Credit: Brian Libby

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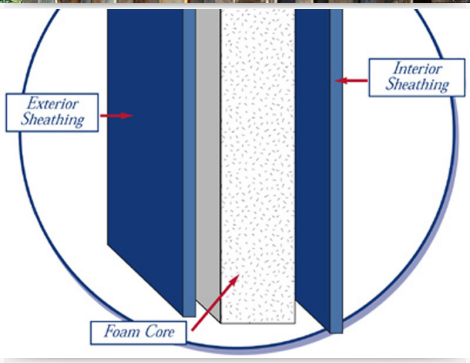

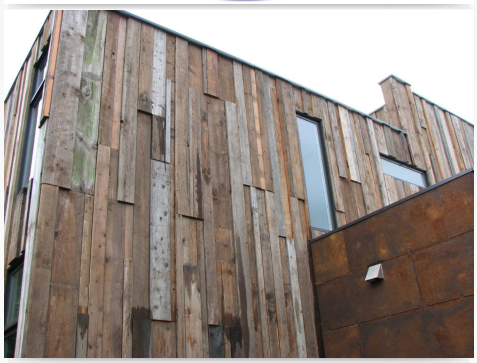

Structural Insulated Panel Demonstration Home

Structural Insulated Panels (SIPs) are an energy and material efficient building product that has been used in homes across the nation for many decades. However, in Portland, these "sandwiches" of insulation and oriented strand board are still uncommon. Energy specialist and owner, David Cohan, used GIF funds to design a 1,800 square foot home in inner northeast that demonstrates the energy and material savings of SIP technology.

Project Highlights

- **SIP ceilings, walls, and floors**
- **Low energy lighting**
- **Solar water heating system**
- **On-site stormwater management**

Portfolio Contents

Final Report

Video Interview with Seed Architects in the Home (External link)

PROPOSAL FOR FUNDING FROM CITY OF PORTLAND GREEN INVESTMENT FUND
>>Structural Insulated Panel Demonstration Home<<

Applicant Information

Name: David Cohan	E-mail address: davidfcohan@hotmail.com
Organization: Owner/builder	Phone: 503-977-2342(h); 503-827-8416 x231(w)
Address: 11930 SW 29th Ave. Portland, OR 97219	Requested GIF amount: $17,000 for design phase; up to $17,000 for construction phase.

Project Information

Current project stage: Conceptual	Project size (est): Total=1800 sf; Footprint=900 sf; Site=5500 sf
Site location: Lot 5 Aser Lane Subdivision, 45th Ave between Ainsworth and Holman.	Project cost: Land cost $125,000; Design plus construction costs rough estimate $275,000.
Building type: Residential	Timeline and projected completion: Begin design work April 2007

Description and Core/Non-Core Goals (30 points)

The main goal of this project is to demonstrate that an extremely energy-efficient, single family home can be designed and constructed with structural insulated panels (SIPs) for approximately the same cost as, and in less time than, an equivalent stick-built house. By funding this project, G-Rated can help lead a transition away from inherently wasteful construction materials and methods that have not changed significantly for decades.

This project builds directly on research directed by team member G.Z. Brown at the Energy Studies in Buildings Laboratory (ESBL) at the University of Oregon and funded by the U.S. Department of Energy. From 1989 to 1999, ESBL successfully completed over $10,000,000 worth of research on the application of SIPs to energy-efficient low-income housing with a focus on cost reduction. A 1000 sf low-income demonstration home was built and 12 variants of the plan were created so that it could be constructed in any orientation.

ESBL's critical contribution was to re-visualize the entire design and construction process to take maximum advantage of SIPs' modular characteristics and their potential for labor savings. ESBL developed and tested design concepts and construction methods and even custom designed panels to improve the efficiency of construction. Prior to this work (and continuing today), SIPs homes were based on designs that were developed for stick-built framing. These designs are not optimized for the modular, structural and thermal characteristics of SIPs panels. The result has been unnecessarily large amounts of wasted material and a deserved reputation for high construction costs.

Unfortunately, the knowledge gained through ESBL's research has seen little application. The two main reasons for this are:

(1) ESBL's focus on low-income housing (as required by the funder, US DOE). While socially important, low-income represents a tiny fraction of the residential new construction market. Therefore even architects and builders who were aware of the research did not see a direct connection to their own work on non-low-income homes.

(2) The risk -- perceived or real -- and the need for training associated with any large change in practice. Since low-income homes have the lowest profit margin in the housing industry, low-income builders' risk tolerance and willingness to allot time to learning that does not have immediate results are extremely low. In general, homebuilders are (justifiably) risk averse because the financial implications of losing money on even one home are so significant.

This project will leverage what was learned by ESBL to design an approximately 1800 sf non-low-income home which uses SIPs panels for floors, walls and ceilings. Also incorporated into the design will be many other energy, water and sustainability features described below.

If the design can be built and sold at or above cost we are committed to building it and we have the financial resources already in place. However, we want to be extremely clear that we are not guaranteeing that the designed house will be built because we are not far enough along in the design phase to secure firm cost bids. As described below, part of the project involves a manufacturing innovation so costs cannot even be estimated reasonably at this time. At the same time, we would not be embarking on this project if we did not think it was feasible and we strongly believe the large potential benefits justify design-phase GIF funding.

Core Goal: Energy use reduction, efficiency and renewable energy

SIPs are an inherently energy efficient product. Thermal bridging through framing members is extremely reduced, yielding a higher overall r-value. More important, the nominal r-value of SIPs is consistently achieved whereas the nominal r-value of fiberglass batts is rarely achieved. Batts' effective r-value is reduced, often by 30% or more, whenever there are gaps or compression during installation. While an extremely conscientious builder can produce a stick-built wall with batts that has performance equal to SIPs, the reality is that most builders cannot afford to be that painstaking in their work and society does not get the benefit it assumes comes from the energy code.

The other major energy benefit of SIPs is that they can more easily achieve low infiltration rates because there are fewer pieces and air cannot flow through the insulation layer. As long as the joints between panels are well sealed the house will be very tight. Controlled testing at Oak Ridge National Laboratory found infiltration reduced by over 90% relative to stick framing[1]. (The same testing showed a 10% reduction in heat loss for a 4.5% SIPs vs a 6.5" stick frame wall!)

Other energy efficiency measures included in this project address some of the largest areas not covered by the Oregon energy code, areas which, in aggregate, now use significantly more energy than those covered by code. These include:

Lighting. A whole-house lighting design will feature all high-efficiency lamps and will greatly reduce or eliminate recessed can lighting on exterior surfaces which has extremely negative energy impacts. Savings in excess of 1000 kWh per year can be achieved without problem.

Plug Loads. This is the fastest growing residential end-use, now estimated to consume 15% of all residential energy[2], and it is not regulated by code. Standard circuiting and receptacles exacerbate the problem because there is no easy way to completely turn off the dozen or more consumer appliances found in a typical home. Our project will research new circuiting patterns and install built-in controls that facilitate turning off consumer electronics and other plug loads in such a way that it will be easy and attractive to average homeowners. We will also eliminate unnecessary minor loads such as GFCI receptacles and light switches with

[1] http://www.r-control.com/downloads/literature/performance_update.pdf. The original ORNL results are also available.

[2] Home Energy Magazine, Jan/Feb 2007. The same article noted, "In order to reach zero energy, a new home will require at least $20,000 worth of PV capacity just to offset the consumption of miscellaneous devices!"

LEDs. To wire the house we will be using an exterior perimeter chase system that was developed by ESBL. This system eliminates running wires through the panels, negating one of the major complaints against SIPs from electricians and builders.

Zonable Heating System. In our extremely tight, highly-insulated house a zonable heating system will virtually eliminate energy use outside of the sleeping areas during the cold night hours when the most heat is normally required. The specific heating system will be selected based on simulation modeling results. If a ducted system is used, both the ducts and the air handler will be inside the thermal envelope.

Orientation and Windows. The design and orientation of the house and the placement of the windows will maximize solar gain in winter to offset heating loads. Strategic overhangs and a low SHGC on west-facing windows will maintain comfortable temperatures without air conditioning in summer. Windows will have a maximum u-value of .30; preliminary research shows that u-.25 windows are now available from a major manufacturer and may be cost-effective in our application.

Appliances. All built-in appliances will be ENERGYSTAR® rated. We will also investigate dedicated outside venting of refrigerator hot air exhaust during cooling season and the design of an insulated refrigerator housing with exterior vents to use the cold outside air to minimize compressor run times in winter.

Renewable Energy Systems. While we strongly believe in the proper application of renewables, our focus in this project is on efficiency because both economically and societally it is far more beneficial to reduce energy use than to meet it through renewable (or fossil fuel!) systems. Our project house will be plumbed and wired for both solar thermal and PV. The decision to install either or both of these systems as part of this project will be based on a review of both energy simulation results and economic analysis including all incentives available at the time of construction. Note that an important intent of this project is to show that the house can be sold on the open market at a price that will make it of interest to other builders. Renewables will definitely be available as an option to the buyer but it could potentially defeat the purpose of our project to install them without considering whether the higher cost would impact the pool of potential buyers.

Moisture and Ventilation. While moisture issues are inherently less problematic with SIPs panels, the combination of using a construction material with little history in the Willamette Valley climate and building an extremely tight house means moisture control and ventilation requirements need to be considered in detail and explicitly incorporated into the design. Ventilation will include a heat recovery system. Care will be taken to isolate dedicated kitchen, bath and laundry fans from general house ventilation.

Energy Simulation Models. Several models will be used to optimize all components of the design. More than one is needed because no single model is best for investigating areas as diverse as foundation heat loss, infiltration, multi-zone heat flows, solar gains and internal loads. Energy Gauge and Energy Scheming will definitely be used. SUNDAY, Energy Quest or others will be used as appropriate. All load calculations will be based on hourly annual models using Portland area TMY weather data.

Core Goal: Materials recycling, salvage, use reduction, reuse and content

Relative to standard framing, SIPs produce much less construction waste because they are built in factories where production processes can be fine-tuned. Because engineered wood products use wood more efficiently than sawn lumber, it requires less forest acreage to build a SIP home than a conventional wood-framed house. The OSB used in SIP skins is made from small diameter trees that can be sustainably harvested. Also, as noted above, one of the main objectives of our project is to create a design based on SIPs' modular characteristics. We

anticipate very, very little waste. Figure 1 on page 7 from the ESBL demonstration home gives one example of how proper design of a SIP home maximizes material use, thus minimizing waste. We will also be employing an innovative on-grade foundation system that uses little or no concrete. This system was successfully demonstrated by ESBL and was shown to be less expensive than other common foundation systems.

A potentially enormous reduction in material use that is a focus of this project is to substitute exterior siding for the outer structural layer of OSB during the manufacture of the panels, eliminating an entire layer of sheathing. ESBL experimented with this approach with encouraging results and we will be working intensively with SIPs manufacturers to try to implement it during this project.

We will make a serious effort to recycle all construction materials, with the understanding that there are major institutional barriers to completely achieving this core goal. The project update for Dolph Creek Townhomes, a 2006 GIF grant recipient, makes it clear that construction recycling in Portland is still problematic. Re-used materials will include, at a minimum, interior walls framed with salvaged wood from the ReBuilding Center. In general, though, our philosophy is that the most effective way to achieve this goal is to use smart design to reduce material use and waste before it occurs.

Core Goal: Water use reduction and efficiency

Water use will be reduced by installation of the already-mentioned ENERGYSTAR® appliances as well as low-flow showerheads and low-flush toilets. A complete landscaping plan featuring native plants and minimal lawn area will be created and made available free to the homebuyer. We will provide a minimum 1000 gallon rainwater storage cistern that will take run-off from the house roof which, if combined with a drip irrigation system, should eliminate the need for potable water for outdoor use. (Assuming the lawn is not watered.) Note again, however, that the house is to be sold on the open market, therefore we cannot guarantee that the potential water reductions inherent in the design will be achieved.

Core Goal: Stormwater management

Our intent is to apply a modified version of the rainwater harvesting system that was used in the Kerby Street homes which won a 2005 GIF grant[3]. The final report makes it clear that the system was successful. Given that, it seems more valuable to build on the lessons learned from a functioning system than to experiment with an untested system. This is particularly true given the report's comment that, "The most challenging aspect of installing the rainharvest system is that the system relies on the coordination of numerous trades and the installation takes place over the course of the entire project." As we assume many of the individuals that were involved are still available here in Portland, we will meet with them in person so that their knowledge can be transferred directly to our project. We also assume that applying the system to a single family home would reduce both the magnitude and the complexity of the challenges that were encountered.

Non-core goals

Elimination/reduction of toxic materials – We will be using expanded polystyrene foam SIPs that are produced without CFCs/HCFCs and with water-based glues.

Indoor environmental quality – Our SIPs will use non-formaldehyde-based glue on the interior. Low VOC paints will be used throughout and all cabinetry will be made from formaldehyde-free materials.

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[3] The system is described in detail in http://www.portlandonline.com/shared/cfm/image.cfm?id=119785.

Innovation and Impact Potential (25 points)

Nationally, SIPs are neither new nor extremely uncommon. They were originally produced in the 1960s and many thousands of homes have been built with them since. In Portland, however, they are quite rare. The Oregon salesman for Premier Building systems, the largest SIPs manufacturer in North America, says that they sell approximately ten homes a year in Portland and none of these use panels for the entire building envelope. If SIPs construction was to become common practice the impacts would be very, very large, resulting largely from: (1) higher achieved r-values (2) lower infiltration rates and (3) waste reduction. These impacts will not be realized, however, until homebuilders see that SIPs homes can be built for a cost comparable to a stick-built home and then sold with the same profit margin. A market benefit of SIPs relative to some newer technologies is that once builders accept them as a viable alternative the impacts can start accruing immediately because this is a fully commercialized industry.

In comparing impacts from this project to other proposed projects, a critical consideration should be that the impacts will be inherent in a SIPs house that follows our design. Builders will not need to be master craftsmen or environmental zealots to achieve them. After 25 years of regional training, starting with Good Cents in the 1980s, standard insulation batts are still not installed well enough to achieve their rated r-value in the vast majority of homes. Ducts still leak excessively and are not even covered in code. It's time to transform the market to an approach where we actually achieve the benefits we are seeking!

Process and Adequacy of Resources

We are requesting GIF funding in two stages. The task for which initial funding is being requested is to create the SIPs-based house design. The house is envisioned as a simple rectangle with two stories and a gable roof. The grant is needed to translate this basic design into an economically viable SIPs design using the knowledge gained in the ESBL research. Basic examples include determining exact dimensions that minimize panel waste and structural modifications to take advantage of SIPs load-bearing characteristics. Energy modeling will be done throughout the design process to explore means of minimizing heating and cooling, optimizing daylighting and window placement, and determining the impacts and benefits of solar thermal and solar electric systems. This project is very design intensive because a smart design is the only way to ensure that construction costs are kept as low as possible.

As the design progresses, we will be working with one or more SIPs manufacturers to ensure that our non-standard specifications can be met. We will also be working from the very beginning to design a panel that replaces the outer OSB with siding. G.Z. Brown has contacts with many SIPs manufacturer from his research at ESBL.

At the end of the design phase, blueprints and energy simulation models will be available upon request. Furthermore, team members have a long history of presenting in high visibility public forums so project results, both successes and failures, will be widely disseminated. The initial funding requested for the design phase is:

Tasks	GIF Funding Requested
Architectural design for SIPs	$10,000
Energy modeling	$2,400
Lighting Design	$1,500
Wiring design/controls research	$1,900
Moisture/IAQ analysis	$1,200
Total Requested Funding	**$17,000**

Note that hours for design support from ESBL hours are not included in the above. These will be paid for separately or provided pro bono.

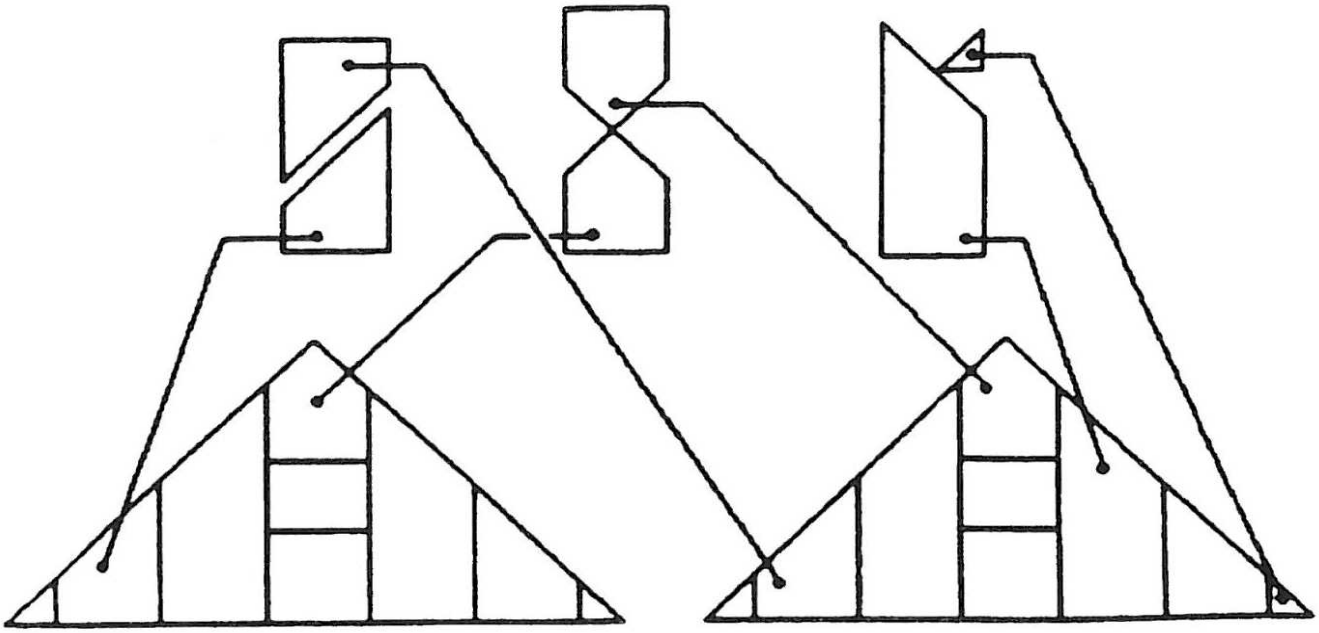
If the design is deemed economically feasible, funding will be requested for the construction phase. This can begin immediately as our site is wholly owned and a $200,000 line of credit has already been secured; we also have a verbal commitment from the same bank that the line can be increased upon request. Construction phase funding would cover training for building crews and subcontractors and part of the hard costs for the various measures described in the proposal. The construction phase funding request will be no more than the design phase request. We prefer not to set a fixed number at this time given the lack of information available.

Team Qualifications

Our project team has all of the expertise needed to bring this project to fruition. We have many years of combined experience in building design, energy efficiency and sustainability. Nathan Good and G.Z. Brown have received national awards.

Name, Organization	Project Role	Biography
David Cohan	Team Coordinator, Owner	David has worked in energy efficiency for 16 years, the past seven as an evaluator and project/contract manager at the Northwest Energy Efficiency Alliance.
Nathan Good, Nathan Good Architect	Architect	Nathan is one of the Northwest's premier green architects. Among recent honors in 2006 he won both the "Excellence in Design " Award from Environmental Design + Construction and the "Western Home Award" from Sunset magazine. See www.nathangoodarchitect.com.
G.Z. Brown, University of Oregon	SIPs Expert, U of O. Professor of Architecture	G.Z. is the founder of ESBL and was director of the SIPs work there. He is the recipient of the 2005 USGBC Leadership Award and the author of Sun, Wind and Light.
David Baylon, Ecotope	Energy Modeler	David is a founder of Ecotope which developed the Wattsun and SUNDAY software programs. Ecotope's modeling work forms the basis of much of the region's residential energy planning for the past two decades. See www.ecotope.com.

Figure 1
Example of incorporating SIPs modular characteristics into the building design to minimize waste. Panel cut-offs at the gable ends are re-used at the opposite end of the building.



Pre-Development Activity Report
For City of Portland Green Investment Fund:
Structural Insulated Panel Demonstration Home

Contact
David Cohan
davidfcohan@hotmail.com
Phone: 503-977-2342(h); 503-827-8416 x231(w)

Project Information

Single family home built from structural insulated panels located on Lot 5, Acer Lane Subdivision (45th Ave. between Ainsworth and Holman).
Lot size 5500 sf; house size 2089 sf; footprint 1300 sf.

Summary

The project received a GIF grant to design an energy efficient single-family home from structural insulated panels (SIPS). The SIPs demonstration house received a building permit from the City of Portland in early June 2008 and construction is expected to start in late June or early July. The majority of the goals in the GIF proposal were achieved, the main one being the use of structural insulated panels for exterior ceilings, walls and floors in a design which will maximize energy efficiency. Two major difficulties encountered were getting initial approval to use SIPs from the City of Portland Bureau of Development Services and the deteriorating housing market which required the project team to be re-constituted and the economic goals to be re-assessed.

Design description

The 2089 sf SIPs house has a modern-style design with an open floor plan, three full bedrooms, a flexible fourth bedroom or office space and 2.5 baths. A 360° "fly-by" of the exterior can be viewed at www.seed-architecture.com/sips/. Prominent architectural features include a 22' ceiling in the kitchen with operable clerestory windows, a covered side patio and a roof deck.

Energy use reduction, efficiency and renewable energy

As noted in the original GIF proposal, SIPs are an inherently energy efficient product because they lend themselves to reduced thermal bridging and low infiltration rates. Panel-to-panel joints reduce the framing materials needed because they are made with insulated SIPs splines rather than lumber. Overall, the framing fraction for walls appears to be less than 5% in the current design[1] compared to typical values of 23% found by Oak Ridge National Laboratory for a standard home using standard 16" OC studs and 16% for a home constructed with advanced framing techniques and 24" OC studs.

Two innovations helped to achieve this low framing fraction which is considerably below even standard SIPs construction. First was the use of a "floating" SIPs floor placed on top of a concrete slab. The panels therefore cover the entire sill plate, eliminating a major source of thermal bridging. Second was to explore leaving a substantial amount of the foam in the SIPs panels in place around window openings. The standard method is to remove all of the foam to a depth of 1½" and then use lumber to bridge completely from one side of the panel to the other to provide structural rigidity and a nailing surface for window installation. Our concept is

[1] The final percentage will be calculated when shop drawings which detail panel placement are completed.

to remove a 1½" wide by 1½" deep groove of foam around each side of the 2x8 panels, leaving several inches of foam in the center. The groove will then be filled with 2x2 framing material, minimizing heat transfer through the panel. The structural engineer has already approved this approach and we will apply it on at least some window openings. The barrier to applying it in all windows is cost as the method is very labor intensive.

All permanently installed lighting in the house is fluorescent or LED with the exception of three low-voltage incandescent luminaires. Additionally, no recessed lighting was used on any surface which was part of the thermal envelope, eliminating a major source of air infiltration in many homes.

The space heating system will be a mini-split ductless heat pump, an extremely efficient product which has only been used in a handful of homes in the Northwest. The units have an HSPF (efficiency rating) of 10, an approximately 25% improvement in performance relative to standard heat pumps. The heating system will be coupled with a heat recovery ventilation system which will provide uniform distribution of air throughout the house while capturing over 80% of the heat in the air that would normally leak to the outside.

While the heat pump can provide cooling as well as heating there should be very little need for it. A large tree to the west of the house blocks a portion of the afternoon heat and the clerestory windows in the 22' high kitchen, when opened, will provide cooling as hot air (assisted by a ceiling fan) will rise and move out of the house, creating a cooling flow of air from the bottom floor.

A thermal solar system will provide approximately half of the annual hot water needed and the house will be wired for solar electric (PV) panels though none will be installed during construction. The buyer will have the option of installing them after purchase.

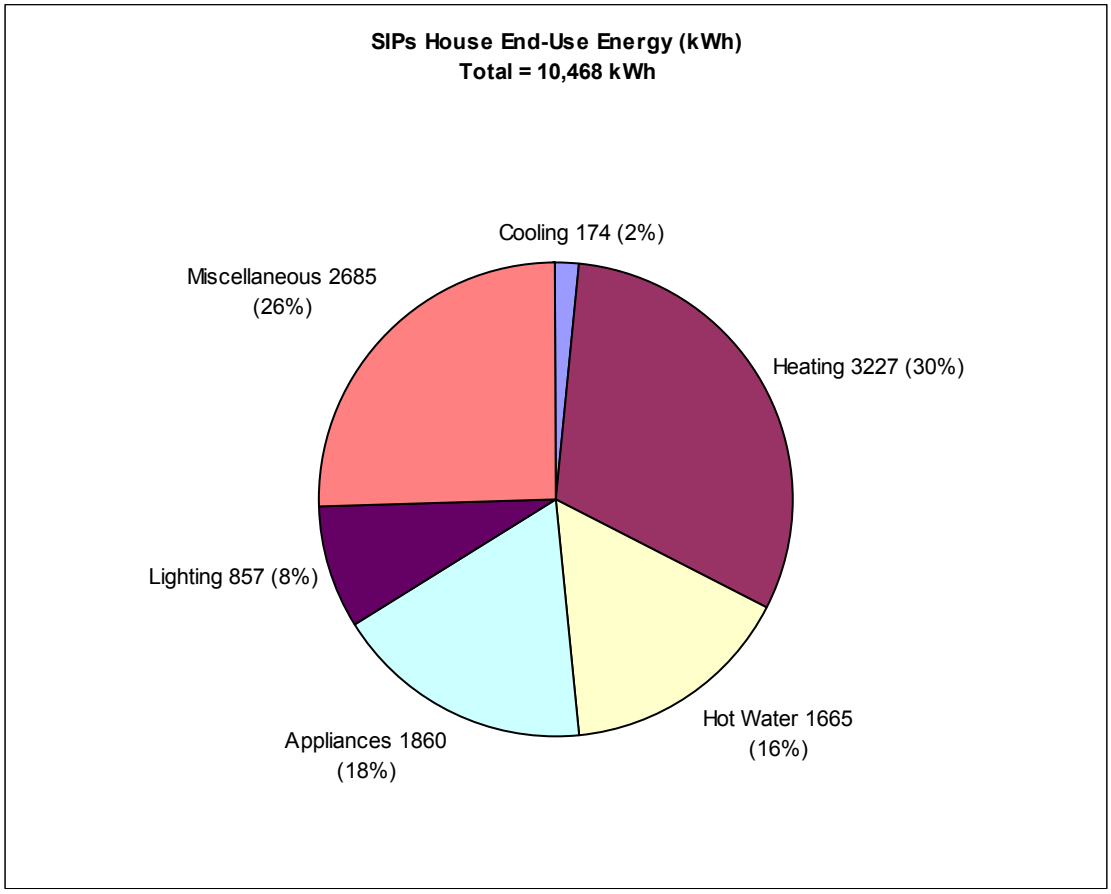
Two energy simulation models, REMRate and EnergyGauge, were run to estimate overall energy use. REMRate produced a HERS (Home Energy Rating System) score of 60 on a scale of 100 to zero where 100 is a standard code home and zero is a zero net energy home. This compares extremely well to Northwest EnergyStar Homes which score approximately 75 and the Oregon Department of Energy High Performance Home which scores approximately a 65.

EnergyGauge estimated overall consumption of 10,468 kWh per year for the as-designed SIPs house, a reduction of 41% relative to the same model's estimate of 17,736 kWh for the same house built to the new (2008) Oregon energy code. This is shown by end use in the table below. For just cooling, heating and lighting, the only end-uses that are actually covered by the energy code, the reduction is 55% -- from 9358 kWh down to 4258 kWh. One important result shown in the table is that in the as-designed SIPs house, the 'Miscellaneous' category (mainly plug loads) now represents over 25% of the total energy use, almost as much as space heating. This has important implications for planning future energy efficiency programs as homes become more and more efficient. The as-designed results are shown graphically in the pie chart below the table.

Estimated Energy Use
Based on Energy Gauge Simulation Model

End-Use	As Designed kWh	Built to Code kWh	Savings
Cooling	174	164	-6%
Heating	3,227	7,695	58%
Hot Water	1,665	3,478	52%
Appliances*	1,860	2,188	15%
Lighting	857	1,526	44%
Miscellaneous	2,685	2,685	0%
Total (kWh)	**10,468**	**17,736**	**41%**

*Assumed to use 85% of code house.



Materials recycling, salvage, use reduction, reuse and content

The project was developed on an eight-foot grid – equal to the width of standard SIPs which are manufactured in 8' x 24' sheets and sold in standard sizes at 2' increments (i.e. 2x8, 4x8, 6x8, etc.). The intent of using the grid was to reduce material use by maximizing the use of standard-sized panels. In practice this approach did not work well because our team, having never worked with SIPs, lacked the understanding to translate expert advice to optimal design. In retrospect, the problem was that, while the wall lengths were indeed on 8' increments, the window and door widths were not (and often could not be) in 2' increments. To give a simplified example, imagine an 8' wall section that includes a 2'3"-wide window. No matter where the window is placed, it is impossible to use two standard-sized panels to complete the wall. If, however, the wall was expanded to 8'3" then any of a number of combinations of standard-sized panels could be used. The material cost for making the wall 8' rather than 8'3"

is that (for example) a 3'9" panel will be needed instead of a 4' panel. The extra 3" are cut off and wasted. The estimated impact in terms of increased material use will be in the range of 5-10%.

We now know that the correct approach is to lay out a very basic floor plan, then determine window and door sizes and placement and then revise the wall lengths so that standard panel sizes can be used. Note that while this may seem obvious in hindsight (and at a superficial level it was understood even when we started) the interplay of the overall house footprint, desired room sizes, and panel sizes would make it extremely challenging for anyone to optimize all three.

In terms of other materials, we are exploring reducing the amount of drywall used by specifying ¼" thickness on all exterior walls. (There is no need to use anything thicker because it doesn't need to provide a rigid service as in a stick-framed wall – the SIPs already do that – it's merely a smooth surface for applying paint. We were disappointed to find that no contractor wanted to use it, in part because it is "fussier" to work with and in part because ¼" corner and trim beads are not available. And while the material would cost $200-500 less, the overall price would probably be slightly higher because of extra labor. We will continue to work with whoever we hire to convince them to use the ¼" material but at this point it is not known if it will happen. We also briefly explored the alternative of plastering directly on the SIPs, thereby completely eliminating drywall on exterior walls, but the cost of was too high.

As mentioned in the proposal, we also looked into substituting exterior siding for the outer structural layer of OSB during the manufacture of the panels which would have eliminated an entire layer of sheathing. For a single demonstration project this turned out to be unfeasible but it may have potential for a multi-building project large enough to justify a special order product. Whether it should be pursued in any case is an open question, however. During our investigation, various people pointed out the negative implications of combining structural materials and external finishes. If the exterior siding failed for any reason the structural integrity of the house might be compromised.

Re-used materials will include, at a minimum, interior walls framed with salvaged wood. We are also looking into salvaged flooring for the living areas and salvaged tile for bathrooms. We have not completed final materials specifications.

We will be tracking total waste during construction and still expect it to be very low relative to standard construction. The SIPs themselves are inherently resource efficient because they use small diameter trees for the OSB and are built in factories where production processes can be fine-tuned.

We will also be setting up systems to recycle as high a percentage of construction materials as possible during construction. In general, though, we retain our original belief that the most effective way to reduce material use and waste is to eliminate it before it occurs through proper design and specification.

Water use reduction and efficiency

Water use will be reduced by installation of ENERGYSTAR® appliances as well as low-flow showerheads and low-flush toilets. A complete landscaping plan featuring native plants and minimal lawn area has been developed. We will be planting the trees specified in the plan and providing the plan free to the homebuyer. We will also be getting a bid to pre-plumb (though not connect) a grey-water system.

Stormwater management

The landscape plan includes both a drywell and a rain garden that will contain all stormwater on site. We are still exploring rainwater storage for use in laundry and toilets but an

initial bid we received for $10,000 makes it unlikely that it will be included, particularly since it was estimated to reduce domestic water use by only 20%.

Challenges

The downturn in the housing market and associated increase in risk necessitated a major shift in financing arrangements which led directly to a change in the originally proposed project team. The original plan was for the owner to provide the entire investment using standard contracts to pay for the architectural design work and construction. As the market slowed toward the end of 2007, this was deemed too risky and the project was in danger of being delayed or cancelled. At this point, Kaya Construction, the builder, offered to share the risk by creating a partnership that also included an architecture firm, Seed Architecture, which had ties to Kaya. Both Kaya and Seed are providing services at well below cost until the sale of the house. Depending on the final sales price they will recoup some or all of their money.

A second major challenge was getting permission from the City of Portland to build with SIPs. Although the brand of SIPs being used in this project has approved results from the laboratory that provides testing for the International Building Code, the product has not yet been placed on the pre-approved list of materials for seismic zone D in which Portland is located.

A series of meetings with the head of structural engineering at the Bureau of Development Services led to an agreement to increase the load requirements in the structural calculations by 75% over the test results to ensure an adequate margin of safety. Our structural engineer pointed out that these loadings are only slightly lower than those required for a commercial parking structure. More important, SIPs homes have been approved in scores of jurisdictions in seismic zone D. Building officials in five of these jurisdictions, including the City of Seattle and the City of Oakland, California, were interviewed and expressed disbelief that a building official would require any additional safety margin for SIPs, and, even more, that he would not accept the submission of a state-licensed engineer using approved test results. This GIF project is the first SIPs home ever approved by the City of Portland.