

LIVING BUILDING CHALLENGE PREREQUISITES

1. SITE DESIGN

(Responsible site selection)

The Kenton Living Building site covers an area of approximately 5,300 s.f. in an established North Portland residential neighborhood currently occupied by a 1950's era duplex. It is directly adjacent to the Interstate MAX light rail line and is zoned R-1 for increased density and potential mixed-use. The team's plans for the re-use of the existing duplex are detailed in the text for prerequisite No. 9.

The site meets all four exclusions listed in the Living Building Challenge prerequisite No. 1:

- It is not within 50-feet of Wetlands
- It is not on or adjacent to Sensitive Ecological Habitat
- It is not on Prime Farmland
- It is not within the 100 year floodplain

2. SITE DESIGN

(Limits to growth)

As stated above, the site selected for Kenton Living Building is currently occupied by a 1950's era duplex, thus meeting the Living Building Challenge prerequisite No. 2 for utilizing only previously developed sites.

It is worth noting that the concepts of 'building re-use/recycling' and 'site redevelopment with increased density' have been part of Renewal Associates' original concept for the site since they acquired it in 2004, well before the Living Building Challenge was announced last November at Greenbuild 2006. Spurred by the Challenge, the Developer formed the Kenton Living Building integrated design team in December 2006 in order to seriously pursue the design and construction of one of the world's first Living Buildings.

3. SITE DESIGN

(Habitat exchange)

Renewal Associates is in negotiations with the Columbia Land Trust in order to purchase and set aside a 5,300 square foot parcel of *otherwise developable* land in the lower Columbia River estuary in order to fulfill the Living Building Challenge prerequisite No. 3 for habitat exchange.

4. ENERGY

(Net zero energy)

Annualized net-zero energy use will be achieved by concentrating on reducing the demand for energy. Specific strategies include designing a well insulated building envelope, specifying energy efficient appliances and lighting, and employing daylighting and passive heating /cooling design strategies. To clarify the specifics of our approach, we have attached a diagram outlining our strategy to achieve net-zero energy (see Exhibit G). As with water usage, reducing demand is key to achieve net-zero use. Compared to a baseline code building, our project will be 71% more efficient, allowing the energy needs for the building to be met with a 20 kW array. The roof for the project has been designed with the optimal slope (for our latitude and climate) for photovoltaics.

Our net-zero energy strategy concentrates on three main areas to achieve maximum energy savings: load reduction, efficient systems and passive systems.

Load Reduction

The primary area of savings will be achieved by reducing the demand for space heating. A residential structure is, by its nature, a skin dominated building (the skin accounts for 31% of the building's energy use), therefore managing the building's wall, window and roof heat gain and loss is the most important step to achieving net-zero energy use. Included in the proposal's cost estimate is a super insulated, thermally broken ladder stud. (See Exhibit E) and ultra high performance wood windows. Early in the design process, Interface Engineering did a study of two different wall systems, comparing ICF (Insulating Concrete Forms) and built-up thermally broken studs. The thermally broken stud was much more cost effective and only marginally less efficient. Also included in the study was a comparison of three different glazing types (Heat Smart Plus 2 with double and triple glazing and Heat Smart Plus 3 with triple glazing) to allow us to use the most energy efficient strategy tied to window orientation. Interface Engineering also prepared a preliminary energy model in order to initially size the PV array.

Efficient Systems

Second, we plan to recover heat energy from the laundry and other miscellaneous equipment and to purchase 100% Energy Star (compact fluorescent) lighting with all exterior lighting occupancy sensors controlled to allow for a greater reduction in lighting use. All Energy Star appliances will be purchased for the complex, including special low energy dishwashers and clothes washers. Individual units will each be net-metered and tied back to their 4 kW PV array, providing clear feedback and incentive to each tenant to monitor their energy use and use energy saving practices in their daily life.

Passive Systems

Finally, we are also proposing energy saving, passive strategies including natural ventilation and daylighting. Careful site massing and placement of windows to capture breezes will allow the building to be cooled in the summer without the addition of air conditioning. Large windows with the glazing specifically selected based on the orientation's requirements for heat gain and light allow the project to be optimized for daylighting without additional heat loss penalties.

5. MATERIALS

(Materials red list)

The entire project team is committed to utilizing materials that will meet the Living Building Challenge prerequisite No. 5 for avoiding "red-listed" materials or chemicals. We will be utilizing SERA's extensive green materials database as our first source for product selection. We look forward to expanding the team's knowledge of compliant materials, products and systems through direct participation in Cascadia's Living Building interactive dialogue page and the evolving Pharos web interface. Clearly the materials red list prerequisite is one of the most challenging for a project of any scale to attain. Yet, it is also one of the most important prerequisite to pursue in order to evolve the market through proactive interaction with manufacturers and suppliers. Our team applauds the Living Building Challenge for bringing the particular issue of toxicity into the realm of green building standards.

6. MATERIALS

(Carbon footprint)

Renewal Associates will purchase a carbon offset for the project in accordance with the Living Building Standard's offset formula, as it is made available.

7. MATERIALS

(Responsible industry)

All wood in the project which can be sourced from FSC certified or salvaged sources, will be. We offer our pledge in this manner because we have found certain commercial construction wood products are not yet available in FSC wood (e.g. engineered wood joists, SIPS panels, etc.) and we feel that moving to all, virgin solid FSC structural timber is probably not the most sustainable approach to building this building. We look forward to engaging Cascadia in this dialogue and are open to changing products and materials, as needed, as the discussion progresses in order to meet the intent and the letter of the Living Building Challenge.

8. MATERIALS

(Appropriate materials radius)

Project materials will be procured in accordance with the Materials/Service Radius requirements set forth by the Living Building Standard. The current conceptual design has already identified most of the project's systems and materials, all of which meet the intent of the Living Building Standard Materials/Service radius except the following "materials conundrum".

Our team has found a product which does not meet three of the LBC's prerequisites, yet it captivates us because of its deep and long-term sustainability potential. It is Agriboard, an agri-fiber SIPS panel manufactured in Kansas. It uses Kansas crop-waste (wheat and rice straw) as its insulating core material contained within a conventional timber frame sandwiched between conventional OSB panels.

Its *problems* are that the OSB panels contain urea-formaldehyde (LBC prereq. No. 5), the timber is not FSC certified (LBC prereq. No. 7), and the product (which we would classify as lightweight) is manufactured 1800 miles away from the project, 800 miles over the allowed radius (LBC prereq. No. 8).

Its *opportunities* are that it represents an approach to a highly insulating envelope product (SIPS) which could be fabricated sustainably in perpetuity in many, if not most locations. This is not true for the typical SIPS technology, which uses petroleum based polystyrene as its insulating material. As a start to solving at least one of the conundrums, we plan to approach our regional SIPS manufacturers to create a demonstration product for this project, using crop waste material from our region. Perhaps we can also link the manufacturer with local producers of FCS plywood to create a product fully meeting the Living Building Challenge.

9. MATERIALS

(Construction waste)

Initially, the Kenton Living Building team anticipated demolition of the existing house with the recycling of the existing materials using the Demolition Recycling Schedule attached as Exhibit J. This plan is in process of revision. Renewal Associates is currently in discussion with Peninsula Community Development, a non profit organization that manages affordable housing in North Portland, to find a new

home for the existing building, thus “upcycling” the building from its current market rate status.

Based on projects SERA and Seabold Construction have done throughout the Portland Metro area we know it is possible to meet the goals identified in the Living Building Challenge for building construction waste recycling. Within a five mile radius of our site we have the following construction waste centers: American Compost & Recycling (wood), Metro (drywall and metals), Schnitzer Steel (metal), the ReBuilding Center (windows, doors and virtually any miscellaneous building item), and Construction Waste Recycling (concrete). Expanding to a twenty mile radius includes five other major recycling centers. See our boards for locations of the major recycling centers relative to our site.

10. WATER

(Net zero water)

We have found that the most difficult LBC prerequisite for this small scale project to meet is net-zero water. To achieve the significant reduction in demand needed to make a combination rain/gray water strategy feasible, we will incorporate the following water saving features: ultra low-flow shower heads, ultra low-flow faucets at sinks, and energy efficient, ultra low water use dishwashers. Water for toilet flushing is almost entirely eliminated through the use of composting toilets and water for clothes washing is greatly reduced through the incorporation of a green dry cleaning machine available for communal use in the basement. We plan to have a commercial grade, energy efficient clothes washer for common use, as well. These strategies combine to reduce potable water demand by 61% compared to a standard residential development.

We have calculated the demand for water using the LEED® residential calculator as follows:

See Exhibit A for LEED® Water Calculator and Exhibit B for Catalog Cuts of the water using appliances proposed.

Number of Occupants =	12				
	Uses / Day	Flow rate	Gallons per Use	Gallons per Day	Gallons per Year
Water Closet	5	N/A	.125	7.5 gallons	2,737.5 gallons
Lavatory	5 (15 sec)	.5 GPM	.125	7.5 gallons	2,737.5 gallons
Kitchen Sink	4 (1 minute)	1.0 GPM	1.5	72 gallons	26,280 gallons
Shower	1 (5 minute)	1.5 GPM	7.5	90 gallons	32,850 gallons
Dishwasher	1 / day / per unit	N/A	4.75	23.75 gallons	8,669 gallons
Clothes Washer	2/ week / per unit	N/A	9-16 (avg. of 12.5)	17.81 gallons	6,500 gallons
TOTAL				218.56 gal/day	79,774 gallons
				18.2 gallons/ person/ day	

Our site area is 5,300 s.f. and the building roof area is 3,320 s.f. Based on the Rain Water Harvesting

Calculator developed by the Texas Water Development Board (see Exhibit C), we do not have enough impervious area on the site to meet even the reduced water demand shown above for twelve people. Because we believe increasing urban density is a fundamental sustainability strategy, we are not considering reducing the project size (and demand) to be in balance with the available collection area; instead, we intend to implement gray water strategies to meet our projected shortfall.

Allowing gray water to be used for the rinse component of the composting toilets and for clothes washing will reduce the annual demand for water usage by approximately 9,240 gallons. Reuse of rain water for clothes washing and toilet flushing is not currently allowed in Portland. Therefore, the Kenton Living

Building Design team will pursue the necessary code appeals for gray water reuse. The Rain Water Harvesting Calculator indicates a catchment area of 3,600 s.f. and a tank size of 40,000 gallons will be adequate to meet our remaining water demand (less gray water reuse). One of our team members created

a spreadsheet to allow us to test our proposed cistern capacity using the last fifty years of actual rainfall data. (See Exhibit D). Based on the spreadsheet, our project would only have been without water for 13 days in 1994 and 3 days in 2001. (Presumably knowing the cistern was close to running dry, tenants would enact further conservation measures)

Our team is exploring the addition of a covered parking or play area south of the units which would provide the additional 280 s.f. of catchment area beyond what is supplied by the current roof design.

11. WATER

(Sustainable water discharge)

The remaining 1,700 s.f. of site area will be developed with native plants and permeable hardscape materials. Based on investigations by our geotechnical engineer, Alder Geotechnical, we know our site is blessed with well draining soils that are wonderfully suited for on-site infiltration of any excess roof runoff, which may occur in the winter during especially wet years. A drywell will be installed to allow excess storm water to soak back into the ground and recharge the Columbia Slough watershed aquifer. The City of Portland does not require pollution reduction treatment before the runoff enters the drywell because the majority of our storm water is clean, rooftop runoff.

In addition to managing storm water on site, achieving the sustainable water discharge prerequisite requires that the project address the building's gray water discharge. Gray water is defined under Oregon code as "untreated household waste water which has not come into contact with toilet waste. Gray water includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washers and laundry tubs. It shall not include wastewater from kitchen sinks or dishwashers."

Achieving gray water discharge will require that several appeals be granted through the City of Portland and State of Oregon Department of Environmental Quality. Specific appeals identified for our project include use of gray water for clothes washing and toilet flushing, and infiltration of gray water discharging onto the site. (Appendix G of the State Plumbing code allows gray water to be used as subsurface irrigation, but DEQ requires all urban locations to connect to a sanitary sewer if they are within 500' of a sanitary line.) Based on inquiries we have made about the possibility of achieving success with a gray water reuse appeal, we know that the State will likely require gray water to be treated to potable standards. However, per discussions with the State Plumbing Inspector, the use of gray water for non drinkable, potable uses, such as washing clothes and flushing of the toilets, may be possible with less treatment and thus less expense.

Pat Lando of Lando and Associates, the landscape architect for our team, will be working with Jon Gray of Interface Engineering (who serves on the state's plumbing advisory board) to explore the best avenues for an appeal. Treatment of gray and black water to potable drinking standards is currently achievable through

both natural (living machines, constructed wetlands) and mechanical (filtering and UV) technologies; designing these incremental innovations into our project will help to enact incremental changes in the law. To meet today's requirements, we propose that food waste will be composted on-site, with a grease

interceptor installed in kitchen sinks and the water conveyed to the composting toilet. In addition, our team is investigating approved methods of gray water discharge into the landscape that will address the build up of salts, bacteria (et al.) in the system, as well as treatments for preventing root penetration.

12. INDOOR ENVIRONMENTAL QUALITY

(Civilized work)

Architectural form influences quality of light, which in turn affects human experience. Studies have shown that daylight can be used to encourage interaction; it can shape our social connectedness by stimulating people to pause, sit, talk, gather or interact. It can also be used to reinforce privacy and separateness. The ability of a residential community to offer both types of space is important to creating a building that provides lasting support for its occupants. Before exploring forms that could best meet the Living Building Challenge's design objectives, we reviewed both qualitative and quantitative daylighting criteria as one of many environmental criteria to be incorporated in the design process. Room depth and height rules of thumb were used to understand how the appropriate quality and quantity of light can be made available to all spaces.

For the Kenton Living Building's eco charette, two very different designs were produced to serve as "straw men" to provoke debate – the first, a linear row of townhouses and the second, a building organized vertically using flats. The opportunities to collect rainwater and the amount of roof area available for photovoltaics remained consistent in both designs. The ability to offer a variety of daylighting solutions and the interaction of a possible community-focused building element (the vertical stair) ultimately led us to arrive at the two-building, stacking flats concept diagram currently proposed. As we continue to develop the design, we are committed to exploring the building's spatial system and its response to light with the same rigor we have spent on integrating the essential disciplines of the building's energy and thermal comfort systems.

13. INDOOR ENVIRONMENTAL QUALITY

(Source control)

Our buildings should be safe havens for us, places of shelter and protection. In order to achieve this we need to build them to be in alignment with people's expectations of safe environments; free from harmful toxins, chemicals and poor, or even harmful, air quality.

The Living Building Challenge rightly forces our industry back to these basic principles.

In order to achieve fundamental indoor environmental quality the Kenton Living Building will meet or exceed all of the elements of prerequisite No. 13:

- All entryways (including those to the basement) will have an external dirt track-in system and an internal counterpart within a distinct interior entry space.
- All kitchens and bathrooms will be provided with separate ventilation to the exterior.
- The project does not have any copy rooms or janitorial closets, but the basement laundry and green dry cleaning area will be provided with separate ventilation to the exterior.
- At a minimum, all interior finishes including, but not limited to paints and adhesives will comply with the current version of SCAQMD 2007/2008 standards. Also, all other interior materials including, but not limited to flooring and casework will at least comply with California Standard 01350 for IAQ

- emissions.
- The building and the entire project site will be designated as non-smoking, even though it is residential building which allows it to qualify for a Living Building Challenge exception. The tenant rental/lease agreement will specify this. The owner/Developer, Renewal Associates, sees the lease agreement as a powerful tool for sustainability education and self-selection of like-minded tenants.

14. INDOOR ENVIRONMENTAL QUALITY

(Ventilation)

In keeping with the team's commitment to a safe indoor environment as outlined above, the Kenton Living Building will provide each unit with a Heat Recovery Ventilator (HRV) to provide plentiful and naturally tempered fresh air during all hours of the day and all seasons, especially when the operable windows are closed during the colder months. The HRV systems will be sized to meet or exceed California's Title 24 requirements.

These systems utilize very high efficiency, variable-speed fans and an air-to-air heat exchanger to maximize their energy efficiency.

15. BEAUTY & INSPIRATION

(Design for spirit)

"Good places provide support conditions and opportunities for people. They provide settings that are precise, generous and evocative; liberating and inspiring as well as accommodating. Good places embody much and their design is always based on much." William Kleinsasser

Much has been written about the need for architecture to provide beauty and inspiration. In addition to being immediately useful and accommodating, responsive to place and setting, well built and well coordinated; good places must be lucid and alive. They must touch the human spirit. Achieving good design requires a synthesis of many factors; it only becomes clear slowly after great effort on the part of the designer.

For the Kenton Living Building, we will continue our design explorations to provide physical conditions for people so that they will find it easy to pause and stay - especially in places where they are anyway (our unit entries, the central stairway and the shared outdoor space). In addition to responding to the place and climate, to utilizing solar and other passive heating and cooling strategies, we are creating a building that embodies and expresses the essential spirit of its place - one that reflects the way the building is formed by the distinguishing qualities of the place. By developing a spatial structure that allows for flexibility, by establishing spatial variety and a range of spatial opportunities, and most importantly, by developing the full potential of in-between, residual or left over spaces, we hope to lift the human spirit of those that inhabit our creation. For the Kenton Living Building, we believe our highest goal is to recognize the opportunity for the synthesis of real beauty and appropriate response to the environmental conditions affecting the world.

16. BEAUTY & INSPIRATION

(Inspiration and education)

The Kenton Living Building's "lessons-learned" as well as many of its elements, will be transferable to projects of different types, sizes, and programs. For example, water conservation strategies involving gray and black water purification and reuse on-site (currently not permissible), will undoubtedly generate a dialogue between the project team and code officials that should lead to wide-spread opportunity and ultimately less expensive approaches to wastewater management. The large solar array will likely be the

first thing to draw attention and is readily transferable to buildings of all scales. The planned display of energy and water data at the northeast corner of the property, which will educate visitors and passers-by as to the building's benefits, is also transferable. For building resident's edification, we plan to have the unit electrical meters and rain and gray water storage tank gauges located along the central "vertical street".

Because the project has the real potential to be the first of its type anywhere, the interest of local and national press should bring strong attention to the need to protect the environment and advance the state-of-the-art in green building, as well as to Portland's continuing leadership in this arena. Through visits, tours, and promotion by both the City's Office of Sustainable Development and the development team, information on the design challenges, solutions, and operations of the building will be widely disseminated. This will serve to build interest and professional capabilities locally, regionally, and beyond.

Our plan to include a modest childcare center in the building means that many young children (and parents) from the diverse and growing local community will be skilled users of the exceptional sustainable features and operations of the Kenton Living Building. This will multiply its "ripple and splash" effects for decades to come.