DEPARTMENT OF COMMUNITY DEVELOPMENT SERVICES

Grants Management Division

m e m o r a n d u m

TO: Mayor Laurel Lunt Prussing

FROM: Elizabeth H. Tyler, FAICP, Director

DATE: April 2, 2009

SUBJECT: Kerr Avenue Project Status Update

Introduction and Background

The purpose of this memorandum is to inform City Council of the status of the Kerr Avenue Project so that Council may provide direction to staff for further action. The Kerr Avenue Project is a response to various goals and strategies from City Council, the 2005-2009 Consolidated Plan, and the 2005 Comprehensive Plan. In the Fall of 2005, the Urbana City Council adopted a common goal to "develop a nationally recognized, model neighborhood that is affordable and uses a fraction of standard energy consumption". The 2005-2009 Consolidated Plan contains goals, strategies, and activities to "provide decent affordable housing opportunities to low- and moderate-income households" (Goal 2) by "increasing the supply of affordable housing" (Strategy 1) through "supporting new construction for homeownership sponsored by CHDOs and other nonprofits" (Activity 1) and "supporting and providing guidance for for-profit developers building new affordable units" (Activity 3). The 2005 Comprehensive Plan also contains related goals and objectives regarding Urbana's unique character, conserving energy, promoting infill development, providing a strong housing supply, and making affordable housing available to low- and moderate-income families.

The City decided to implement these goals on its property on Kerr Avenue as its next major housing project, following successes at Eads Street and Crystal View Townhomes. HOME funds were set aside in the 2005-06 Annual Action Plan to pay for "market studies, site planning and architectural/engineering services." The City had acquired the property on Kerr Avenue, between Cunningham Avenue and Division Street, in 2004 with HOME and CDBG funds as a potential development site. Phase I of the project began in 2006 with a request for proposals for a design concept. Farr Associates of Chicago was selected as the design consultant, and a design charrette was held in the summer of 2007. The outcome of Phase I was a report that presented two site design concepts and provided several recommendations regarding architectural and sustainable practices proposed to be employed in the project. The site plans are attached as Exhibit "A".

A second request for proposals was issued in March of 2008 to select the developer for the project. The City received two responses and a committee comprised of staff and a Councilmember selected e-co lab's team to lead the development in May 2008. Since that time, staff has been meeting with e-co lab to explore our options and to solidify the development team and project approach. Staff has also been working to restructure the project to make it more viable in the current market.

The Ecological Construction Laboratory (e-co lab) is one of Urbana's Certified Housing Development Organizations. Specializing in passive solar technology, e-co lab's mission is to design super energy-efficient buildings, serving low- to moderate-income families, by providing safe, affordable, environmentally friendly homes. E-co lab has partnered with the City to develop two affordable, super energy-efficient homes for low- to moderate-income families, and is currently working on a third home. Passive solar is a building design technique that takes advantage of the sun's energy to keep the home warm in the winter. Built with a tight envelope and high levels of insulation, passive houses use a heat exchanger to keep a constant flow of fresh air circulating into the house. E-co lab is also a leader in the passive house movement in the United States, and puts on an annual Passive House Conference.

Project Proposal

A summary of the e-co lab proposal, including recently updated figures is attached as Exhibit "B". A full copy of the proposal is available upon request. The development proposal submitted by e-co lab calls for 48 ultra energy-efficient dwelling units: ten single-family homes, 18 townhouse units, four four-plexes and four apartment units. Exhibit "B" shows the site layout and renderings for some of the units. The site gently slopes to the south, which allows it to take advantage of passive solar design. A single street will run down the site, with single family homes and duplexes to the west, and town homes and attached single family houses to the east. The street will terminate in a cul-du-sac, and a multi-use path will continue to the west through the Crystal View Townhomes site. The site design also contains other "green" features, such as bio-swales, rain gardens, edible landscaping, and community gardens. Homes could be wired for solar power or could contain green roofs.

To undertake this project, E-co Lab has assembled an experienced development team:

- E-co Lab is acting as the architect and project manager, designing ultra energy-efficient homes based on passive house principles.
- Homeway Homes will build the houses using component prefabricated at their central Illinois facility.
- IBACOS is slated to provide energy performance monitoring and verification.
- HDC Engineering will complete the site design and infrastructure work.

- Conservation Technologies would consult on any active solar systems such as solar thermal or photovoltaics if funding is available.

- E-co Lab and the City are currently in talks with Devonshire Group to manage the development and marketing of the project. While Devonshire is tentatively identified as the project developer, the firm has not yet fully committed to the project.

Staff and E-co Lab will be working to solidify the membership of the development team over the next several weeks and if necessary will meet with other interested local developers to complete the team. As soon as the development team is confirmed, City staff will negotiate a development agreement with Council direction and work with E-co Lab to move the project forward.

Issues and Discussion

In order to make the project more viable to a developer in the current economic climate, staff is suggesting some modifications from the requirements outlined in the request for proposals. Initially, the City was planning on donating the land for the project to the developer. Since the property was purchased with federal HOME funds, the project must be started within a certain period of purchasing the land, and any homes built on the site must be affordable to low or moderate-income households making less than 80 percent of the area median income. Unfortunately, the HUD-specified time limit for construction is not sufficient for project completion. The affordability requirement may hinder the developer's ability to find purchasers in the current housing market, as families that meet the income limits may not be able to qualify for a mortgage. To remedy these concerns, staff is proposing to sell the land to the developer, with a guarantee to put those funds back into the project as homebuyer assistance. This would allow for a portion of the homes to be sold at market rate, a similar approach as used in the Crystal View Townhomes development to the west of this project. Staff is also recommending a mixed-income development approach for the project, with 60 percent of the homes to be sold as affordable units to income-qualified buyers, and the remaining 40 percent of the units would be sold at market rate. Another advantage of recapturing the federal funds is that some market rate units could be rented. This would allow for families to purchase a duplex home and use rental income from the other half to supplement their mortgage payments, a strategy recommended by Farr Associates in their report.

In addition, using the mixed-income approach allows the potential for market rate homes in the development to be outfitted with enhancements to make them carbon-neutral. Features such as solar photovoltaic panels or solar hot water heaters, while cost prohibitive for affordable units, may be an attractive selling point to market- rate buyers. All units, affordable and market-rate alike, could be pre-wired for solar panels should the owners decide to install photovoltaics in the future. This would also open the door for the entire development to become carbon-neutral if funds become available for the purchase of photovoltaics.

One of the recommendations from the Farr Associates design charrette was to provide a "menu" of construction types, such as modular homes, straw bale, and passive house. This concept remains a possibility, as some of the lots could be developed with alternative construction types. Ownership patterns are also not set in stone. A local group has expressed interest in establishing a cohousing development on the site. Cohousing is a community-oriented development of separate individual homes that share common space for gatherings, meals, and recreation. The townhouses with courtyards in the preliminary site design could easily be adapted for cohousing. This menu of housing types and ownership models would support the Council goal of making the project a national model for affordable, energy-efficient housing.

Fiscal Impacts

The City currently has approximately $210,000 of HOME funds, plus matching City funds, and $122,000 of CDBG funds invested in the property. E-co Lab has revised the draft project pro forma, as shown in Exhibit B. Under the new pro forma, E-co Lab has identified several state, federal, and private grant sources. New grant sources are being explored, such as the American Recovery and Reinvestment Act (ARRA) and new Department of Energy grants. A significant portion of project funding will come from Urbana's CDBG and HOME funds over the next three to four years.

The project budget has requested CDBG funds of $300,000 for the development of infrastructure for the neighborhood (the project site is in the Community Development Target Area). The City would need to identify an additional $116,683 in CDBG for the project in addition to the CDBG funds reclaimed from the land purchase ($122,000) and the $61,317 in CDBG funds allocated for the project in the FY 2008-2009 Annual Action Plan.

An additional $1,440,000 in grant sources remain to be identified. The City's allocation of HOME funds would provide a portion of this amount. Upon sale of the property, the City will commit $210,000 of recovered HOME funds to the project. Identifying additional HOME funds from City resources will be difficult and may take an extended period. The FY 2009-2010 AAP includes $31,104 in HOME and local match for City Redevelopment Programs, which includes the Kerr Avenue project. Because e-co lab is a certified Urbana HOME Consortium CHDO, future CHDO set aside may be allocated to the project with the concurrence of the Consortium members. Staff is working with e-co lab to identify other potential funding sources to reduce the need for HOME program funding for the project.

Staff Recommendation

Staff recommends that City Council move to direct staff to continue to work with e-co lab to finalize the development team and move forward with predevelopment activities and funding source identification for the Kerr Avenue Model Development. Upon finalization of the development team, staff will draft a development agreement to be approved by the Mayor and Council. Planning approvals could occur this fall, with site work and then construction to begin in phases thereafter.

Prepared by:

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Jeff Engstrom AICP, Planner I

Attachments: Exhibit A: Site Design Concepts from the Farr Associates Report
Exhibit B: E-co Lab Proposal Summary
Exhibit C: Updated Project Pro Forma

cc: Katrin Klingenberg
e-co lab
110 South Race St
Suite 202
Urbana, IL 61801

Exhibit A: Preliminary Site Design Concepts from the Farr Associates Report

SCHEME 'A': 3.19 ACRES, 48 DWELLING UNITS

Conceptual view illustrating integration of walkable urbanism with high performance infrastructure and buildings

SCHEME 'B': 3.19 ACRES, 46 DWELLING UNITS

Conceptual plan illustrating integration of walkable urbanism in high performance infrastructure and buildings.

Proposal for Kerr Avenue Model Sustainable Community Development

Prepared By
Ecological Construction Laboratory
110 S. Race Street
Urbana, IL 61801

in Association with:

IBACOS
Homeway Homes
Conservation Technologies
HDC Engineering
Devonshire Group

Contact: Katrin Klingenberg, Executive Director
katrin.klingenberg@e-colab.org

May 12, 2008

e-co lab
ecological construction laboratory

1 STATEMENT OF UNDERSTANDING OF PROJECT

The Ecological Construction Laboratory has been dedicated since its inception in September 2003 to promote and develop affordable community housing opportunities that put sustainable and energy efficient construction practices first.

Among all environmental concerns global climate change and the need for reducing carbon emissions is at the forefront of our minds and appears as the most urgent topic of our times. Carbon emissions are directly linked to our energy consumption habits. The International Energy Agency predicts that the energy demand on planet earth will grow by more than 60% by 2030 and we are already emitting twice than what the earth's atmosphere can safely handle. This is why we consider carbon reduction the foremost responsibility of a sustainable designer.

We put first in our design practices:

- The Passive House Energy Standard as minimum requirement for energy conservation of a home
- The Cradle-to-Cradle design principles for materials, components and products cycles (Equity, Economy, Ecology) for a healthy societal system and environment

We can make a decisive difference with how we decide to construct our habitat: Homes and buildings are approximately responsible for 40% of the nation's green house gas emissions and those could easily be saved through a combination of conservation and renewable energy use! We feel that fulfilling the 2030 Challenge brought forward by Ed Mazria should be the most important goal for community development practices. The Challenge asks for all new buildings to be constructed carbon neutral by 2030. Why not start today to build the home of the future?

To meet that goal today we at e-co lab have made the commitment to adhere to the most stringent energy standard currently available worldwide: ***the Passive House Standard*** reduces space conditioning needs by 90%, resulting in an overall energy consumption reduction of 75% *without* employing any active photovoltaic technologies. (We will attach a sample energy balance for one of our proposed home typologies including precisely calculated CO_2 emissions later on in this proposal).

It is our commitment to show that the passive house standard is economically feasible today and that ***we can design and build the first affordable certified***

1 STATEMENT OF UNDERSTANDING OF PROJECT

passive house development in the nation here in Urbana! (see chapter 4 – Principles of Passive House Design) The goal is to construct a reliable model of energy efficiency and sustainable living, one that is reproducible throughout the nation in every climate zone.

We can do so because our designs start with conservation first to minimize the losses and maximize the gains passively, minimizing the need to invest in renewable technologies which, in large quantities, are cost prohibitive.

We disagree with Farr & Associates opinion that both site schemes are equally optimizing solar gains. Scheme A clearly allows for optimal use of passive solar energy for all units. With scheme A the carbon-neutral passive house development becomes possible, for scheme B this goal would become cost prohibitive because of orientation and shape of proposed buildings. Therefore we elected to propose our design for scheme A.

The remainder of energy needed after employing conservation techniques first can be provided from renewable resources.

Photovoltaic systems (and wind) are still a very big expense and currently unaffordable for the development. The dream is alive! The photovoltaic system needed per house to make the development an entirely ***carbon-neutral development*** is very small. Already a 4 kW system per housing unit will meet the remaining energy needs of 25% per unit on an annual basis and even possibly overproduce. The investment needed for such a system after rebate is an additional $550,000 currently not included in the Pro-Forma. If a grant or donation can be obtained to cover that cost, ***Urbana could realize the first affordable carbon-neutral, zero energy development in the nation!***

(While we would love to be LEED certified, we do think that $50,000 in LEED certification fees are better spent otherwise, on an edible landscape for example or sculptures in the rain garden water basin! The development as proposed will likely exceed LEED by far)

2 The Team

Team Contributions

We are bringing together a unique team of individuals with a wide range of backgrounds and extensive experience, working together in an interdisciplinary environment to accomplish our goals. The firm's principals have significant experience in Architecture, Renewable Technologies, Building Science, High Performance Home Design and Construction, Construction Management, Sustainable Design and green guided Real Estate Development.

Urbana's own e-co lab and the Passive House Institute US|PHIUS have developed a national reputation in being on the forefront of promoting and developing state of the art high performance practices, detailing, conferences and energy modeling tools.

We approached three developers, two in town and one from Indianapolis who all expressed interest but were reluctant at this point to commit to a partnership. We have been able to interest HDC Engineering in taking on the site design and the civil engineering part.

The team at e-co lab will consult with Homeway Homes, who functions as the builder and is also an experienced developer, to design passive houses meeting the stringent energy standard which can be prefabricated in an economical way in their manufacturing facility. Actual Homeway bid numbers are reflected in the Pro-Forma and project descriptions. In addition, e-co lab's executive Director is currently the only authorized person in the United States to certify Passive Houses due to her affiliation with the European Passivhaus Institut. E-co lab will provide each home typology with the official seal of approval "Quality Approved Passive House".

The first home to be built on site will serve as a sales office and green feature exhibit to showcase the advantages of green living throughout the pre-sale process. Our marketing partner Devonshire and Coldwell-Banker is starting a green line of real estate agents who are specifically trained in aspects and sales of green homes. A comprehensive affirmative marketing plan and certain customization finish options offered through the Homeway Home design studio will make the development very attractive to potential buyers, even in a difficult housing market.

2 The Team

Our Building Science Partner IBACOS is a Building America Partner of the DOE and will provide monitoring and performance verification at no cost to the project within the framework of the latest energy efficiency grant awarded in 2007.

Conservation Technologies will size and consult on the active solar systems such as solar thermal and if funding is available on the photovoltaic system/wind.

As an optional marketing opportunity e-co lab has been approached by the University of Illinois 2009 Solar Decathlon Team. The team proposed to design the 2009 entry for e-co lab to build and own and to use as a sales office and as an educational advertisement tool for the Kerr Avenue Model Development. The Solar Decathlon is a high profile event and will guarantee exceptional media publicity and exposure.

2 The Team

Mission Statement

Ecological design is the essence of sustainability and vice versa.

e-co lab is a non-profit Community Housing Developer setting out with a vision to bridge the gap between affordable housing community design and green design practices. ***e-co lab*** envisions sustainability and health in community design through facilitating an interconnected, multi-disciplinary design approach in low-income housing.

Only if we learn to think in ecological terms and understand our environment as being composed out of interrelated complex dynamic systems, only then we are going to be able to design ecological and responsibly related habitat. The city is only then sustainable if it is successfully designed to learn, evolve and change and therefore to last.

e-co lab pledges to make the forefront of sustainable building practices and energy efficiency technology available to our community's lower income members *"to design ecological and responsibly related habitat"*.
Through building the most energy efficient homes possible we will harvest the economic wealth of greatly reduced utility bills. The economic grounds our homes will be built on are more stable, therefore more sustainable for the family and the community.
e-co lab also pledges to build homes using *only* materials safe for human health and the environment. We intend to build for a healthy future of the families, the community and the local and global ecosystem.

2 The Team

e-co lab Key Staff Biographies

Title and Role	Key Qualifications
Katrin Klingenberg Founder and Executive Director, Lead Designer	Community development, project management and delivery, sustainable development and passive house design specialist, energy efficiency workshops, building science and construction technologies, design and construction analysis, educator
James M. Kernagis Assistant Director and Construction Manager	Building design assistance, integrated systems design, quality assurance, construction management, training curriculum development, conferences and event planning, financial management
Ian Schnack Building Envelope Analyst	Modeling, building design assistance, on-site engineering and management - blower-door test performance and infrared testing, residential HVAC system design, building energy simulation, domestic water systems design, thermal comfort analysis
Alex Hothan Designer	Building design assistance, building energy simulation, Graphic Design, 3D modeling, all architectural phases SD-CD

KATRIN A. KLINGENBERG

1996 Ball State University, Master of Architecture

1994 Technische Universität Berlin, Germany, Bachelor of Architecture Equiv.

BIOGRAPHY	PROFESSIONAL EXPERIENCE
Executive Director	Ecological Construction Laboratory, e-co lab, Founder 2003-Present, Urbana, IL
Principal	Passive House Institute US|PHIUS, Co-founder 2007-Present, Urbana, IL
Principal	Nicolas Smith / Katrin Klingenberg, Design/Build 2002-2003, Chicago, IL

2 The Team

EVIDENCE OF ABILITY TO MEET PROJECT GOALS CONCERNING ENERGY EFFICIENCY AND AFFORDABILITY

Technical Capability

IBACOS' technical capability is illustrated in the knowledge and experience of our individual staff members, as well as in the section on Experience. Our staff consists of registered architects, professional engineers, building scientists, and individuals with expertise in research methodology, information, marketing and communications, manufacturing processes, quality assurance and quality control, and project management.

Although the entire body of this proposal and the attached document – "IBACOS Key Staff and Technical Capabilities" illustrate our technical capability, of particular note are:

1. Analytical Modeling and Systems Design
2. Process Management and Field Support to Builders
3. Building Performance Measurement and Analysis
   - 3.1. Measurement: Long Term
   - 3.2. Measurement: Short Term
   - 3.3. Building Envelope Performance
   - 3.4. Space Conditioning System Performance
   - 3.5. Water Heating Performance
   - 3.6. Lighting, Appliances, and Plug Loads
   - 3.7. Onsite Power System Performance
4. Technical Report Writing and Communications

RESPONDER'S PAST EXPERIENCE AND PERFORMANCE HISTORY WITH SIMILAR PROJECTS

Experience

The following outlines key experience in the field of residential energy efficiency and building science. The examples are not exhaustive, but exemplify IBACOS' experience in managing and executing partner-based building science projects with the U.S. building industry, as well as state and local stakeholders; designing, developing, integrating, and testing advanced building energy equipment, components, and systems; performing systems engineering research work; resolving technical and market barriers to adoption of advanced building energy systems; identifying technical and market barriers; and coordinating with contractors, manufacturers, and code officials. Projects have met whole house source energy saving targets of 30% to 70%. IBACOS

2 The Team

was instrumental in the design of a prototype house at the Yuma Army base, which won the 2004 US Office of Federal Environmental Executive "Closing the Circle" award for Sustainable Buildings

1. Lab and Demonstration Homes
   1.1. Lab Homes
   1.2. American Lung Association Health House
   1.3. Home of the Future
   1.4. The New American Home – 2001 - 2007
2. Partnering with Manufacturers
   2.1. Carrier Corporation development of ""Thermidistat"
   2.2. Owens Corning System Thinking Home Program
   2.3. Cardinal Glass Industries and Carrier Corporation – field study of thermal comfort in unoccupied lab homes
3. State Program Involvement
   3.1. Colorado State program initiative
   3.2. Southface (Atlanta GA) integrating Building America into EarthCraft House standards
   3.3. Wisconsin and North Carolina support to integrate Building America research results in their Energy Star Homes and other high performance home initiatives
4. Detailed Research
   4.1. Ventilation
   4.2. Foundation
   4.3. Domestic hot water
   4.4. Thermal comfort
   4.5. Builder operational process and QA / QC research for high performance home implementation
5. Modeling Tool Capabilities
   5.1. TRNSYS
   5.2. DOE2
   5.3. HERS tools (Energy Gauge USA, REM / Rate)
   5.4. HVAC design tools (WrightSuite, Elite, internally developed tools)
6. Community Scale Programs
   6.1. Civano – Tucson, AZ
   6.2. Noisette – North Charleston, SC
   6.3. Summerset at Frick Park – Pittsburgh, PA
   6.4. Legends at Mansfield – Columbus, NJ
7. Working with Builders to Integrate Advanced System Strategies
   7.1. Yuma Proving Grounds, Yuma Arizona
   7.2. Tindall Homes – Columbus, NJ
   7.3. Aspen Homes – Loveland, CO
   7.4. Heartland Homes – Pittsburgh, PA
   7.5. Hedgewood Properties – Atlanta, GA
   7.6. Kacin Construction – Pittsburgh, PA
8. Building Science Training
   8.1. Integrated duct designs
   8.2. Building science training
   8.3. Quality- and risk-related field and process assessments for builders

2 The Team

About Homeway Homes

We are the Midwest 's premier builder of quality-focused, value conscious modular homes in Central Illinois, Missouri, Iowa and Wisconsin. We have more than 40 basic plans to begin your custom home building experience, and with our centrally-located modular building facility in Deer Creek, Illinois, we have a large range of territory for which we can build. Come see why we're Quality Built for Better Living.

Mission Statement
To provide our Authorized Builders with unparalleled quality construction, service and value to every Homeway Home we build.
To take the homebuilding industry to the next level of controlled quality, timeliness, customization and affordability.
To be an asset to the community in which we live and provide great jobs for great people.

Our Facility
Located in central Illinois along I-74, in Deer Creek Business Park , at 100 Homeway Court , you'll find a facility where Quality Built for Better Living truly takes form. Homeway Homes broke ground in Deer Creek , Illinois in August, 2004, and production began in June of 2005. The facility houses over 60,000 square feet of production and storage space and over 5,000 square feet of administrative office space. One of the unique aspects of the facility is the use of a visitors viewing deck, which, at over 200 feet long, will allow visitors to tour the facility during production. The public will be able to see first hand the quality built into each home.
The facility is state-of-the-art, using modern equipment and tools to complete three homes per week at start-up. This kind of production is possible due to the constantly evolving technology of modular construction. The end result is a home that is top-of-the-line in quality, and very economically built.
Homeway Homes begins the building process by using computer aided design (CAD) drawings to accurately engineer each component that goes into every home built. By using Auto CAD, we can build each home "virtually" on the computer and check it for accuracy before it proceeds to the facility floor for production."
"This assures a quality home from the start," says Chief Engineer, Justin Thomas. "Once the plans are sent to production, the building process starts with building the floor system on a level and square jig." From there, the modular unit goes through 15 different stations adding the walls,

2 The Team

ceiling, floor, electrical, plumbing, cabinets and trim. One of the best things about modular-built homes is that the home is built indoors in a controlled environment.
"It is not exposed to rain or other outdoor elements," says Kris Swords, assistant production supervisor.
In seven to ten days, the home finishes the building process. It is ready to be delivered to the site where the final installation, finishing touches and quality inspections are done, and the home is turned over to the new owners.

Quality Built, Top To Bottom
Homeway Homes will initially employ 50 people whose top priority is quality work.
"Every thing we do is quality," says Rich Schieler, production supervisor. "From the quality designs to materials to workmanship, quality is job one.'"
Homeway Homes employs a full time Quality Control Inspector whose sole job is to inspect every station for superiority of materials and workmanship.
"We are thankful that Homeway Homes can provide good quality jobs for people and their families right here in central Illinois ," says Homeway Homes general manager, Brian Schieler. "We are a family business that has our roots in this community and have lived in this area all our lives. We are glad to be a part of this community."

Code Adherance
The Homeway Homes facility builds its modular homes to the strictest of building codes.
"With the advanced Auto CAD system, Homeway can design a vast array of floor plans and elevations from ranches, two stories, and cape cods," explains Brian Schieler. "We can personalize the home of your dreams."
"Adding it all together, the new facility can build homes stronger (see our Energy-Strength page), quicker and less costly than traditional on-site built homes."
"By buying in bulk quantities and using modular technology, we lower our costs." says Sales Manager, Ted Schieler. "We pass these savings on to our customers. People who didn't think they could afford a new home are surprised they now can."

Authorized Builder Network
Homeway Homes sells its modular home products through a network of Authorized Builders. Although the company's main business is homes, Homeway Homes also builds commercial buildings such as schools, office buildings and banks for example. In addition, Homeway Homes designs and builds apartment complexes, duplexes and condos.
With the facility in production, visitors are invited to come visit. When you do you will see why our attention to "Quality Built" truly means "Better Living" for you!

2 The Team

CONSERVATION TECHNOLOGIES

CONSERVATION TECHNOLOGIES
Building Performance • Ventilation • Renewable Energy

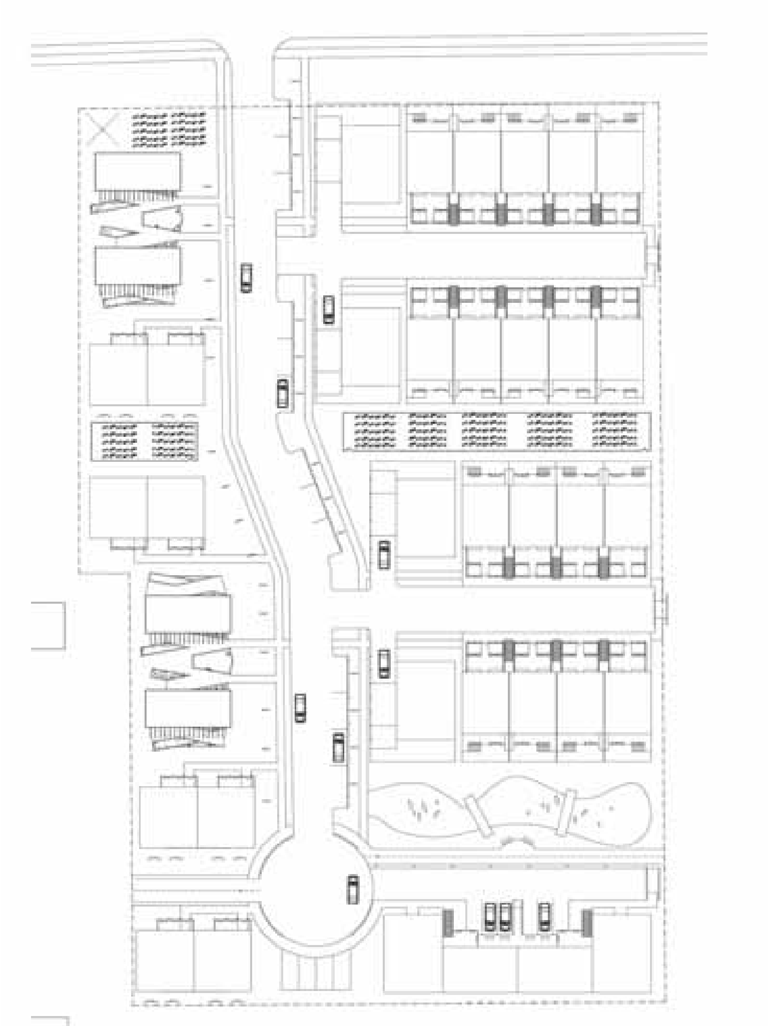
Who We Are

Conservation Technologies' background is in building construction, the performance of buildings, and energy issues in general. When builders moved toward more air-tight and better insulated building construction techniques, we were there for the various side effects of that transition. Tighter construction, as well as the use of new materials with properties different than those traditionally used, led the industry into a stream of problems. Elevated interior relative humidity levels, inconsistent energy performance, indoor air quality problems, backdrafting combustion equipment and bulk water intrusion are all examples of issues that have kept the building performance industry on its toes over the last few decades. Conservation Technologies' is researching the growing evidence of rapidly approaching energy supply problems. We are trying to move the building performance industry in a direction that focuses on energy issues in addition to problems in buildings.

Conservation Technologies sells energy efficient building supplies, Venmar heat recovery ventilation systems, and solar electric and hot water systems. We also consult in building design and performance. We work with various utilities on the design and delivery of energy efficiency and conservation programs. Conservation Technologies has a comprehensive support team that includes sales, installation and technical support professionals. We serve a growing area in the upper Midwest from our Duluth office.

Additionally, we present seminars on ventilation, diagnostics and energy efficiency at national and regional conferences.

4 The Design – House Types and Renderings



The Site Plan: Scheme A

1. Layout for Solar Access: The e-co lab team chose Scheme A. As we mentioned earlier in the Statement of Understanding of the Project, we disagree with Farr & Associates on the assessment that both schemes are equally optimizing passive solar gains. With the ambitious goal in mind of factor 10 space conditioning reduction Scheme B would cost a lot of money: the money

4 The Design – House Types and Renderings

that can't be saved. The two sustainable guiding Principles of e-co lab, energy efficiency and cradle-to-cradle design including aesthetics, need to be met equally. Scheme B can be done but the difference is so significant that it would render an *affordable* passive house development impossible.

2. Town home, single family and apartment typologies: The proposed aesthetic of scheme B also appears to fit more a densely populated urban site. This is desirable and ecological but as of right now that condition does not exist in the vicinity of the Kerr site. The surroundings of Kerr Ave to the North consist mostly of low density housing and single-family homes. We like to respond to the existing surrounding fabric with single family and mostly townhouse developments to the east of the site towards the commercial end. This way density will be increased significantly, we meet the economic goal of units required, but also we allocate lots of space for community gardens, edible landscaping and partial single family developments to honor the surrounding community pattern and continue it into the Kerr Ave Development site.

3. Maintaining existing Topography: We propose to not to grade the site but to work with the existing topography. The site topography is perfect for solar access as the houses terrace southward. We can make use of the topography to provide parking and it is ecologically sound to keep the topsoil on site. The quality of the topsoil on this particular site is exceptional. Sustainable water management with bio swales and rain gardens, edible landscaping and community gardens for food production are a unique opportunity of this specific site.

4. Access roads: Pervious pavers are extremely costly. Therefore we have opted for pervious concrete for all access road and parking surfaces. To alleviate loads on storm water management there are two bio swales, one on each side of the main access road. We also like to propose to not to connect through traffic to the Lakeside Terrace redevelopment. For one, it will add significant cost to both developments and as of right now it is questionable that the Lakeside Terrace Developers are willing and able to figure this into their budget. As a good side effect it will also slow traffic down and make the street safer for kids. We like to propose an alternative: The Kerr Ave main access road will end in a circular plaza continued by a smaller road, big enough for an emergency vehicle, connecting to Lakeside Terrace. In essence, it is a bike path that in case of an emergency can serve as a pass through for emergency vehicles. A drop-down

4 The Design – House Types and Renderings

pole will prevent traffic other than bikes and pedestrians from passing at all other times.

Home Typologies

1. The Contemporary Shotgun House:

4 The Design – House Types and Renderings

4 The Design – House Types and Renderings

Project Description

The contemporary take on the shotgun house is the first Passive Houses designed to be pre fabricated in a modular home factory. The footprint is 16'x40'. The house consists out of two modules. It is a three bedroom, two bath single-family residence with 1280 sqft. It is designed to receive a solar thermal system at a minimum, if funding is available a PV/T system (a new product on the market that combines photovoltaic cells and solar thermal collectors in one panel enhancing PV production by cooling them).

The cost is estimated by Homeway Homes at $128 per sqft finished living space turnkey completion including passive house superinsulation, airtight measures, high performance windows, all decks, trellises and green building materials i.e. Hardiboard siding (the solar thermal system is excluded).

Project Specifications:

3-bedroom plus den, 2 bath, generous south deck with rainwater catchment basin for landscape irrigation

Location	Kerr Avenue Model Sustainable Development
Area	1280 sq ft
Foundation	Concrete Piers to frost, Crawlspace or shallow basement, to be determined during value engineering
First floor insulation	4" spray-foam,12 inches blown-in fiberglass (R-81)
Wall framing	2x4 double stud wall
Wall insulation	4" spray-foam, 8" inches blown-in fiberglass, (R-65)
Roof framing	2x10
Roof insulation	4" spray-foam,10 inches blown-in fiberglass (R-73)
Air tightness	0.6 ACH @ 50 Pascal
Windows	Thermotech windows, tri-pane, argon filled, insul. frame
Ventilation system	Recoupe Aerator Energy Recovery ventilator
Supplemental Heating	500 Watt electric baseboard heaters per bedroom (optionally replaced by fans w/heating capacity)
Supplemental Heating & Cooling	Samsung 9000 Btu mini split air to air heat pump
Domestic hot water system	Stiebel-Eltron solar thermal flat plate collectors and Tank-in-Tank water heater w/ electric booster

4 The Design – House Types and Renderings

PHPP Calculation Results for the Shotgun House:

Year of Construction:	2008			Utilization Pattern:	Dwelling
Number of Dwelling Units:	1	Interior Temperature:	20.0 °C	Type of Values Used:	Standard
Enclosed Volume V_e:	353.7 m^3	Internal Heat Gains:	2.1 W/m^2		
Number of Occupants:	2.0			Planned Number of Occupants:	2 (Design)

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 81.6 m^2

	Applied:	Annual Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	10	kWh/(m²a)	15 kWh/(m²a)	Yes
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	94	kWh/(m²a)	120 kWh/(m²a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	49	kWh/(m²a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	118	kWh/(m²a)		
Heating Load:	24	W/m^2		
Frequency of Overheating:		%	over 25 °C	
Specific Useful Cooling Energy Demand:	17	kWh/(m²a)	15 kWh/(m²a)	No
Cooling Load:		W/m^2		

Verification:	Annual Method
Specific Space Heat Demand, Annual Method	9.9
Specific Space Heat Demand, Monthly Method	14.8

We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The calculations with PHPP are attached to this application.

Issued on:

signed:

Figure 1: Passive house verification sheet showing energy consumption total

The verification page of the PHPP program summarizes all entries in regards to insulation levels of the envelope, airtightness values, window U-values, appliances, lighting etc. This picture shows that the shotgun house meets the passive house standard in all three required categories.

In this calculation a 4 kW photovoltaic system is assumed. It produces more that the house consumes over the course of a year total.

Similarly, the related carbon emissions are being predicted with the modeling tool. Please find the carbon balance for the shotgun house in the illustration below. PE stands for Primary energy or source energy. The program does take already losses due to energy production, fuel source and transport into account.

4 The Design – House Types and Renderings

Heating, Cooling, DHW, Auxiliary and Household Electricity		36.6	94.0	23.6
Total PE Value	94.0	kWh/(m²a)		
Total Emissions CO_2-Equivalent	23.6	kg/(m²a)		(Yes/No)
Primary Energy Requirement		120	kWh/(m²a)	Yes

Heating, DHW, Auxiliary Electricity (No Household Applications)		18.2	49.1	12.4
Specific PE Demand - Mechanical System	49.1	kWh/(m²a)		
Total Emissions CO_2-Equivalent	12.4	kg/(m²a)		

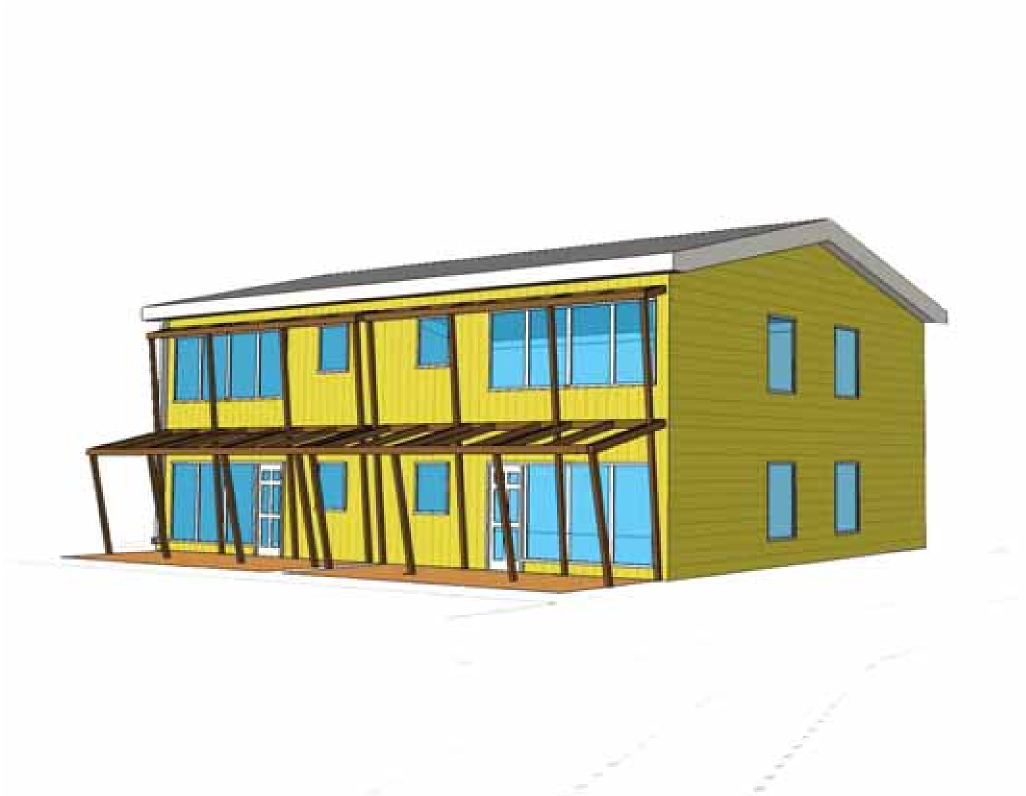
Solar Electricity		kWh/a	PE Value (Savings)	CO_2-Emission Factor
Planned Annual Electricity Generation	*Separate Calculation*	4800	kWh/kWh	g/kWh
			0.7	250
Specific Demand		58.8	41.2	14.7
PE Value: Conservation by Solar Electricity	117.6	kWh/(m²a)		
CO_2-Emissions Avoided Due to Solar Electricity	25.3	kg/(m²a)		

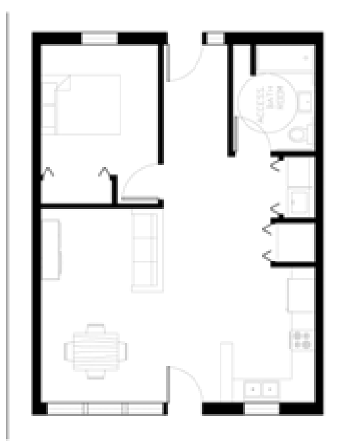
Figure 1: Carbon emissions equivalent of the total energy consumption and savings through the installation of a 4 kW PV system

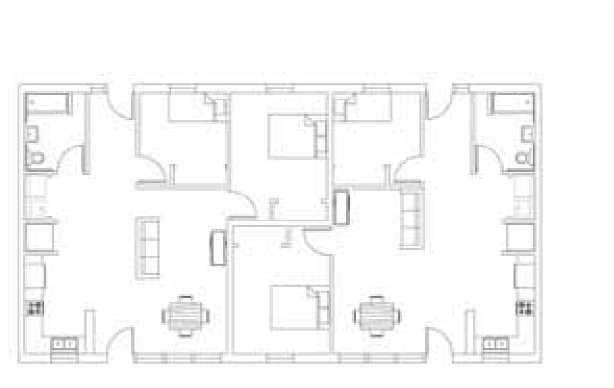
The proposed shotgun house is a negative carbon house as it generates more renewable electricity than it uses for its own purposes that then can be sold back to the grid. All house types have been calculated this way. The shotgun house is the most challenging to realize the standard for due to its size and surface to volume ratio (long and skinny versus cubical and compact). Therefore all other larger house types perform equal or better in terms of the energy use and carbon emissions and those will not be listed separately.

4 The Design – House Types and Renderings

2. The quadplex:







4 The Design – House Types and Renderings

Project Description

The quadplex Passive Houses contains 4 appartments, which can vary in size from a 1-bedroom to a two and three bedroom. Currently drawn are 4 equal 861 sqft 2 bedroom, 1.5 bath units.
The two units on the first floor are fully ADA accessible. The upper units are accessed by exterior stairs.
This typology is also designed to be pre fabricated in a modular home factory. The footprint is 32'x60'. The house consists out of four modules.
It is designed to receive a solar thermal system at a minimum, if funding is available a PV/T system (a new product on the market that combines photovoltaic cells and solar thermal collectors in one panel enhancing PV production by cooling them).

The cost is estimated by Homeway Homes at $128 per sqft finished living space turnkey completion including passive house superinsulation, airtight measures, high performance windows, all decks, trellises and green building materials i.e. Hardiboard siding (the solar thermal system is excluded).

Project Specifications:

2 bedroom version, 1-1.5 bath, generous south deck with rainwater catchment basin for landscape irrigation

Location	Kerr Avenue Model Sustainable Development
Area	861 sq ft
Foundation	Concrete Piers to frost, Crawlspace or shallow basement, to be determined during value engineering
First floor insulation	4" spray-foam,12 inches blown-in fiberglass (R-81)
Wall framing	2x4 double stud wall
Wall insulation	4" spray-foam, 8" inches blown-in fiberglass, (R-65)
Roof framing	2x10
Roof insulation	4" spray-foam,10 inches blown-in fiberglass (R-73)
Air tightness	0.6 ACH @ 50 Pascal
Windows	Thermotech windows, tri-pane, argon filled, insul. frame
Ventilation system	Recoupe Aerator Energy Recovery ventilator
Supplemental Heating	500 Watt electric baseboard heaters per bedroom (optionally replaced by fans w/heating capacity)
Supplemental Heating & Cooling	Samsung 9000 Btu mini split air to air heat pump
Domestic hot water system	Stiebel-Eltron solar thermal flat plate collectors and Tank-in-Tank water heater w/ electric booster

4 The Design – House Types and Renderings

3. The Single Family Home, "Gate House" for Town House Courts:

4 The Design – House Types and Renderings

Project Description

The single family "gate house" defines the western edge of the semi-private town house courtyard. It has an attached garage and it can be determined by the courtyard community to use those attached garages as courtyard shared vehicle parking.
The single family Passive House has 4 bedrooms and two full bath on two levels. It has a total of 1400 sq ft.The first floor is fully ADA accessible.
This typology is also designed to be pre fabricated in a modular home factory. The footprint is 24'x32'. The house consists out of four modules.
It is designed to receive a solar thermal system at a minimum, if funding is available a PV/T system (a new product on the market that combines photovoltaic cells and solar thermal collectors in one panel enhancing PV production by cooling them).

The cost is estimated by Homeway Homes at $128 per sqft finished living space turnkey completion including passive house superinsulation, airtight measures, high performance windows, all decks, trellises and green building materials i.e. Hardiboard siding (the solar thermal system is excluded).

Project Specifications:

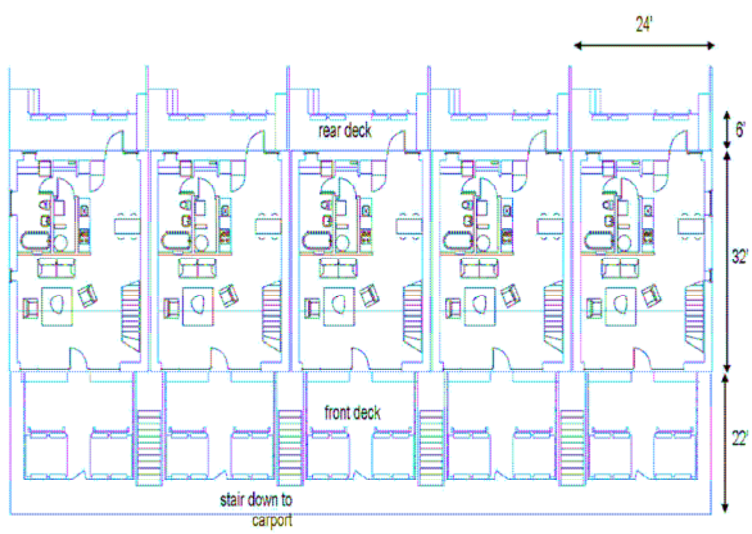
4 bedroom, 2 bath, generous south deck with rainwater catchment basin for landscape irrigation attached garage option, partial green roof

Location	Kerr Avenue Model Sustainable Development
Area	1400 sq ft
Foundation	Concrete Piers to frost, Crawlspace or shallow basement, to be determined during value engineering
First floor insulation	4" spray-foam,12 inches blown-in fiberglass (R-81)
Wall framing	2x4 double stud wall
Wall insulation	4" spray-foam, 8" inches blown-in fiberglass, (R-65)
Roof framing	2x10
Roof insulation	4" spray-foam,10 inches blown-in fiberglass (R-73)
Air tightness	0.6 ACH @ 50 Pascal
Windows	Thermotech windows, tri-pane, argon filled, insul. frame
Ventilation system	Recoupe Aerator Energy Recovery ventilator
Supplemental Heating	500 Watt electric baseboard heaters per bedroom (optionally replaced by fans w/heating capacity)
Supplemental Heating & Cooling	Samsung 9000 Btu mini split air to air heat pump
Domestic hot water system	Stiebel-Eltron solar thermal flat plate collectors and Tank-in-Tank water heater w/ electric booster

4 The Design – House Types and Renderings

4. The Town House:

townhomes with
carport



4 The Design – House Types and Renderings

Project Description

There are two town houses courtyards planned for the eastern side of the site. The town houses form a semi-private town house courtyard. The slope of the site provides the opportunity of south-facing decks with two parking spots for each home and additional storage if desired for each home.
The town house have 3 bedrooms and two full bath on two levels. They have a total of 1380 sq ft. The first floor is fully ADA accessible from the north side of the building.
This typology is designed to be pre fabricated in a modular home factory. The footprint is 24'x32'. The house consists out of four modules, but in this case long ways. Four of five townhouse rows are planned for the site. All townhouses are prefabricated at once in eight economical modules.
All town homes are designed to receive a solar thermal system at a minimum, if funding is available a PV/T system (a new product on the market that combines photovoltaic cells and solar thermal collectors in one panel enhancing PV production by cooling them).

The cost is estimated by Homeway Homes at $123 per sqft finished living space turnkey completion including passive house superinsulation, airtight measures, high performance windows, all decks, trellises and green building materials i.e. Hardiboard siding (the solar thermal system is excluded).

Project Specifications:

3 bedroom, 2 bath, generous south deck with rainwater catchment basin for landscape irrigation, 2-car car port and additional storage

Location	Kerr Avenue Model Sustainable Development
Area	1400 sq ft
Foundation	Concrete Piers to frost, Crawlspace or shallow basement, to be determined during value engineering
First floor insulation	4" spray-foam,10 inches blown-in fiberglass (R-73)
Wall framing	2x4 double stud wall
Wall insulation	4" spray-foam, 6" inches blown-in fiberglass, (R-57)
Roof framing	2x10
Roof insulation	4" spray-foam,8 inches blown-in fiberglass (R-65)
Air tightness	0.6 ACH @ 50 Pascal
Windows	Thermotech windows, tri-pane, argon filled, insul. frame
Ventilation system	Recoupe Aerator Energy Recovery ventilator
Supplemental Heating	500 Watt electric baseboard heaters per bedroom (optionally replaced by fans w/heating capacity)
Supplemental Heating & Cooling	Samsung 9000 Btu mini split air to air heat pump
Domestic hot water system	Stiebel-Eltron solar thermal flat plate collectors and Tank-in-Tank water heater w/ electric booster

4 The Design – House Types and Renderings

Site Renderings including proposed 5kW Windmill at Entrance to the Development

4 The Design – House Types and Renderings

Bioswales and community gardens

4 The Design – House Types and Renderings

4 The Design – House Types and Renderings

Principles of Passive House Design

The Passive House concept is a comprehensive approach to cost-effective, high quality, healthy and sustainable construction. It is predicated on two fundamental goals: minimizing energy losses and maximizing passive energy gains. Simple enough. But excelling at achieving these goals has led to extraordinary results: *70-90% less energy* is used in space heating and cooling than in conventionally constructed buildings. This places passive house at the forefront of the world's standards for energy efficient construction.

To attain such outstanding energy savings, a passive house designer systematically implements these essential principles of design:

4 The Design – House Types and Renderings

- Superinsulation
- Elimination of Thermal Bridges
- Airtightness
- Energy/Heat Recovery Ventilation
- High Performance Windows & Doors
- Optimization of Passive Solar and Internal Heat Gains

The Passive House Planning Package (PHPP) is a powerful and accurate energy modeling tool that helps a designer to appropriately integrate each of these principles.

Superinsulation

The insulation applied to a house provides thermal benefits very much like those of a thermos bottle. The contents are able to maintain a relatively constant temperature. Warm contents stay warm and cool contents stay cool, despite potentially extreme exterior conditions. In a passive house, the entire envelope of the building - walls, roof, and floor or basement - is well insulated. One of the first things one often notices when visiting a passive house is the thickness of its walls. This is to accommodate the level of insulation required to properly minimize thermal heat loss. Of course, the level of insulation needed to achieve passive house standard can vary greatly depending on the project and climate. The Tahan House in Berkeley, California required only 6" of blown-in cellulose insulation; while the Skyline House in the far harsher climate of Duluth, Minnesota needed a much more considerable 16" of blown-in cellulose.

There is a wide range of wall construction choices available to passive house designers and builders. Conventional lumber and masonry, double-stud walls, structural insulated panels (SIPs), insulated concrete forms (ICFs), truss joist I-beam (TJI) walls, steel and straw bale are all legitimate options. Similarly, there are several insulation possibilities. Cellulose, high-density blown-in fiberglass, polystyrene, and straw bales are all valid selections for a passive house. Many spray foams, while providing high R-values and an ease of application, are often avoided amid concerns that they still have an environmental downside that outweighs their advantages. Development on these spray products is ongoing. Vacuum insulated panels (VIPs) are relatively new and, as yet, pricey. However, their outstanding insulating value can greatly decrease wall thickness in applications where that is a concern. Still higher-tech insulations are also in

4 The Design – House Types and Renderings

development. The application and performance of insulation can be directly measured using thermographic imaging.

Elimination of Thermal Bridges

Heat will flow out of a building on the easiest path available to it, the path of least resistance. It will pass very quickly through an element that has a much higher thermal conductivity than surrounding material. Such a condition is called a "thermal bridge." Thermal bridges can significantly increase heat losses, and decreased interior surface temperatures can also, in worst-case scenarios, create moisture problems. A passive house avoids these issues by limiting or eliminating thermal bridges. When the "thermal bridge coefficient," which is an indicator of the extra heat losses of a thermal bridge is less than .01 W/(mK), the detail is said to be "thermal bridge free." Additional heat losses are negligible and interior temperatures are sufficient to avoid any critical humidity or condensation issues.

Thermal bridges occur at edges, corners, connections and penetrations. A bridge can be a single lintel or several wall ties that pass through an envelope. A balcony slab that is not thermally isolated from an interior concrete floor is a profound example of a thermal bridge. An appropriate thermal isolation is called a "thermal break." Without providing for a thermal break, such a balcony will act as a very large cooling fin…in the wintertime! It is important that design and execution are planned to eliminate or mitigate such elements; limiting penetrations, employing external bearings and heat transfer-resistant materials when necessary. Again, thermographic imaging can be used to measure the effectiveness of the designer and builder in limiting thermal bridges.

Airtightness

Airtight construction helps the performance of a building by limiting the infiltration of unwanted cold (or, in the summer, hot) drafts, thereby limiting the need for unnecessary space conditioning. But airtightness also helps prevent warm, moist indoor air from penetrating the structure and possibly causing structural damage. In hot, humid climates, airtightness helps prevent infiltration of humid *outside* air, which can damage construction when condensing inside the wall.

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Airtight construction is achieved through a careful attention to creating an intact, continuous layer wrapping the entire volume of the building envelope. It requires special care around windows, doors, penetrations, and roof/wall/floor joints. Insulation materials are generally NOT airtight, and a separate layer needs to be present. It can involve a variety of membranes, tapes, plasters, glues, shields, and gaskets. There is regular innovation in materials that help to achieve airtight construction.

Tightness is measured through the application of a blower-door test, which involves applying a large fan to a building to determine, under a designated pressure, the air infiltration that the building experiences through all its gaps and cracks. It is best to conduct the blower-door test at a point in construction when leaks can be found and addressed. Leaks can be detected during a blower-door test either by hand, by employing tracer smoke, and again by looking at thermo graphic images. Passive houses are extremely tight. At a standard test pressure of 50 Pa, a passive house must allow no more that 0.6 air changes per hour. Built passive houses employing timber, masonry, pre-fabricated elements, and steel bearing structures have all achieved this superior level.

Airtightness does not mean that you can't open the windows! passive houses have fully operable windows and it's perfectly fine for residents to open them when they like. In fact, it is often possible to *enhance* energy performance in the summer by opening windows for night cooling.

Energy Recovery Ventilation

Perhaps the most common misperceptions of passive house stem from such misunderstandings regarding the air flow. "A house needs to breathe," is commonly heard. Well, a passive house does breathe…exceptionally well. The health and comfort of the occupants are the most important objectives of the passive house designer.

Excellent indoor air quality is indispensable, and can only be achieved when fresh air is regularly replenished and stale air removed. A passive house is ventilated using a balanced mechanical ventilation system. Given the extent to which designers go to in order to minimize energy losses, it only follows that the demands of our mechanical system's energy use be rigorous. To that end, we employ energy recovery ventilators (ERVs) (or heat recovery ventilators (HRVs) in colder, drier climates). These machines incorporate an air-to-air energy recovery, which conserves a great majority of the energy in the exhaust air and

4 The Design – House Types and Renderings

transfers it to the incoming fresh air. This significantly reduces the energy needed to treat that incoming air. State of the art ventilation systems may have heat recovery rates of 75-95%!

The ventilation system generally exhausts air from the rooms that produce moisture and unwanted odors, such as the kitchen and bathrooms. Humidistats installed in these rooms indicate when moisture levels are elevated, initiating an appropriate adjustment in the flow rate of the ventilation. The exhaust air returns through the ventilator on its way out of the building, where it passes through a heat exchanger which transfers the reusable heat energy to the incoming fresh air. It is important to note here that there is no mixing of the exhaust air with the incoming air. Only its heat is transferred.

In fact, the air supplied to the building is of a superior quality. The ventilator operates to provide a constant supply of fresh air, while at the same time constantly removing unwanted moisture and any noxious gases or unwanted smells that might be present. It is not recirculated air, as usually found in forced air systems. The incoming air is filtered and balanced. It is distributed at a generally low flow rate which is very quiet and not at all drafty (The Passivhaus Institut recommends an air change rate of between 0.3 and 0.4 times the building's volume per hour. The PHPP recommends 30 cubic meters per person per hour). It is distributed by means of small, unobtrusive, but highly effective diffusers.

The primary difference between the *heat* recovery ventilator (HRV) and the *energy* recovery ventilator (ERV) is that the HRV conserves primarily heat and cooling energy. The ERV transfers humidity as well. In summer it can help keep humidity to the outside; in the winter it helps to prevent indoor air from becoming overly dry. For in-between seasons, when no conditioning is needed, a bypass can be installed for either system, which can be thermostatically controlled in order to not heat the incoming air. Alternatively, the ventilation systems can be turned of all together, and ventilation can be provided by opening the windows.

An additional opportunity to increase the efficiency of the ventilation system is to employ ducts buried in the earth. During the winter, the ground has a higher temperature than the outdoor air and during the summer the ground has a lower temperature than the outdoor air. Therefore it is possible to preheat fresh air in underground ducts in the winter, or to cool it in the summer. This can be done either directly, passing the air through buried air ducts; or it can be accomplished indirectly, by circulating water in underground pipe and using it to heat or cool the air with a water-to-air heat exchanger.

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High Performance Windows & Doors

In modeling the energy of a building, passive house designers consider windows and doors in terms of their *insulating* value. Of course they are being made tighter, reducing losses through infiltration/exfiltration. But high thermal conductivity in windows and doors is no longer the status quo either. Doors have been provided with appropriate thermal breaks and double gaskets, and high-performance windows are proving themselves to be especially cost-effective in passive house applications.

There have been extraordinary advances in window quality over the past 30 years and the thermal loss coefficient of windows has dropped dramatically. Low-emittance ("low-e") coating is a microscopically thin, transparent layer of metal or metallic oxide deposited on the surface of glass. Facing that coating into the gap between window panes, which are now filled with low-conductivity argon or krypton gas rather than air, greatly reduces the window's radiant heat transfer. Different low-e coatings have been designed to allow for high, moderate, or low solar gain, for buildings from heating-dominated to cooling-dominated climates. Now, *triple*-pane low-e coated, argon-filled windows (with special low-conductivity spacers) have insulated and thermally-broken frames. Any perceivable "cold radiation" or convective cold air flow, even in periods of heavy frost, has been eliminated.

Optimization of Passive Solar and Internal Heat Gains

The design principles discussed so far have focused primarily on the fundamental goal of minimizing energy loss. Let us now focus on energy gains.

In beginning a project, passive house designers are concerned with the orientation of a building. They look for buildings, trees or landforms that might cast shadows during short winter days of low sunlight. They incorporate the demands of preferred vistas that might not accommodate their ideal orientation. But, in general, they try to limit windows on the north face of buildings, while providing larger areas of glazing to the south. In climates of the northern hemisphere that have primarily heating loads, windows to the north are provided no direct solar heat gain, while those to the south are afforded a great deal of it. Furthermore, increased direct natural lighting can decrease the expenditure of energy needed to provide light. Design can also enhance the enjoyment of that available sunlight, orienting bedrooms and living rooms to the south; and utility

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room, closets, and circulating spaces to the north, where sunlight is not as crucial.

In a passive house, windows function as solar collectors. In most climates, the solar energy that is passively gained through the windows is the most crucial contribution offsetting heat losses. Windows are designed, oriented, and installed accordingly. But the goal is not simply to achieve as much solar gain as possible. Design should balance solar gain within energy calculation…and within the glazing budget! Energetically, there is potentially a point of diminishing returns here, as the net heat loss can become greater than the gain over the course of the year.

Also, in summertime and in primarily cooling climates, it's very important to prevent an excess of solar heat. This can often be largely accomplished through the introduction of appropriate shading devices. Roof eaves that are of proper length can effectively shade south-facing windows from unwanted solar radiation when the sun is higher in the summer, and still allow for powerful solar gains when needed in the colder months of lower-angle sunlight (Deciduous growth, such as trees or vines on trellis, can also shade sunlight in the summer, while admitting it in winter). In climates that have significant cooling loads, limiting unshaded east- and west-facing windows should also be considered. Morning and late afternoon, low-angle sunlight can generate a great deal of heat in such windows. Low solar-gain low-e coating has also been mentioned.

Another, perhaps less obvious, source of heat gain is internal. Given the exceptionally low levels of heat loss experienced in a passive house, heat from less-considered sources becomes significant. Household appliances, electronic equipment, artificial lighting, candles, people…all can have a significant effect on the heat gains of a passive house.

A Word on Cooling and Dehumidification

Contemporary passive house design concepts have been largely developed in central Europe, which is of significantly milder climates than other regions. Implementation of designs that meet the Passive House standards for energy consumption are more challenging in climates of more extreme cold, heat, or humidity. There are many in the more extremely cold climates and passive houses in hotter conditions are now starting to be built.

In these cooling-load situations, as in heating-load ones, space-conditioning loads are minimal. As mentioned earlier, cool contents also tend to stay cool in

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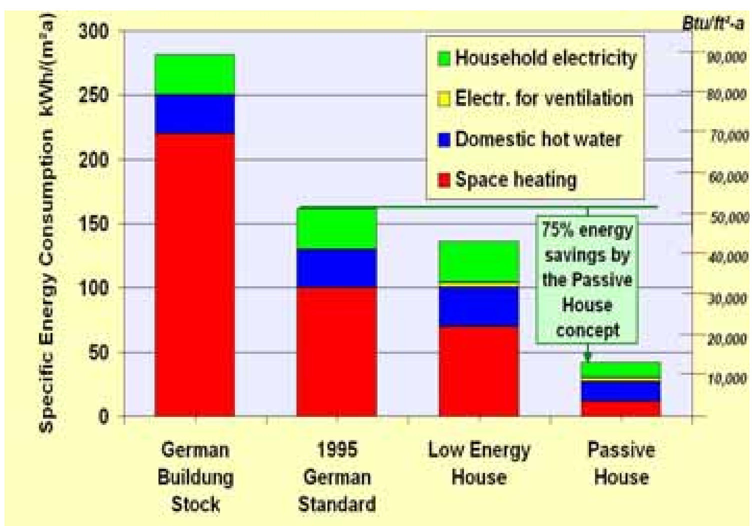
the well-insulated passive house. Standard measures for prevention of excess solar gain, convective venting behind siding and roofing, and night-cooling will often suffice in maintaining indoor comfort. In humid climates, the bulk of any additional cooling is found to be in removing the latent moisture. Introduction of a very small and efficient air-to-air heat pump (a "mini-split") can remove this moisture and provide adequate cooling.

The Passive House Standard

There are many elements to passive house design that need to be integrated…wall thickness, R-or U-values, thermal bridge co-efficient, airtightness, ventilation sizings, windows, solar orientations, climate, energy gains and losses. The Passive House Planning Package starts with the whole building as one zone of energy calculation and, allowing the designer to manipulate a number of essential variables, enables the computation of the energy balance of the design. The Passive House Standard is met when:

- The space heating requirement of the design is less than or equal to 15kWhr/m2a
- The primary energy use of the design is less than or equal to 120 kWhr/m2a
- The airtightness of the building is verified to be at or below 0.6 ACH @50Pa
-



Comparison of specific energy consumption levels of dwellings

4 The Design – House Types and Renderings

Affordability and Economic Viability

Passive House design focuses intently on energy balances; energy gains and losses. That focus entails a valuation of energy efficiency that is far beyond the norm. But the norm is changing and energy efficiency is becoming profoundly important, both economically and environmentally. It has been called a "low-hanging fruit." It is improvement and innovation that can, and should, be very readily attained.

Compared to an identical building that complies with the minimum local energy codes, the higher insulation, window and ventilation system standards of a Passive House lead to extra initial investment costs, but on the other hand also to investment cost savings, for example by eliminating a traditional heating system.

The average cost increase is about 11% (ranges from 5%-17% depending on economic location and climate). Taking the operating cost savings into account this will result in a payback period of approx. 10-15 years. However, in this type of analysis future energy price developments introduce a relatively high degree of uncertainty.

A better measure to evaluate the economic viability is by determining the value of energy saved. For that we assume that the additional investment for the energy efficiency technologies and the solar thermal systems over 25 years of its useful service life would earn 4% interest. Additional operating and maintenance costs for the Passive House components are added to that figure. By dividing the annual costs for those components as we just determined by the annual energy cost savings, we receive a value per kilowatt-hour saved. This ratio is well suited for comparison taking into account future changes in cost of energy supply.

Preliminary Budget
3/18/2009

DATE: 5/12/2008
# of UNITS: 48

TOTAL DEVELOPMENT COSTS	Total	Per Unit
ACQUISITION		
Land (%)	280,000	5,833
Pre-closing costs	-	-
Site work	650,000	13,542
TOTAL ACQUISITION	930,000	19,375
HARD COSTS		
Construction @$130 per Sq. Ft.	7,216,560	150,345
Solar Thermal Systems (optional - not included)		
Photovoltaics, small wind (optional - not included)		-
TOTAL HARD COSTS	7,216,560	150,345
SOFT COSTS		
Architect / Engineering	360,000	7,500
LEED Programming (50,000 - not included)		-
Insurance	20,000	417
Title work	4,000	83
Legal	25,000	521
Appraisal	5,000	104
Survey/Site Tests	4,000	83
Environmental Survey	4,000	83
Construction Period Operating Expenses		
Property Taxes	10,000	208
Other Operating Expenses	10,000	208
Financing Costs	300,000	6,250
Marketing	80,000	1,667
Realtor fees	219,648	4,576
Appraisal and Title Work at Sales	50,000	1,042
Soft Costs Contingency	50,000	1,042
Home Ownership Association Setup Costs	2,500	52
Home Ownership Association Equity Setup	10,000	208
TOTAL SOFT COSTS	1,154,148	24,045
TOTAL DEVELOPMENT COSTS	**9,300,708**	193,765

TOTAL SOURCES	Total	Bedrooms/Bath	Square Feet	Sales Price	Number of units	Total Sq Ft	$/Sq Ft Constr
4 Single Fam. free standing	780,000	4 BR / 2 BA	1,400	195,000	4	5,600	728,000
2 Single Fam. attached	290,000	4 BR / 2 BA	1,400	145,000	2	2,800	364,000
4 Shotgun Houses	559,600	3 BR / 2 BA	1,280	139,900	4	5,120	665,600
4 Fourplex (8 accessible)	1,880,000	2 BR / 1.5 BA	861	117,500	16	13,776	1,790,880
18 Townhouse Units	3,330,000	3 BR / 2 BA	1,360	185,000	18	24,480	3,182,400
4 Appartments (2 accessible on)	482,000	2 BR / 1.5 BA	934	120,500	4	3,736	485,680
Sales Subtotal	**7,321,600**				**48**	**55,512**	**7,216,560**
CDBG Grants	300,000						
HOME and other Revenue sources	1,440,000	Over 2 Years					
EE Grant: 4 Fourplex x 3500 (S)	34,440						
EE Grant: 10 Single x 2500 (S)	25,000						
EE Grant: 18 Town x 2.5 sqft (S)	61,200						
EE Grant: 4 Appt x 2.5 sqft (S)	9,340						
Tax credits EE: $1500 per unit	72,000						
IL Clean Energy Comm. Found.	200,000						
Green Comm. Found.	46,000						
FHLB	300,000						
Grants Subtotal	**2,487,980**						
TOTAL SOURCES	**9,809,580**						
Total Developer Overhead	**508,872**	**7.1%**					