person. By 2005, this increased to 27%.[3]
- Americans spend on average, 90% of their time indoors.[4]

Energy Use

- A new single-family house in Michigan – as studied in 1998 by CSS – consumes 1.3 GJ per square meter annually.[5]
- A similar study of 3 houses in Sweden built in the 1990's shows annual energy consumption of 0.49 – 0.56 GJ per square meter – less than half the energy consumed in the Michigan house.[6]
- Between 1990 and 2006, total residential CO_2 emissions increased by 26% while population increased by only 20%.[7]
- The residential sector accounts for 21% of the total energy consumption in the U.S.[8] The breakdown of this energy consumption is shown in the figure to the right.

Average U.S. Residential Energy Consumption[9]



[1] Rusk, D. (1999) *Inside Game Outside Game: Winning Strategies for Saving Urban America.* Washington, D.C. Brookings Institution Press.
[2] National Association of Home Builders (2007) *Housing Facts, Figures and Trends*, U.S. Census Bureau and Wilson, A. and J. Boehland (2005) "Small is Beautiful, U.S House Size, Resource Use, and the Environment." *Journal of Industrial Ecology*. Vol 9, No. 1-2, 277-287.
[3] U.S. Census Bureau (2004) *Historical Census of Housing, Tables Living Alone* and (2006) *American Housing Survey for the United States: 2005.*
[4] Wilson, S. (2004) "Design for Health: Summit for Massachusetts Health Care Decision Makers." Presentation September 2004.
[5] Blanchard, S. and P. Reppe (1998) *Life Cycle Analysis of a Residential Home in Michigan* (CSS98-05).
[6] Adalberth, K. (1997) "Energy use during the Life Cycle of Single-Unit Dwellings: Examples." *Building and Environment*, Vol. 32, No. 4, 321-329.
[7] Energy Information Administration (EIA) (2007) *U.S. Carbon Dioxide Emissions from Energy Sources 2006 Flash Estimate.*
[8] EIA (2007) *Annual Energy Review 2006* Report No. DOE/EIA-0384(2006).
[9] EIA (2007) *Annual Energy Outlook 2006 with Projections to 2030*

Exhibit 5: Residential Building Factsheet, *continued*

Life Cycle Impacts[5]

The Center for Sustainable Systems conducted a case study to inventory life-cycle energy consumption from manufacturing, construction and operational phases of a new 2,450 ft² single-family house built in Ann Arbor in 1998.

- The case study house required 172 tons of concrete, 24 tons of wood and wood products.
- 90% of the life cycle energy consumption occurred during operation; only 10% went into building and maintaining the house.
- Top contributors to the primary energy consumption of the case study house were polyamide for carpet, concrete in foundation, PVC for siding, window frames and pipes, and asphalt roofing shingles.
- 75% of the materials in the case study house are currently recyclable; however, the U.S. average recycling rate of building materials from demolition and construction is only 20-30%.[10]

The following off-the-shelf energy efficiency strategies were then modeled to quantify the resulting life-cycle energy savings:

- wall and ceiling insulation increased from R-15 to R-35 and R-23 to R-49 respectively; building infiltration (leakage) reduced by half
- wooden basement walls instead of concrete; basement thermal insulation increased from R-12 to R-39
- double-glazed windows upgraded to include low-e treatment and argon fill
- energy-efficient appliances chosen; stove & dryer switched from electricity to natural gas
- energy-efficient lighting (fluorescent) adopted throughout
- building-integrated shading (overhangs) created on south-facing windows
- hot-water heat recovery installed
- air-to-air heat recovery used with ventilation system
- glass fiber thermal insulation replaced with recycled cellulose
- recycled-materials roofing shingles (wood/plastic)

- A 63% building life-cycle energy reduction was achieved through the above measures, all with readily available technology.
- Life cycle greenhouse gas emissions were reduced from 1,013 to 374 metric tons of CO_2-equivalent, over the 50-year lifetime of the house.
- Despite the additional material requirements, the total embodied energy was reduced by about 4%.
- Installation of a high efficiency HVAC system and cellulose insulation ranked as the most effective strategies in reducing annual energy costs.

Solutions and Sustainable Alternatives

Reduce operational demand of the home

From a life-cycle perspective, energy and water consumption during the life of a building contribute much more to its environmental impact than do building materials. The following suggestions can significantly reduce operational energy demand:

- Use passive heating methods – passive solar, waste heat from disposed hot water.
- Make use of passive cooling – night-flushing, shading.
- Use adequate insulation – recommended R-values in the Midwest climate: attic R-49, walls R-18.[11]
- Add ceiling fans, and the A/C can be comfortably set about 5 degrees higher.
- Maximize day-lighting – sky lights, south facing windows.
- Consider decentralized, "passive" sanitary services – compost toilet, living machine, rainwater use for toilets, greywater for gardening.
- Convert appliances from electric to natural gas, reducing primary energy consumption by about 75%.
- Install a low-flow showerhead – less than 2.5-gallons-per-minute – to save both water and energy.
- Save 40% of hot water heating energy with a simple wastewater heat exchanger.

Select durable and/or renewable materials

Building materials with long lives may have greater upfront cost, but long-term savings and reduced environmental impact are achieved by avoiding replacement. Renewable building materials also offer potential environmental advantages.

- Durables to consider: cork or hardwood vs. carpet, standing-seam roofing vs. asphalt shingles
- Renewables to consider: cork, linoleum, wool carpet, certified wood and plywood, strawboard, cellulose insulation, straw-bale
- Substituting asphalt shingle roofing with recycled plastic/wood fiber shingles can reduce embodied energy by 98% over 50 years

Resources

Blanchard, S. and P. Reppe. (1998) *Life Cycle Analysis of a Residential Home in Michigan* **(CSS98-05)**

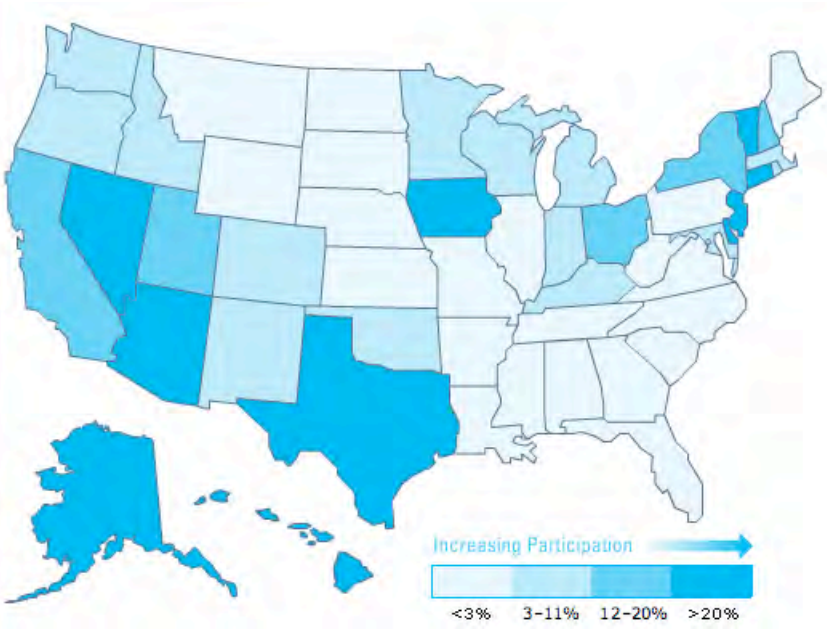
Keoleian, G. A., S. Blanchard and P. Reppe (2001) "Life Cycle Energy, Costs, and Strategies for Improving a Single Family House", *Journal of Industrial Ecology* 4(2), p. 135-156. **(CSS00-11)**

[10] U.S. EPA (1998) *Characterization of Building-Related Construction and Demolition Debris in the United States* Report No. EPA530-R-98-010.

[11] U.S. Department of Energy, Energy Efficiency and Renewable Energy (2006) "Energy Savers: Tips on Saving Energy & Money at Home: Insulation." http://www1.eere.energy.gov/consumer/tips/insulation.html

Exhibit 6: Energy Star Market Penetration

U.S. EPA. (2007). ENERGY STAR Qualified New Homes Market Indices for States. *Retrieved November 25, 2007 from* http://www.energystar.gov/index.cfm?fuseaction=qhmi.showHomesMarketIndex



Energy Star Qualified New Homes, by state

State	2006 ENERGY STAR Qualified New Homes[1]	2006 One-Unit Housing Permits[2]	2006 ENERGY STAR Market Penetration
Alaska	1,024	1,612	64%
Arizona	20,101	55,633	36%
California	18,105	107,714	17%
Connecticut	1,606	7,107	23%
Delaware	1,217	5,015	24%
Hawaii	2,086	5,597	37%
Iowa	5,866	10,250	57%
Nevada	18,891	26,722	71%
New Hampshire	820	4,826	17%
New Jersey	5,351	17,113	31%
New York	2,569	19,981	13%
Ohio	3,462	27,514	13%
Texas	60,839	162,750	37%
Utah	3,554	22,595	16%
Vermont	501	2,071	24%

Exhibit 7: LEED-NC Buildings by state 2005

US Green Building Council. (2007). About USGBC. *Powerpoint file. Retrieved November 25, 2007, from https://www.usgbc.org/ShowFile.aspx?DocumentID=3376*
(via http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1720)

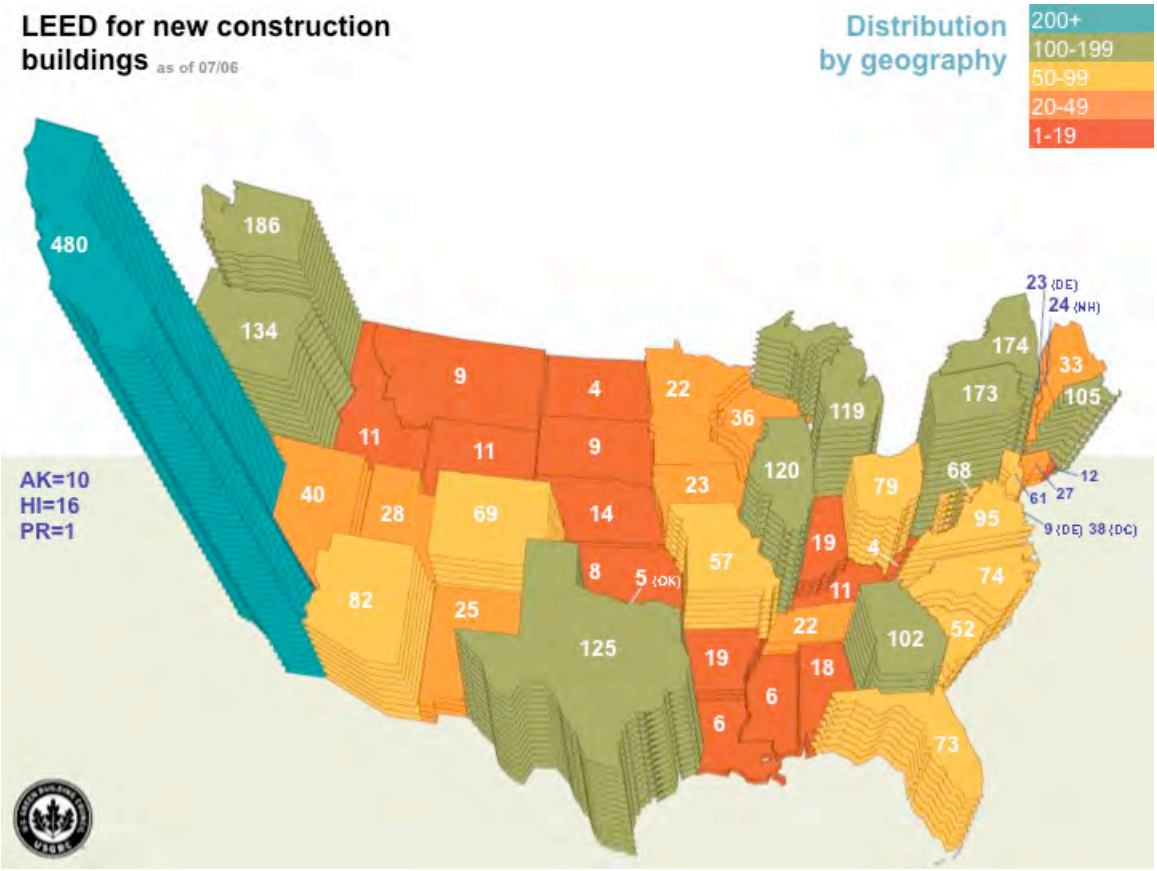


Exhibit 8: LEED for Homes Checklist

U.S. Green Building Council. (2007). LEED for Homes Program Pilot Rating System Version 1.11a. January. Retrieved November 24, 2007, from http://www.usgbc.org/ShowFile.aspx?DocumentID=2269

Project Checklist LEED for Homes

for Homes

Builder Name:	
Responsible Party (if different):	
Home Address (Street/City/State):	

Input Values: *Click here if you're experiencing problems*
No of Bedrooms: 4 Floor Area (SF): 2400

Minimum No. of Points Required:
Certified: 45 Silver: 60 Gold: 75 Platinum: 90

Detailed information on the measures below are provided in the companion document "LEED for Homes Rating System"

Y / Pts	No	N/A						Max Points Available
				Innovation and Design Process (ID)	(Minimum of 0 ID Points Required)			**9**
			1.1	**Integrated Project Planning**	Preliminary Rating			Prerequisite
			1.2		Integrated Project Team			1
			1.3		Design Charrette			1
			2.1	**Quality Management for**	Durability Planning; (Pre-Construction)			Prerequisite
			2.2	**Durability**	Wet Room Measures			Prerequisite
			2.3		Quality Management			Prerequisite
			2.4		Third-Party Durability Inspection			3
			3.1	**Innovative / Regional Design**	Provide Description and Justification for Specific Measure			1
			3.2		Provide Description and Justification for Specific Measure			1
			3.3		Provide Description and Justification for Specific Measure			1
			3.4		Provide Description and Justification for Specific Measure			1
0				Sub-Total				
Y / Pts	No	N/A		**Location and Linkages (LL)**	(Minimum of 0 LL Points Required)		OR	**10**
			1	**LEED-ND Neighborhood**			**LL2-5**	10
			2	**Site Selection**	Avoid Environmentally Sensitive Sites and Farmland		**LL1**	2
			3.1	***Preferred Locations***	Select an Edge Development Site		**LL1**	1
			3.2		***OR*** Select an Infill Site		**LL1**	2
			3.3		Select a Previously Developed Site		**LL1**	1
			4	**Infrastructure**	Site within 1/2 Mile of Existing Water and Sewer		**LL1**	1
			5.1	**Community Resources**	Basic Community Resources / Public Transportation		**LL1**	1
			5.2	**& Public Transit**	***OR*** Extensive Community Resources / Public Transportation		**LL1**	2
			5.3		***OR*** Outstanding Community Resources / Public Transportation		**LL1**	3
			6	***Access to Open Space***	Publicly Accessible Green Spaces		**LL1**	1
0				Sub-Total				
Y / Pts	No	N/A		**Sustainable Sites (SS)**	(Minimum of 5 SS Points Required)		OR	**21**
			1.1	**Site Stewardship**	Erosion Controls (During Construction)			Prerequisite
			1.2		Minimize Disturbed Area of Site			1
			2.1	**Landscaping**	No Invasive Plants			Prerequisite
			2.2		Basic Landscaping Design			2
			2.3		Limit Turf			3
			2.4		Drought Tolerant Plants			2
			3	**Shading of Hardscapes**	Locate and Plant Trees to Shade Hardscapes			1
			4.1	**Surface Water Management**	Design Permeable Site			4
			4.2		Permanent Erosion Controls / Professional Design of Erosion Control			2
			5	**Non-Toxic Pest Control**	Select Insect and Pest Control Alternatives from List			2
			6.1	**Compact Development**	Average Housing Density ≥ 7 Units / Acre		**LL1**	2
			6.1		***OR*** Average Housing Density ≥ 10 Units / Acre		**LL1**	3
			6.3		***OR*** Average Housing Density ≥ 20 Units / Acre		**LL1**	4
0				Sub-Total				
Y / Pts	No	N/A		**Water Efficiency (WE)**	(Minimum of 3 WE Points Required)		OR	**15**
			1.1	**Water Reuse**	Rainwater Harvesting System			4
			1.2		Grey Water Re-Use System			1
			2.1	**Irrigation System**	Select High Efficiency Measures from List			3
			2.2		Third Party Verification			1
			2.3		***OR*** Install Landscape Designed by Licensed or Certified Professional		**WE 2.2**	4
			3.1	**Indoor Water Use**	High Efficiency Fixtures (Toilets, Showers, and Faucets)			3
			3.2		**OR** Very High Efficiency Fixtures (Toilets, Showers, and Faucets)		**WE 3.1**	6
0				Sub-Total				

Exhibit 8: LEED for Homes Checklist, *continued*

Project Checklist (cont'd)

HERS Index Value Achieved: 85
IECC Climate Zone: 1
EA 1.2 Pts Achieved: 0.0

Y / Pts	No	N/A						
				Energy and Atmosphere (EA)	(Minimum of 0 EA Points Required)	OR	**38**
			1.1	**ENERGY STAR Home**	Meets Performance Requirements of ENERGY STAR for Homes		Prerequisite
			1.2		Exceeds Performance of ENERGY STAR for Homes	**EA 2-10**	34
			7.1	**Water Heating**	Improved Hot Water Distribution System		2
			7.2		Pipe Insulation		1
			11	**Refrigerant Management**	Minimize Ozone Depletion and Global Warming Contributions		1
0				Sub-Total (or Sub-Total from Adendum A - Prescriptive EA Credits)			
Y / Pts	No	N/A					
				Materials and Resources (MR)	(Minimum of 2 MR Points Required)		**14**
			1.1	**Material Efficient Framing**	Overall Waste Factor for Framing Order Shall be No More than 10%.		Prerequisite
			1.2		Advanced Framing Techniques		3
			1.3		***OR*** Structurally Insulated Panels	**MR 1.2**	2
			2.1	**Environmentally Preferable**	Tropical Woods, if Used, Must be FSC		Prerequisite
			2.2	**Products**	Select Environmentally Preferable Products from List		8
			3.1	**Waste Management**	Document Overall Rate of Diversion		Prerequisite
			3.2		Reduce Waste Sent to Landfill by 25% to 100%		3
0				Sub-Total			
Y / Pts	No	N/A					
				Indoor Environmental Quality (IEQ)	(Minimum of 6 IEQ Points Required)	OR	**20**
			1	**ENERGY STAR with IAP**	Meets ENERGY STAR w/ Indoor Air Package (IAP)	**IEQ2-10**	11
			2.1	**Combustion Venting**	Space Heating & DHW Equip w/ Closed/Power-Exhaust	**IEQ 1**	Prerequisite
			2.2		Install High Performance Fireplace	**IEQ 1**	2
			3	**Moisture Control**	Analyze Moisture Loads AND Install Central System (if Needed)	**IEQ 1**	1
			4.1	**Outdoor Air Ventilation**	Meets ASHRAE Std 62.2	**IEQ 1**	Prerequisite
			4.2		Dedicated Outdoor Air System (w/ Heat Recovery)	**IEQ 1**	2
			4.3		Third-Party Testing of Outdoor Air Flow Rate into Home		1
			5.1	**Local Exhaust**	Meets ASHRAE Std 62.2	**IEQ 1**	Prerequisite
			5.2		Timer / Automatic Controls for Bathroom Exhaust Fans	**IEQ 1**	1
			5.3		Third-Party Testing of Exhaust Air Flow Rate Out of Home		1
			6.1	**Supply Air Distribution**	Perform Duct Design Calculations	**IEQ 1**	Prerequisite
			6.2		Third-Party Testing of Supply Air Flow into Each Room in Home		2
			7.1	**Supply Air Filtering**	≥ 8 MERV Filters, w/ Adequate System Air Flow	**IEQ 1**	Prerequisite
			7.2		***OR*** ≥ 10 MERV Filters, w/ Adequate System Air Flow		1
			7.3		***OR*** ≥ 13 MERV Filters, w/ Adequate System Air Flow		2
			8.1	**Contaminant Control**	Seal-Off Ducts During Construction	**IEQ 1**	1
			8.2		Permanent Walk-Off Mats *OR* Shoe Storage *OR* Central Vacuum		2
			8.3		Flush Home Continuously for 1 Week with Windows Open		1
			9.1	**Radon Protection**	Install Radon Resistant Construction if Home is in EPA Zone 1	**IEQ 1**	Prerequisite
			9.2		Install Radon Resistant Construction if Home is not in EPA Zone 1	**IEQ 1**	1
			10.1	**Garage Pollutant Protection**	No Air Handling Equipment OR Return Ducts in Garage	**IEQ 1**	Prerequisite
			10.2		Tightly Seal Shared Surfaces between Garage and Home	**IEQ 1**	2
			10.3		Exhaust Fan in Garage		1
			10.4		***OR*** Detached Garage or No Garage	**IEQ 1**	3
0				Sub-Total			
Y / Pts	No	N/A					
				Awareness and Education (AE)	(Minimum of 0 AE Points Required)		**3**
			1.1	**Education for Homeowner**	Basic Occupant's Manual and Walkthrough of LEED Home		Prerequisite
			1.2	**and/or Tenants**	Comprehensive Occupant's Manual and Multiple Walkthroughs / Trainings		1
			1.3		Public Awareness of LEED Home		1
			2.1	**Education for Building Mgrs**	Basic Building Manager's Manual and Walkthrough of LEED Home		1
0				Sub-Total			
0				**Project Totals** (pre-certification estimates)	*Estimated Performance Tier:*		*130*

Exhibit 9: Green Home Guide

Retrieved November 25, 2007, from http://www.greenhomeguide.org

Exhibit 10: Costs and Benefits of Green Buildings

The Kats Study

LEED Rating	Sample size	Cost premium
Platimum	1	6.50%
Gold	6	1.82%
Silver	18	2.11%
Certified	8	0.66%
Average	--	1.84%

Source: Kats, G. (2003) The Costs and Financial Benefits of Green Buildings, *(Sacramento: California Sustainable Building Task Force). Retrieved November 25, 2007 from http://www.usgbc.org/Docs/News/News477.pdf.*

Exhibit 10: Costs and Benefits of Green Buildings, *continued*

The Reed Research Group

LEED Rating	Cost premium
Platimum	11.5%
Gold	4.5%
Silver	3.1%
Certified	0.8%

Source: Morrison Hershfield, cited in "Construction Forecast Monthly," Reed Research Group, September 2005. As References on page 17 of Turner Construction (2005) 2005 Survey of Green Building *(Sacramento, CA: Turner Green Buildings) http://www.turnerconstruction.com/greensurvey05.pdf*

Capital E Analysis

Category	20-year NPV/sf
Energy savings	$5.80
Emissions savings	$1.20
Water savings	$0.50
Operations/Maintenance savings	$8.50
Subtotal	$16.00
Average extra cost of Green Building	(-$3.00--$5.00)
Total 20-year Net Benefit	$11-$13

Source: Kats, G. (2003) Green Building Costs and Financial Benefits *(Massachusetts Technology Collaborative: Westborough, MA). http://www.cap-e.com/ewebeditpro/items/O59F3481.pdf*

Energy Performance for a Building meeting ASHRAE Standard 90.1-1999 with a High-Performance Green Building

	Base Case Building Annual Energy Cost	High-Performance Building Annual Energy Cost	Percent Reduction
Lighting	$6,100	$3,190	47.7%
Cooling	$1,800	$1,310	27.1%
Heating	$1,800	$1,280	28.9%
Other	$2,130	$1,700	20.1%
TOTAL	$11,800	$7,490	36.7%

Source: US Dept. of Energy (2003) The Business Case for Sustainable Design in Federal Facilities *(Washington DC: US. Dept. of Energy) http://www1.eere.energy.gov/femp/pdfs/bcsddoc.pdf*

Exhibit 11: Energy and Water Prices

Energy Information Administration. (2003). Residential Electricity Prices: A Consumer's Guide*. Retrieved November 25, 2007, from http://www.eia.doe.gov/neic/brochure/electricity/electricity.html*

Region	Energy $/kWh	Water $/1,000 Gal.
New England	$0.1659	$17.23 NJ
Northwest	$0.7210	$13.60 ID
California	$0.1415	$44.03 CA
Southwest/Rockies	$0.9730	$17.23 NM
New York	$0.1622	$31.61 NY
Mid-Atlantic	$0.1307	$19.07 DE
Upper Midwest	$0.8490	$11.60 MN
Alaska/Hawaii	$0.2034	$17.23 HI
South/Southeast	$0.8730	$10.46 AZ
Lower Midwest	$0.9720	$22.05 IN

Exhibit 12: LivingHomes' Profile of Steve Glenn

Retrieved August 30, 2007, from http://www.livinghomes.net/viewPerson.html?id=1

Would you like to sign in?

My Virtual Homes | Mailing List | Contact

People

Steve Glenn is an entrepreneur committed to positive social change through both for- and non-profit organizations. He is the founder and CEO of LivingHomes, LLC — a developer of modern, prefabricated homes designed by world-class architects that feature healthy/green materials and energy systems, all at a great price value. A fan of architecture and an avid Lego enthusiast from a very young age, Glenn tried his hand at design in college only to find the he lacked both the talent and temperament to be an architect. Instead, Glenn concluded that the world could use more real estate developers like Jim Rouse who focus on projects that reflect a deep appreciation for the aesthetic, environment and communities in which they're created. From Lego to prefab, LivingHomes represents the fulfillment of a life-long ambition to create a company that aspires to 'wed profit and purpose' by developing homes that make great design, functionality, and sustainable design practical and affordable.

Glenn spent most of his career in technology. Glenn founded and served as CEO for PeopleLink, a leading provider of enterprise e-community solutions to clients which included Oracle, GE, MTV, Paramount, Reuters and CBS. He is also a founding Partner of idealab!, a business incubation firm that raised over $1 billion in equity, and founded or invested in a number of successful companies including GoTo/Overture (OVER), NetZero/United Online (UNTD), CitySearch (TMCS), Tickets.com (TKTS), eToys and CarsDirect. Prior to idealab!, Glenn worked for Walt Disney Imagineering as co-director of the Virtual Reality Studio.

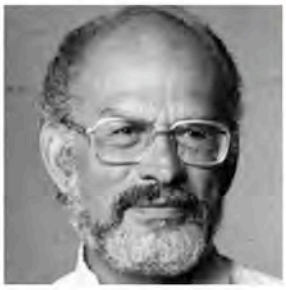
Glenn is also involved with a number of non-profits. Prior to LivingHomes, Glenn worked for nearly two years with the William Jefferson Clinton Foundation first managing the development of a $330 million program in Mozambique that will provide care and treatment to over 350,000 HIV+ individuals. He then managed the development of a childhood health initiative with the American Heart Association.

Glenn co-founded and serves on the board of the Sustainable Business Council, Kaia Parker Dance Fund, and the Hope Street Group. He is also a member of the board of directors for LA Works and the Brown University Entrepreneur Forum.

He holds a bachelor's degree with honors in Organizational Behavior from Brown University, and received a scholarship for the Career Discovery Program in Urban Planning at the Harvard Graduate School of Design. Glenn stills plays with Legos. A lot.

Exhibit 13: LivingHomes' Profile of Ray Kappe

Retrieved August 30, 2007, from http://www.livinghomes.net/rayKappe.html



Ray Kappe: Warm Modernist

Ray Kappe, FAIA, is renowned for his residential architecture which has been characterized as 'the apotheosis of the California House.' His designs evince a mastery of warm, modern spaces, clearly expressed construction systems, and environmental sensitivity . "I've always sought out the edges, the views, and a feeling of expansiveness," Kappe said.

During his first ten years of practice, he completed fifty custom post-and-beam houses. Exploring modular systems, prefabrication, passive energy and active solar systems, Kappe has completed commercial, low-cost housing, condominium, hotel and college buildings. He has also been involved in urban design and planning, as well as social and community advocacy. Responding to a question about the ten most important principles that helped make him a successful architect, planner, and educator, Kappe included the following two: "Always be willing to explore, experiment and invent. Do not accept the status quo;" and "Maintain good moral and social values."

In 1972, after three -and-a-half successful years as professor and Founding Chairman of the Department of Architecture at California Polytechnic State University, Pomona, Kappe resigned. With a group of faculty members and students, he started the Southern California Institute of Architecture (SCI-Arc). The SCI-Arc model of education encourages learning through creative discourse and supports diversity of opinion within the framework of a common vision. Today the school is 34 years old, with 3,000 graduates working and teaching all over the world. It is considered one of the top architecture schools in the country.

Kappe has received many awards including the Richard Neutra International Medal for Design Excellence, the California Council/AIA Bernard Maybeck Award for Design, and the Topaz Medal, the highest award in architectural education . His own residence was designated a Cultural Heritage Monument by the City of Los Angeles in 1996. Stephen Kanner, President of the A + D (Architecture + Design) Museum in Los Angeles wrote, "Ray's own home may be the greatest house in all of Southern California."

Ray continues to design from his strengths, even as his work incorporates new technology. "I'm no different in my mind than when I first started," he says. "I'm doing the kinds of things now I would have done 50 years ago. I feel like a 25-year-old."

Related

- Ray Kappe LivingHomes
- Custom LivingHomes
- Past Work
- SCI-Arc
- Bio
- Book (Themes and Variations: Ray Kappe)
- Recent Exhibit

Exhibit 14: Example LivingHomes Configuration

Retrieved August 30, 2007, from http://www.livinghomes.net/configure.html?model=rk1&step=0

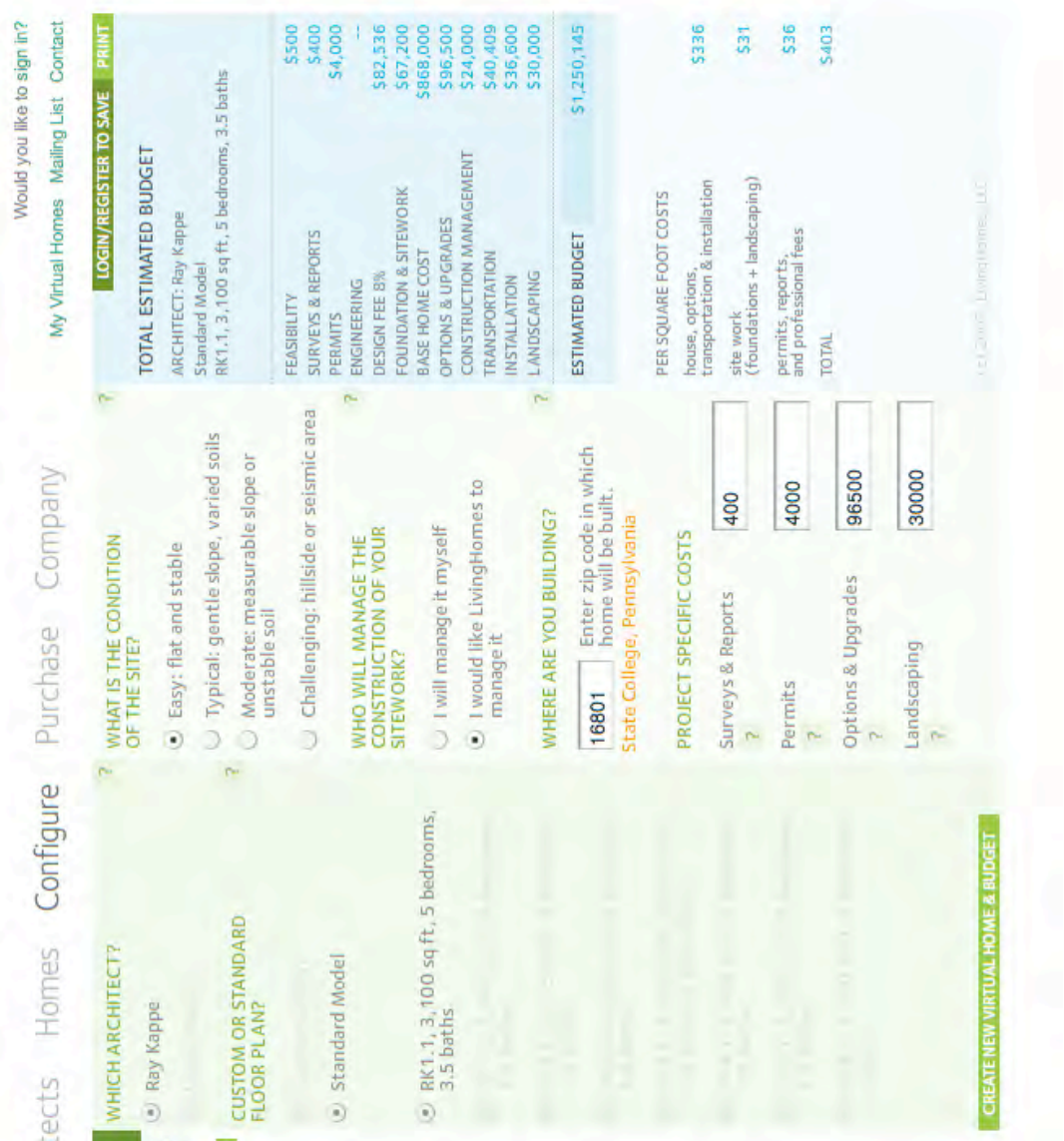


Exhibit 15: LivingHomes' Team Profile

Retrieved August 30, 2007, from http://www.livinghomes.net/persons.html

Amy Sims
Sous Chef
Architects I Like
Sverre Fehn, Renzo Piano , Rick Joy, Will Bruder, Bruno Mathsson
Buildings I Like
Norwegian Pavilion at the Venice Bienalle, Casa Malcontenta
Books That Inspire(d) Me
The Kite Runner, Francesco Clemente Watercolors, Biomimicry
Music I'm Listening To
The Be Good Tanyas, Shelby Lyn, Lilly Allen
Ways I Reduce My Ecological Footprint
Drive a Prius, capture and rescue my dishwater, recycle, renovated my 1922 house to include insulation, compost
Favorite Links
www.kcrw.org

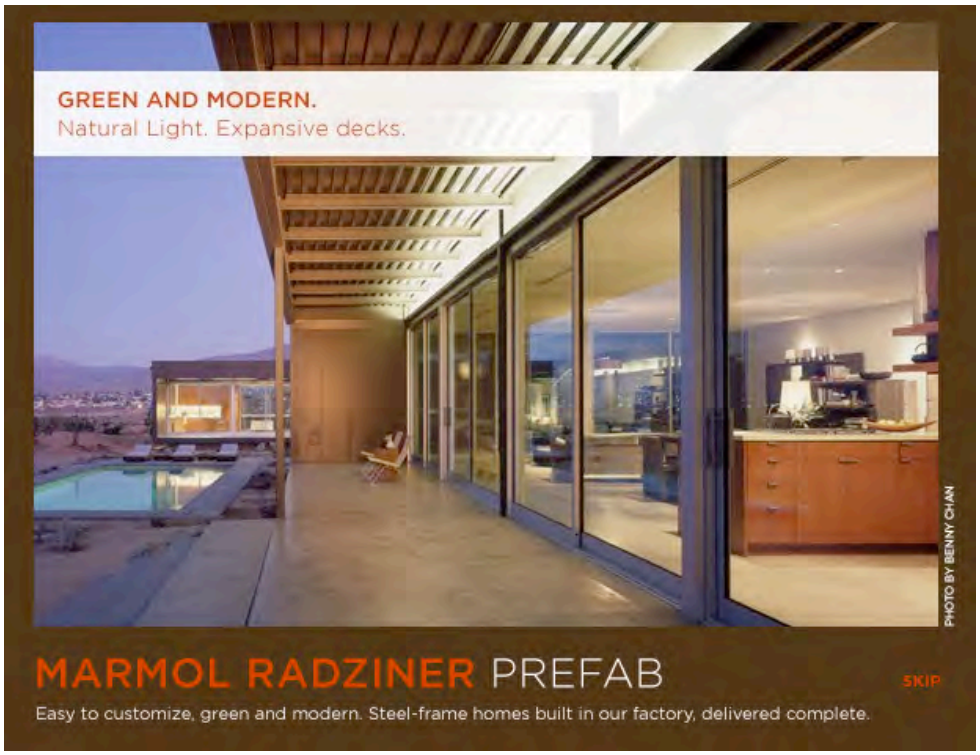
Erich Volkert
Voice of Future LivingHomes Customers
Architects I Like
Eero Saarinen, Shigeru Ban, Charles Eames
Buildings I Like
Haga Sofia, the Glass House, old factories (open trusses/exposed brick), and bridges
Books That Inspire(d) Me
Cradle to Cradle, The Tipping Point, Crossing the Chasm, The Age of Spiritual Machines
Music I'm Listening To
80's, Massive Attack, Gotan Project, Chicane, and Radiohead
Ways I Reduce My Ecological Footprint
All my light bulbs are fluorescent, ride my bicycle to work, recycle, practice vermiculture
Favorite Links
www.gokgs.com/, www.howstuffworks.com/, www.popsci.com/popsci/

Karen Bragg
Project Architect
Architects I Like
Murcutt, Piano, Sinan
Buildings I Like
La Tourette, Chapman Studios
Books That Inspire(d) Me
The Little Engine That Could
Music I'm Listening To
Tyson and Rita's music
Ways I Reduce My Ecological Footprint
Rapid 720
Favorite Links
http://earthquake.usgs.gov/eqcenter/recenteqsus/,
http://www.loslobos.org/site/player/index.html?album=watch ,
http://www.howstuffworks.com/

Rita Sampat
Junior Architect
Architects I Like
Samuel Mockbee, Alvar Aalto, William McDonough, oh and Amy, Karen and Finn.
Buildings I Like
Ehrlich House by JFAK.
Books That Inspire(d) Me
TCradle to Cradle, Sun Wind & Light, The Art of Innovation, Tipping Point
Music I'm Listening To
Girl Talk, Gotan Project, BADA, Al Green, Tiga
Ways I Reduce My Ecological Footprint
recycling, composting, offsetting my emissions and hopefully riding my bike soon
Favorite Links
google, craigslist, and slickdeals

Evan Ryan
"project manager is fine"
Architects I Like
Buckminster Fuller, Frank Gehry, William McDonough, Charles Eames
Buildings I Like
Casa Mila Barcelona, Fallingwater
Books That Inspire(d) Me
Natural Capitalism, The Power of One, Tao of Pooh
Music I'm Listening To
The Deadly Syndrome, Arcade Fire, Wolfmother, Bob Dylan, JJ Cale
Ways I Reduce My Ecological Footprint
bike to work, recycle, buy local meats and produce, unplug appliances before leaving house
Favorite Links
www.goodmagazine.com , www.surfline.com , www.worldchanging.com , www.101greatgoals.com

Exhibit 16: Marmol Radziner
Retrieved October 1, 2007, from http://www.marmolradzinerprefab.com/



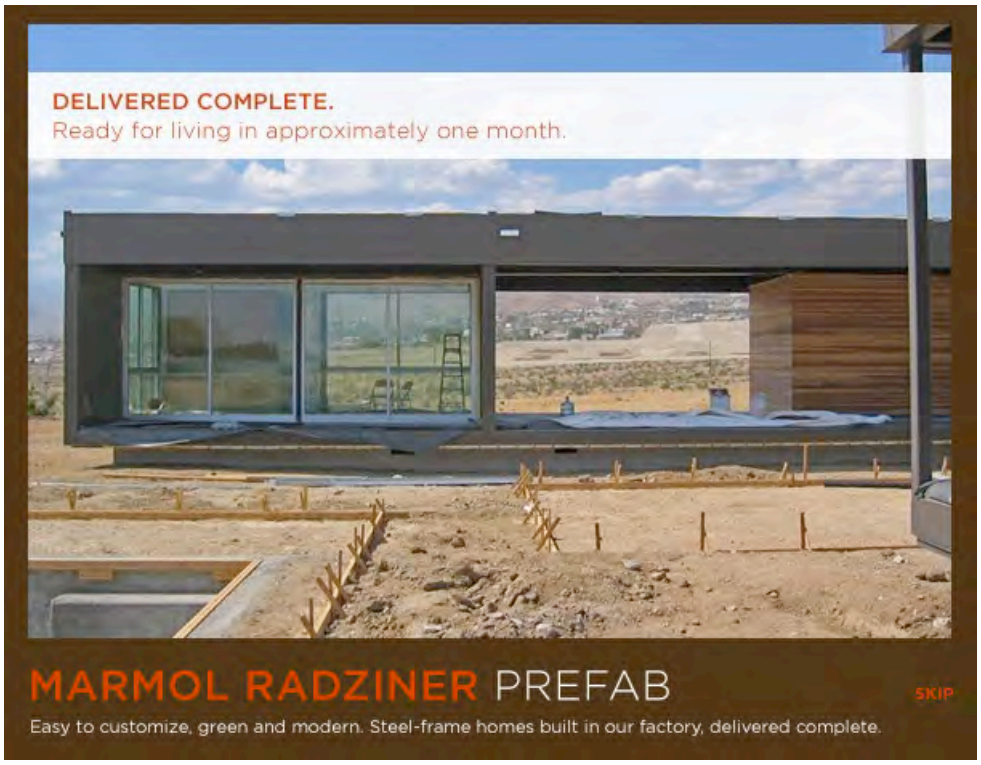


Exhibit 17: Michelle Kaufmann Designs

Retrieved October 1, 2007, from http://www.mkd-arc.com/homes/glidehouse/