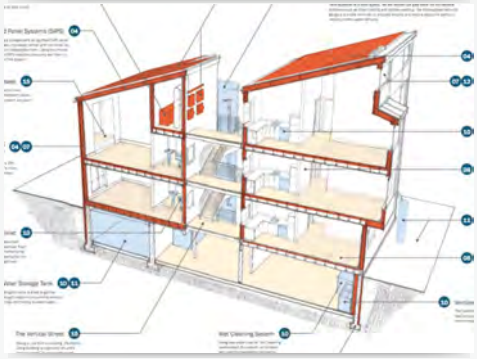


Kenton Living Building

Imagine a building that generates 100% of its electricity needs with on site renewable energy, that only uses rainwater collected on-site for all plumbing fixtures and that sends no waste water into Portland's sewer system. These triple-net-zero aspirations describe only a few strategies that the Kenton Living Building will use to meet the Cascadia Region Living Building Challenge (LBC). As a new four-unit condo project, the Kenton Living Building will serve as a model for development that truly meets the needs of today and the future.

Project Highlights

- **Solar PV system**
- **Living Building Challenge housing:**
- **Net-zero water**
- **Net-zero energy**
- **Sustainable water discharge**
- **Sustainable materials and procurement**

Portfolio Contents

- **GIF Summary Report**
- **Living Building Challenge Poster**

Project Website (External Link)

KENTON LIVING BUILDING

Design Team

DEVELOPER
Renewal Associates

ARCHITECT
SERA Architects

MEP ENGINEERS
Interface Engineering

LANDSCAPE ARCHITECT
Lando and Associates

CIVIL ENGINEER
MGH Associates

BACKGROUND

The germination of the Kenton Living Building project occurred at a chance meeting of R. Peter Wilcox, president of the sustainable development firm Renewal Associates LLC, and Clark Brockman, sustainable architect with SERA architects, at the 2006 USGBC Greenbuild conference in Denver. It was at that Greenbuild that the idea of living buildings was first shared with members of the USGBC. Clark was already familiar with the living building concept through his involvement as a board member of the Cascadia Green Building Council. Peter was searching for ways to push sustainability much further in his own infill, transit-oriented development work, which included the just-begun Mississippi Avenue Lofts project in Portland, anticipated to be certified LEED Platinum. And Peter owned what both he and Clark felt to be an ideal piece of property in a highly visible location right on the light rail line in the Kenton neighborhood of North Portland.

The idea of developing a living building – effectively the first building that would meet the test of true sustainability – this was, and remains, extremely compelling. Both knew that the design and development challenges would be extreme, but were anxious to do what had not yet been and needed to be done.

As Peter and Clark, soon joined by Lisa Petterson of SERA, began to dig deeper into the logistics of this living building project, they quickly recognized an opportunity for significant seed funding for this extremely costly undertaking. This came in the form of the largest grant commitment ever made by the City of Portland's highly competitive Green Investment Fund. That grant has made everything described in the following report possible. And the City of Portland is the object of thanks for their vision and concrete actions to help sustainable developers and architects push the envelope of sustainable design.

Thus began the Kenton Living Building project, and it is not over yet…

GIF Summary Report

SUMMARY

The 5,300 sf Kenton Living Building site is located at 1504-6 N. Watts, right on the Interstate MAX Light Rail. The new four-unit project, that replaces the above grade elements of an existing duplex, will total 6,170 sf on a 1,846 sf foundation. To maximize density a small area with a new slab-on-grade has been added to the northern portion of the site.

The tremendous innovation of the Kenton Living Building is embodied in its attempt at fulfillment of the Living Building Challenge™. In doing so, the Kenton Living Building will accelerate the advancement of Portland's green building movement towards full sustainability. Four challenges face the design team: achieving net-zero water, net-zero energy, sustainable water discharge, and materials selection and procurement.

The most difficult Living Building Challenge™ goal for a project of this scale is net-zero water. We anticipate the Kenton Living Building will comply through careful collection and reuse of rain and gray water. The project team plans to submit a code appeal seeking approval to treat its 40,000 gallons of rain water to potable standards. In fact, no storm water will ever leave the site. Black water (waste water from toilets and kitchen sinks) will be eliminated by the installation of evaporating composting toilets (the resulting night soil will be used in an FSC forest partnered with the project). These water innovations will acheive net-sero water by integrating multiple strategies that have been used in isolation in Portland, but never before in aggregate.

Net-zero energy will be achieved by concentrating on efficient use, storage, and reuse of energy. The remaining energy will be produced by a 24kw solar photovoltaic array. We anticipate that the Kenton Living Building envelope will outperform the Oregon Energy Code by 70-75%.

Using SERA's extensive green materials database as our first source for product selection, we will be challenging manufacturers in our region to create compliant materials, products and systems that are ecologically sound, as well as environmentally

Figure 1 — Photographs from the EcoCharrette

friendly.

PROCESS REPORT

This section of the Report summarizes the processes the team utilized to determine how the Kenton Living Building (KLB) could achieve the sustainability goals of the project. This section is divided into five subsections as follows:

- Ecocharrette
- Net Zero Water
- Sustainable Water Discharge
- Net Zero Energy
- Materials / Radius

A summary of the how the project intends to meet each of the sixteen prerequisites of the Living Building Challenge™ follows this section.

PRELIMINARY INVESTIGATIONS

Prior to the EcoCharrette the team prepared a site analysis to review the effects of various climatic factors on the project. The analysis included a review of the site's potential solar access, wind availability, monthly rainfall, and monthly temperatures, to give the team an understanding of the effects these factors would have on the overall project.

The team also prepared a solar / shading analysis of the site to assist in locating PV on the exterior of the building where other buildings in the immediate area would not be shading it. This analysis was done with the surrounding buildings at their current height, and then was redone with the lots to the south of the site built to the full height allowed by zoning. A copy of the solar / shading analysis follows this plan.

One of the difficulties of the site is it is not located optimally for passive solar, as the site is elongated in the north / south direction.

Figure 2 — Site aerial and photograph

PRELIMINARY ENERGY END-USE BREAKDOWN

To prepare for the EcoCharrette, Interface Engineering produced an energy analysis of a typical residential building. Through this process of identifying the anticipated energy loads, the team was able to focus on energy strategies which would make the greatest difference.

ECOCHARRETTE GOALS

Through this preliminary work and the team's expertise in energy efficient design, a target energy use index for the project of between 10-14 kBTU/sf was established. This equates to approximately 75% energy improvement over a comparable building.

Energy reduction strategies proposed at the EcoCharrette included:

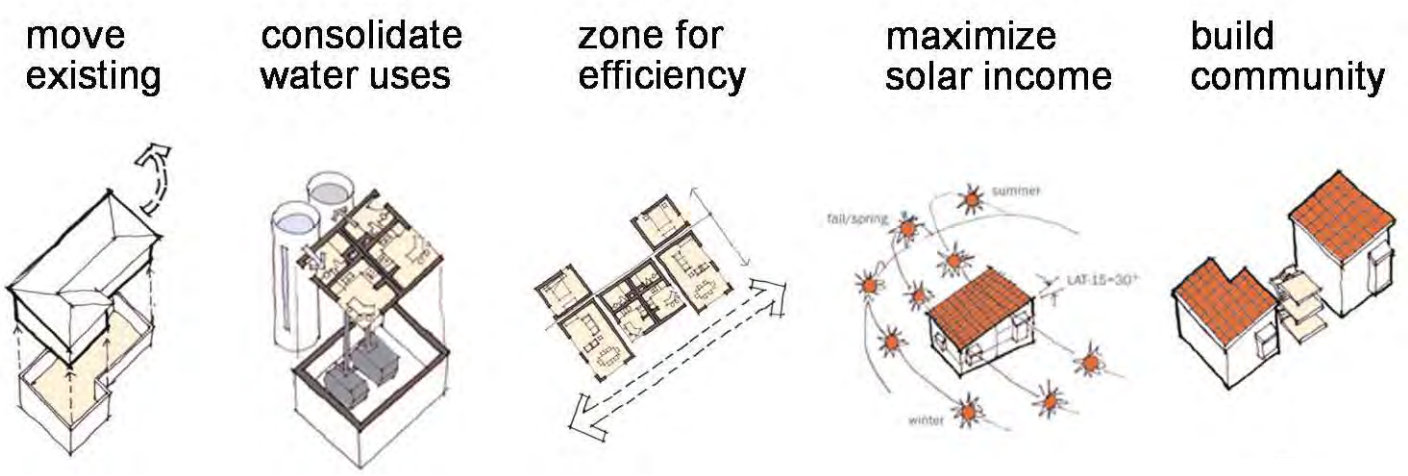
- Highest performance envelope
- Maximized use of passive systems
- Slabs/ Mass
- Daylighting / Passive Solar
- Incorporate most efficient lighting and appliances
- Make Occupant's aware of their energy use in order to incent lower energy use.

During the charrette, the team determined simple first cost passive systems would be favored over more expensive systems.

Following the EcoCharrette, the team developed the concept using a series of vignettes. The overall project goal for the Kenton Living Building is to meet all of the prerequisites of the Living Building Challenge™. In the sections that follow, we highlight four specific prerequisites which are the most challenging for the project. An appendix outlines our approach and costs associated in meeting each of the Living Building Challenge prerequisites.

A summary of the how the project intends to meet each of the sixteen prerequisites of the Living Building Challenge™ follows this section.

Figure 3 — Vignettes from concert development



NET ZERO WATER

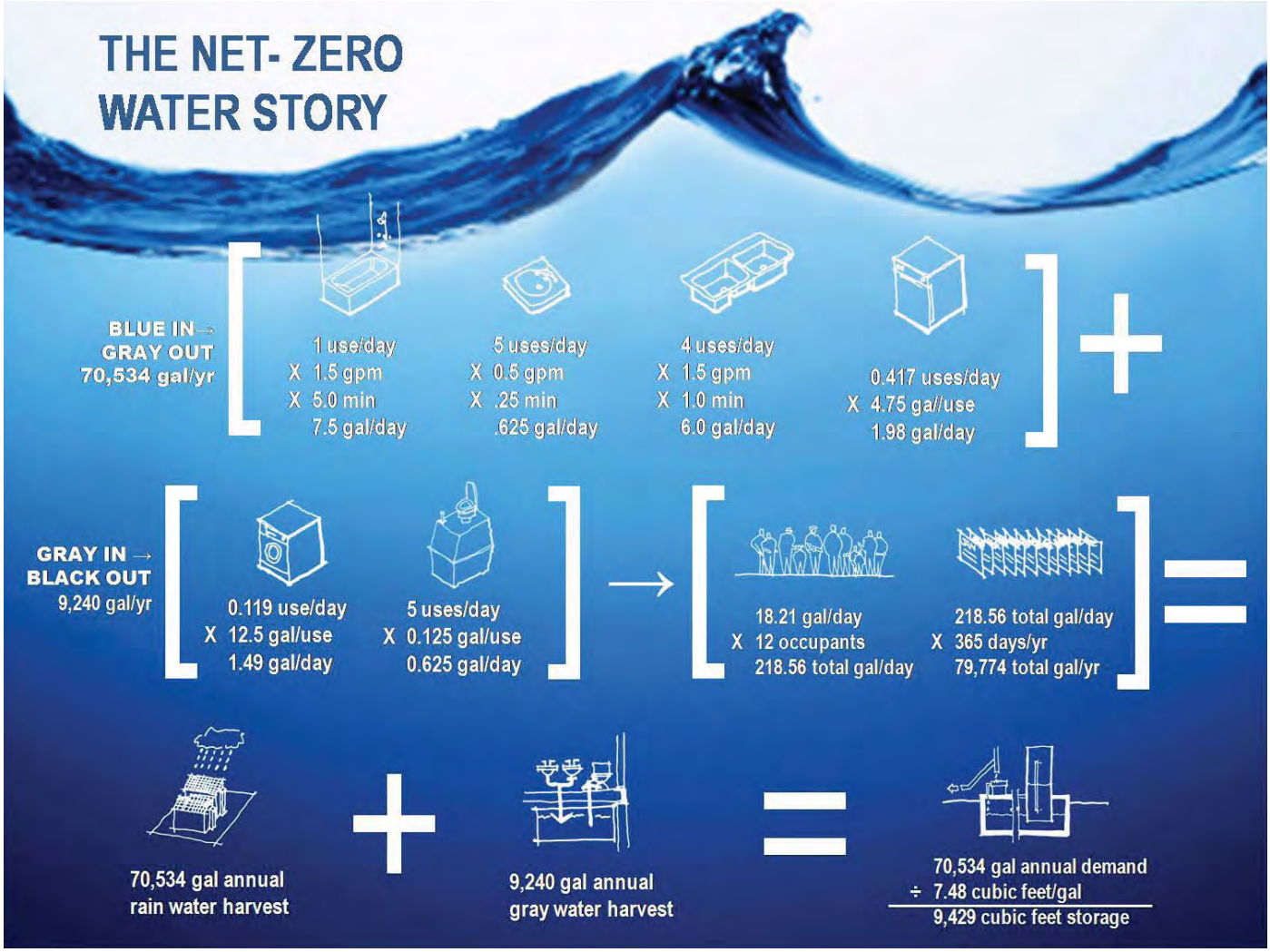
GOALS

The Living Building Challenge™ Prerequisite 10 (Net-Zero Water) declares: *"100% of the occupant's water use must come from captured precipitation or reused water that is appropriately purified without the use of chemicals"*.

METHODS

The most difficult LBC prerequisite for a project of this scale is net-zero water. To achieve this prerequisite, significant reduction in demand is needed to make a combination rain/gray water strategy feasible. Since conservation is the first step, the project started by employing 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; 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

Figure 4 — The net-zero water story



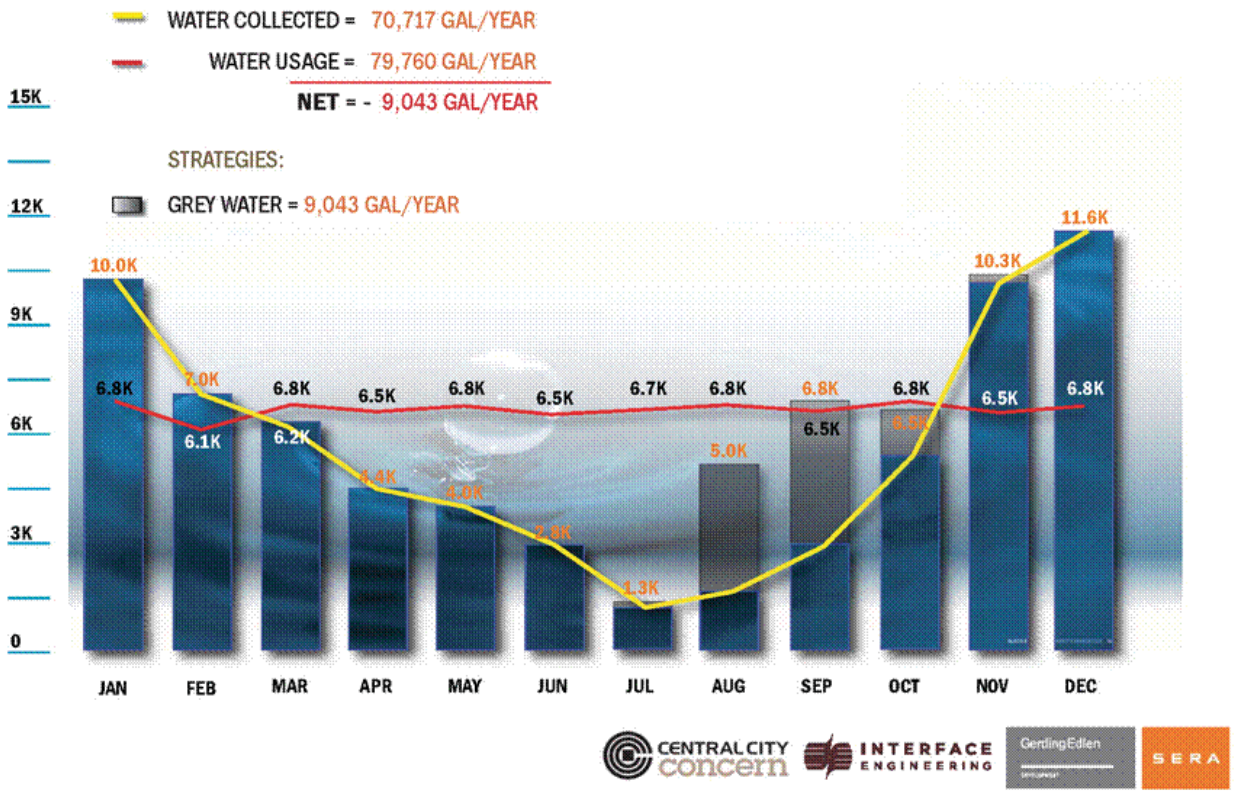
to reduce potable water demand by 61% compared to a standard residential development.

Using the rain Water Harvesting Calculator developed by the City of Portland, we quickly realized we do not have enough impervious area on the site to meet even the reduced water demand for a building with eight to twelve people living full time in it. Because we believe increasing urban density is a fundamentally sustainable strategy, we are not considering reducing the project size (and thus demand). Therefore in order for the project to be in balance with the available collection area; instead, we intend to implement a gray water collection and reuse strategy to meet our projected shortfall; a strategy that was in violation of the Uniform Plumbing Code when we started the project. Another consideration for increasing the available water would be the use of a neighboring property's roof run-off. As well as negotiation, this would require a stormwater easement.

OUTCOMES

The allowance of gray water to be used for the rinse component of the composting toilets and for clothes washing will reduce the project's annual demand for water usage by approximately 9,000 gallons, allowing the remaining 70,000 gallons of water able to be collected meeting the project's projected usage. Realization that the Kenton Living Building could not legally use greywater to meet this prerequisite led the team to begin the process of appealing the building and state health code regulations that prevent grey water reuse. At

Figure 5 — Annual water collection and use



first we met significant resistant from code officials and the industry alike. Through a grant SERA pursued with Central City Concern, funded by the Bullet Foundation, we identified 22 different appeals or jurisdictional hurdles which need to be overcome to achieve net-zero water in Oregon. Although Kenton Living Building does not need to treat its black water (due to the incorporation of composting toilets), we faced significant opposition to even the small amount of greywater reuse proposed for the project. Today, in part because of the report "Achieving Water Independence in Oregon's Mixed Use Buildings", we now have three additional statewide allowable uses for grey water, and the Kenton Living Building project considers net-zero water achievable.

As the result of the recent alternate means and methods the project's water use strategy is now legal. Two separate alternate means and methods allow greywater to be used for toilet flushing and clothes.Figure 5 shows the amount of rainfall falling on the Kenton Living Building by month and the amount of water anticipated to be used by the project's residents.

STRATEGIES

The amount of roof area needed to collect that amount of potable water was analyzed utilizing data from the City of Portland Rainwater Harvesting Calculator. To analyze the extreme conditions, averages from five dry years and five wet years were analyzed. The area needed to provide adequate potable water to meet demand was compared to the roof area available for the new design. The team found that even in a dry year the building could collect water for all potable water requirements. Potable water is defined as water to be used in sinks, showers, dishwashers, and for drinking. The five wet years were used to calculate the size of the rainwater tank, noting that the tank could serve as a detention facility to assist in storm water management. Excess flow from the tank will be sent to a local drywell proposed for the site.

SUSTAINABLE WATER DISCHARGE

GOALS

The Living Building Challenge™ Prerequisite 11 (Sustainable Water Discharge) declares: "100% of storm water and building water discharge must be handles on-site".

METHODS

The unbuilt portion of the site (approx. 1,700sf) will be improved with native plants and permeable hardscape materials. Based on investigations by our geotechnical engineer, Alder Geotechnical, we know the 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 will be 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."

OUTCOMES

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 (both approved), and discharge of gray water by infiltration 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. Recent greywater law changes may allow for the treatment and discharge of greywater for irrigation. This is the last remaining technical hurdle for the Kenton Living Building in its pursuit of the Living Building Challenge™.

STRATEGIES

Pat Lando of Lando and Associates, the landscape architect on 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.

NET ZERO ENERGY

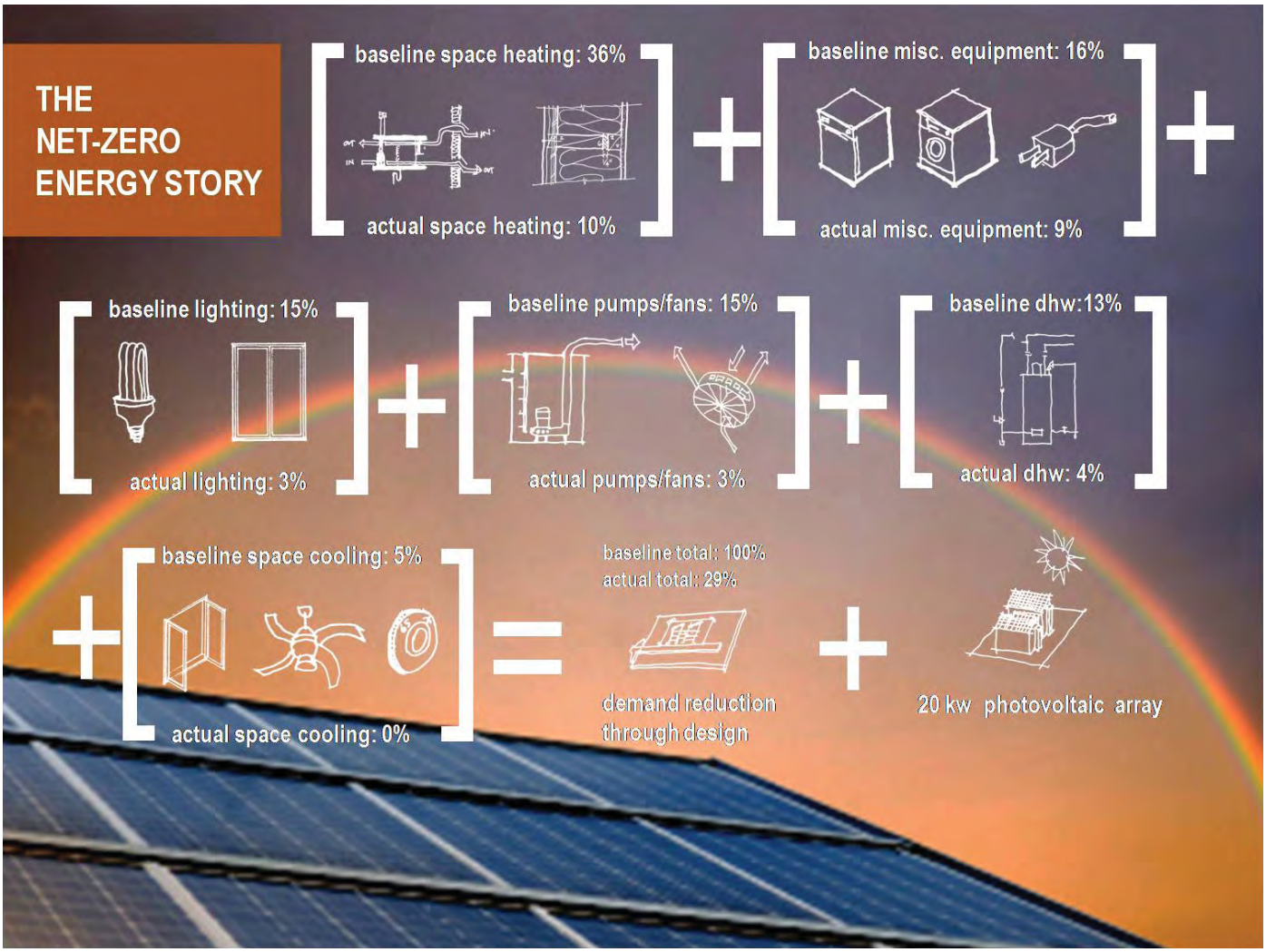
GOALS

The Living Building Challenge™ Prerequisite 4 (Net-Zero Energy) declares: *"100% of the building's energy needs are supplied by on-site renewable energy"*.

METHODS

Our net-zero energy strategy concentrates on three main areas to achieve maximum energy savings: load reduction, efficient systems and passive systems. To maximize load reduction, the Kenton Living Building first employed all energy conservation strategies possible, including super efficient envelope, utilizing ladder stud construction to eliminate thermal bridging, triple glazing, heat recovery ventilators and simple radiant heating. Through predictive modeling we anticipate that the Kenton Living Building will exceed the Oregon Energy Code by 70-75% with the remaining energy produced by a 24kw solar photovoltaic array. Next the Kenton Living Building project looked at reductions through energy efficient lighting (all compact fluorescent lighting and linear fluorescents) and energy efficient appliances. Finally passive design strategies were employed where possible.

Figure 6 — The net-zero energy story



OUTCOMES

The amount of energy used by a building is a result of the interaction of climate and the building's program. If a building design is optimized to take advantage of its interaction with the climate and use patterns, both its total and peak energy use can be substantially decreased, thereby reducing first cost and operating costs.

To aid in understanding our approach, we have also attached our annotated analysis showing our strategy to achieve net-zero energy. As we saw with water usage, reducing demand is key to achieve net-zero. Based on the code calculations, our project will be 71% more efficient than a code building, allowing the energy needs for the building to be met with a 24 KW array.

Since its apex in the 1970's, solar design has lost traction in the architectural community. The reputation passive solar and daylighting design has for producing unappealing buildings springs from a lack of integration between technology and art and a lack of integration of the building into its context. Examples include photovoltaics placed at unpleasant angles, at odds with the lines of the building and roof forms that are not designed with the greater community, including adjacent residents or businesses, in mind.

Early schemes for the Kenton Living Building suffered from this same folly. One of the outcomes of the redesign effort was a realization that context related site issues needed to come first. The revised Kenton Living Building addresses the concern of early studies, while still producing the energy needed for net zero energy. When the design of the PV array was adjusted from the optimal tilt (32 degrees) to horizontal, power production suffered a 10% reduction. In order to compensate for that loss, the array was increased in size from 20 to 24 kW (a 10% margin was also added to the equation).

STRATEGIES

Load Reduction
The primary energy savings will be achieved by reducing the demand for space heating. A residential structure is, by its nature, a skin dominated building (heat gains and losses from the envelope 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. The change from five flats to four townhouses greatly reduced skin losses as well. Included in the proposal's cost estimate is a super insulated, thermally broken ladder stud 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 lighting (compact fluorescent) with all exterior lighting controlled by occupancy sensors to allow for a greater reduction in lighting use.LED lighting was also considered but the current market is not producting commerical viable LED at a reasonable cost. 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 the 24 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 use 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. Although the site's orientation (long axis North–South) did not allow all units to take advantage of passive solar design, the southern-most unit has been designed to maximize gains from passive solar.

MATERIALS

GOALS

The project team has identified four of the five materials rerequisites as potentially difficult for the Kenton Living Building. The text of these four prerequisites is given below.

Prerequisite Five – Materials Red List
The project cannot contain any of the following Red List materials or chemicals.

- Cadmium
- Chlorinated Polyethylene and Chlorosulfonated Polyethlene
- Chlorofluorocarbons (CFCs)
- Chloroprene (Neoprene)
- Formaldehyde (added)
- Halogenated Flame Retardants
- Hydrochlorofluorocarbons (HCFCs)
- Lead
- Mercury
- Petrochemical Fertilizers and Pesticides
- Phthalates
- Polyvinyl Chloride (PVC)
- Wood treatments containing Creosote, Arsenic, or Pentachlorophenol

Prerequisite Seven – Responsible Industry
All wood must be certified by the Forest Stewardship Council (FSC), from salvaged sources, or the intentional harvest of timber onsite for the purpose of clearing the area for construction.

Prerequisite Eight – Appropriate Materials/Services Radius
Source locations for Materials and Services must adhere to the following restrictions:
Weight/Distance List

ZONE	MATERIAL OR SERVICE	MAXIMUM DISTANCE
7	Ideas	12,429.91 miles
6	Renewable Energy Technologies	9,000 miles
5	Assemblies that actively contribute to building performance once installed	3,000 miles
4	Consultant Travel	1,500 miles
3	Light, low density materials	1,000 miles
2	Medium Weight and density materials	500 miles
1	Heavy, high density materials	250 miles

Prerequisite Nine Leadership in Construction Waste
Construction Waste must be diverted from landfills to the following levels:

MATERIAL	MINIMUM Diverted/ Weight
Metals	95%
Paper and Cardboard	95%
Soil, and Biomass	100%
Rigid Foam, Carpet & Insulation	90%
All others – combined weighted average	80%

METHODS

Project materials will be procured in accordance with the Materials/Service Radius requirements set forth by the Living Building Challenge™. The current conceptual design has 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".

Early in the design process, our team 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 local 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 (prohibited by Living Building Challenge™ prerequisite 5), the timber is not FSC certified (required by LBC prerequisite 7), and the product (which we would classify as medium weight) is manufactured 1800 miles away from the project, which is 1300 miles over the allowed radius (see Living Building Challenge™ prerequisite 8).

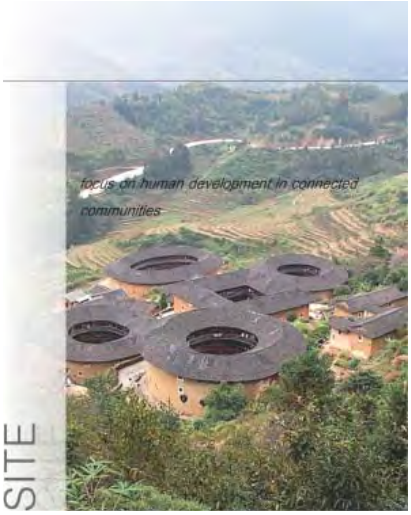
Its opportunities are that it represents an approach to a highly insulating envelope product (SIPS) which could be fabricated sustainably in perpetuity in many, if not most locations. This is not true for the typical SIPS technology, which uses petroleum based polystyrene as its insulating material.

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 prerequisites to pursue in order to evolve the market through proactive interaction with manufacturers and suppliers.

OUTCOMES

Initially, the Kenton Living Building team anticipated demolition of the existing house with the recycling of the existing materials. Renewal Associates opened discussions withwith two different local community development corporations, and later with vacant property owners in the area 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.



SITE

LIVING BUILDING CHALLENGE™ PREREQUISITE APPROACH

The sustainability plan below outlines the Kenton Living Building's approach to meeting each of the sixteen prerequisites of the Living Building Challenge™ with an estimated cost for each prerequisite.

1. RESPONSIBLE SITE SELECTION

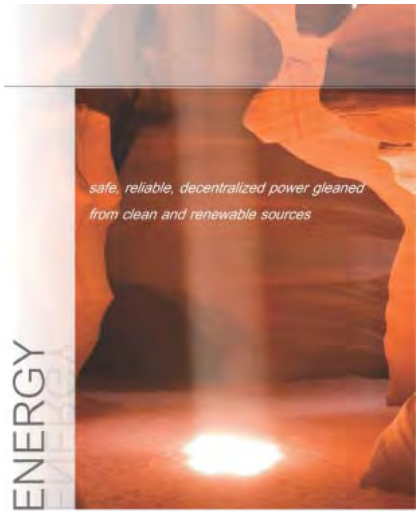
Statement	The Kenton Living Building will not be built on or adjacent to the following locations: sensitive ecological habitat, prime farmland, or within 100 year flood plain.
Approach	The current site proposed for the Kenton Living Building is located on a dense urban site in the Kenton neighborhood in Portland and meets the requirements of this prerequisite.
Est. Cost	None

2. LIMITS TO GROWTH

Statement	The Kenton Living Building will not be built on undeveloped land.
Approach	The site for the Kenton Living Building is an existing duplex in the middle of Kenton. The site is adjacent to the Interstate MAX Line and is surrounded on all sides by development, and therefore meets the requirements of this prerequisite.
Est. Cost	None

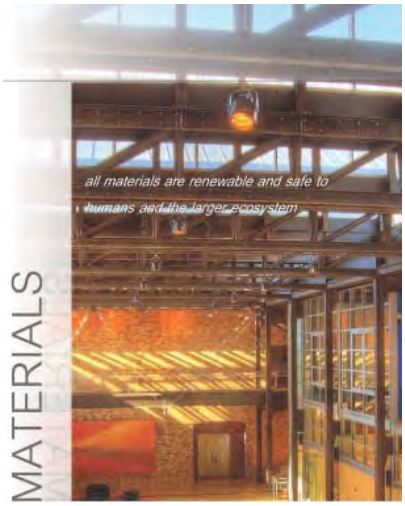
3. HABITAT EXCHANGE

Statement	The Kenton Living Building is committed to environmental restoration.
Approach	The Developer of the project plans to purchase a plot of land equal to the project's site area (~5,300 s.f.) along the banks of either the Willamette or the Columbia River and will deed it to remain undeveloped in perpetuity. (This committment exceeds the requirements of the LBC and begins to be restorative in nature.
Est. Cost	unknown



4. NET-ZERO ENERGY

Statement	The Kenton Living Building has committed to building a project where one hundred percent of the building's energy needs will be supplied by on-site renewable energy on a net annual basis. The building will be grid connected, using the grid as energy storage.
Approach	The Kenton Living Buildingwill incorporate a myriad of features and employ numerous strategies in order to achieve the Net Zero Energy Prerequisite. These features include: • Heat recovery ventilators • Natural ventilation • Daylighting • Energy efficient lighting and appliances • Improved glazing (Triple glazing tuned by elevation) • Improved building envelope (ladder stud to min. inflitration) • Energy modeling • Roofs shaded with photovoltaics to minimize heat gain The Kenton Living Building assumes building occupants will take an active role in managing their energy useage. Power meters displaying each unit's energy use will be prominently displayed in the common walkway in order to allow homeowners to actively draw comparisons between different plug loads (task lighting, small appliances, etc) as well as compare their energy usage.
Approach	After all energy conservation measures are included the projects will meet its net zero energy through the incorporation of photovoltaics. Photovoltaics were analyzed using the most efficient panel on the market today – the Sanyo HIT 205 panel.
Est. Cost	$200,000-300,000



5. MATERIALS RED LIST

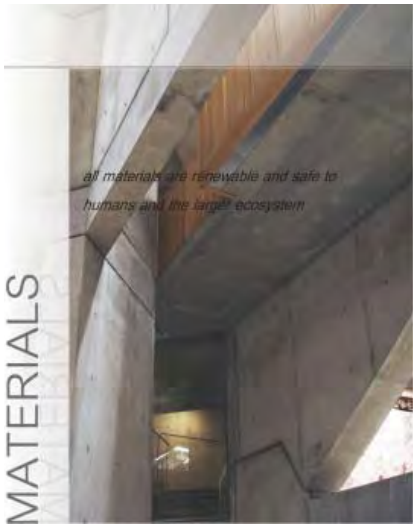
Statement	The Kenton Living Building will use only the safest materials available and will work with industry to expand the availability of red list free products in our area.
Approach	The entire project team is committed to utilizing materials that will meet the Living Building Challenge™ prerequisite 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.
Est. Cost	unknown

6. CONSTRUCTION CARBON FOOTPRINT

Statement	The project must account for the embodied carbon footprint of its construction through a one-time carbon offset tied to the building's square footage and general construction type.
Approach	Renewal Associates will purchase a carbon offset for the project in accordance with the offset formula provided by the Living Building Challenge™.
Est. Cost	unknown

7. RESPONSIBLE INDUSTRY

Statement	The Kenton Living Building supports material reuse and ecologically sensitive forestry.
Approach	All wood in the project which can be sourced from FSC certified or salvaged sources, or will be vetted through the Living Building Challenge™'s prreview process. 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™.
Est. Cost	unknown

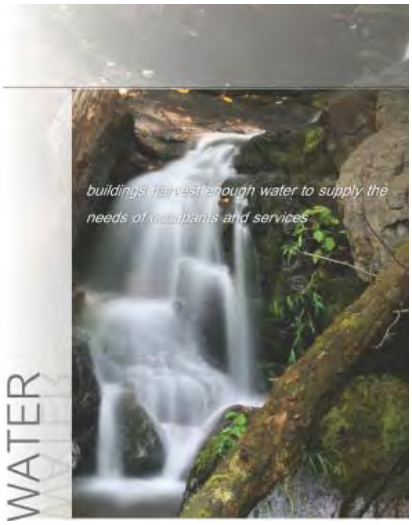


8. APPROPRIATE MATERIALS SERVICE RADIUS

Statement	The Kenton Living Building will promote local economies and will minimize the environmental impacts of material transportation and supports the use of local consultants.
Approach	All materials will be procured within the appropriate radii identified. The primary team members are all local, with specialty consultants from no more than 3,000 miles.
Est. Cost	unknown

9. LEADERSHIP IN CONSTRUCTION WASTE

Statement	The Kenton Living Building aims to not generate any once–through waste in the construction of the project.
Approach	Initially, the Kenton Living Building team anticipated demolition of the existing house with the recycling of the existing materials. Later, a strategy that offered a higher level of reuse — relocating the house to another site — was explored. Unfortunately the site identified for the house has been purchased. The developer of the project continues to explore the possibility of another site. 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.
Est. Cost	None

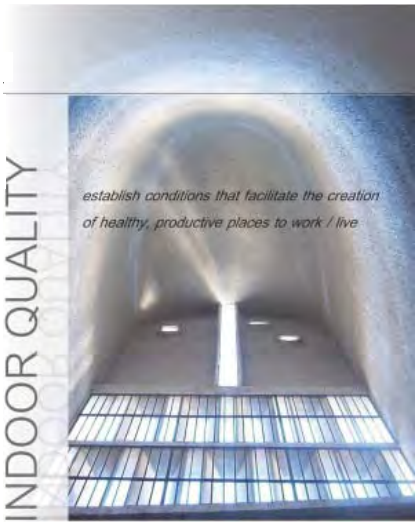


10. NET ZERO WATER

Statement	The Kenton Living Building will incorporate strategies to achieve net zero water.
Approach	Using a similar approach as Net Zero Energy, conservation measures were added to the project first. The project will incorporate low flow fixtures and fittings, low water use dishwashers, and composting toilets. Rainwater would be stored in a 40,000 gallon epoxy lined water proof concrete storage tank, which would be fitted with circulation pumps to circulate water within the tank to avoid stagnation. The rainwater would be treated via filters, with other treatment options which will meet both the Health code and the Living Building Challenge™.
Est. Cost	$200,000

11. SUSTAINABLE WATER DISCHARGE

Statement	The Kenton Living Building will capture, treat and reuse all of its waste water.
Approach	The project proposes to reuse all greywater. Treatment is developed that allows it to be infiltrated . Effluent from the composting toilets and clothes washing system will be cleared annually too an FCS certified forest. All storm water and excess treated waste water will be either infiltrated back into the soil on the site in conjunction with the proposed groundwater recirculation system or used to irrigate gardens. Any excess storm water could also be given back to the aquafer via drywells. Porous pavements, vegetated planters and swales are proposed as part of the landscape strategy to manage storm water.
Est. Cost	included in net-zero water



12. A CIVILIZED ENVIRONMENT

Statement	The Kenton Living Building recognizes that the health, productivity, and satisfaction of its occupants relies on access to light and air.
Approach	The project as designed is shaped so that all occupiable space is within 30′ of an operable window.
Est. Cost	none

13. HEALTHY AIR - SOURCE CONTROL

Statement The Kenton Living Building understands the imperative for superior air quality to support occupant health and the challenges of locating in an urban area.

Approach The Kenton Living Building will be designed to have an external dirt track in system and an internal one contained within a separate entry space, all kitchens and bathrooms must be separately ventilated, all interior finishes, paints and adhesives must comply with SCAQMD standards, all other materials, such as floor and caseworks must comply with California Standard 01350 for IAQ emissions, the building must be non-smoking.

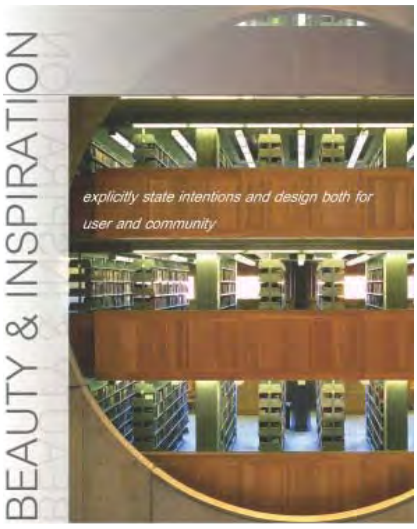
Est. Cost N/A (The project includes this in its base cost.)

14. HEALTHY AIR—VENTILATION

Statement The Kenton Living Building recognizes the importance of fresh air in the work environment.

Approach The Kenton Living Building will be designed to meet the stands of California Title 24.

Est. Cost N/A (The project includes this in its base cost.)



15. BEAUTY AND SPIRIT

Statement The Kenton Living Building celebrates the role of people in a Living Building and embraces the need for beauty and inspiration to create a wonderful work space.

Approach *"Architects must be deeply rooted in place and circumstance; it requires a delicate sense of form.; it must support man's emotional life."* — Alver Aalto

"Failure to nourish the soul is experienced as a failure to provide the right physical environment. It is not enough for architect to support the human body, it must also support the human spirit."
— Christopher Day

The Kenton Living Building will contribute to the renaissance of an inner city boulevard by building on a site that is on light rail, within walking distance of an elementary school, a major river, and a revitalizing town center. Many of the project's innovations will be visible to everyone passing by the site. An interactive display at the sidewalk will tell the on-going environmental story of the Kenton Living Building.

The Kenton Living Building will demonstrate how to use much less of our planet's scarce resources for building and operating housing - while creating urban living that interacts with the earth and sun in a remarkable way.

Est. Cost N/A

16. INSPIRATION AND EDUCATION

Statement	The Kenton Living Building will serve as an example of sustainable design in a growing neighborhood.
Approach	The Kenton Living Building will supply lessons to be learned to its design team and its residents. Many of the design elements will be transferable to projects of different types, sizes, and programs. 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 grey water storage tank gauges located along the central "vertical street" to encourage comparison of conservation efforts and discussion of strategies. 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 leadership. Through visits, tours, and publication by both the 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 provisional plan includes a modest childcare center in the building. This neighborhood amenity would introduce many young children (and parents) from the diverse and growing local community to the exceptional sustainable features and operations of the Kenton Living Building. This will multiply its "ripple and splash" effect of this one project for decades to come.
Est. Cost	N/A

RENEWAL ASSOCIATES, LLC

Kenton Living Building Beauty and Spirit
R. Peter Wilcox, Owner-Developer

The truly remarkable design and construction team for the Kenton Living Building (KLB) has not only *beautifully* solved the technical and constructional challenges involved in this early Living Building experiment, they have also created a thoughtfully contextual and elegant building form. Yet there are several other ways in which Beauty and Spirit are present in the KLB.

The KLB will contribute to the renaissance of a blighted inner city boulevard by replacing an anonymous and under-scaled building on a site that is significant - because it is on light rail and within walking distance of an elementary school, a major river, and a revitalizing town center - with *a building of major importance to both the planet and local community*.

Many of the project's innovations will be visible to everyone walking, riding on a bike or light rail, or driving by the site. The KLB will actually *bloom* like the Living Building's flower symbol with its beautiful and brimming-with-optimism photovoltaic array covering the entire roof. An interactive display at the sidewalk will tell the on-going environmental story of the KLB.

The KLB will demonstrate the cradle-to-cradle paradigm of "eliminating the concept of waste" by completely reusing everything on its site, including an existing foundation and an existing duplex which we are working to move and up-cycle from its current use as a market-rate rental into affordable housing. This is a *spiritual* as well as profoundly responsible action. The KLB will demonstrate how to use MUCH less of our planet's scarce resources for building and operating housing - while creating urban living that interacts with the earth and sun in a remarkable and, perhaps even, *spiritual* way.

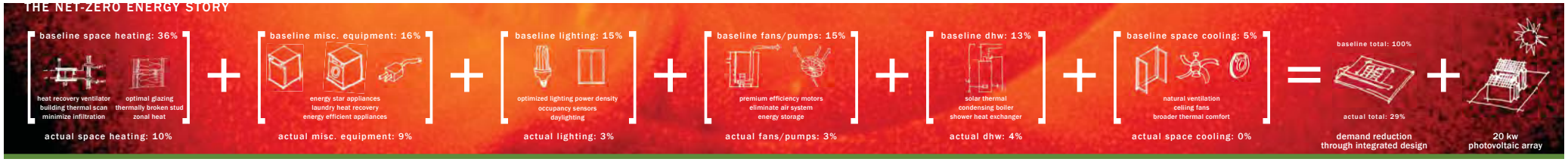
Finally, the KLB is *beautiful* in the way that it is leveraging Portland's green reputation and commitment to ensure that the most advanced models of sustainable development continue to be built in a place where professionals and citizens from around the world are already coming to learn about living sustainably.

2243 NE 20TH AVE ■ PORTLAND OR 97212 ■ 503.490.5407
WWW.RENEWALASSOCIATES.NET

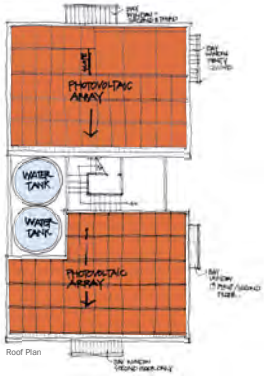
Figure 8 — Floor Plans

Figure 7 – Elevation

THE NET-ZERO ENERGY STORY



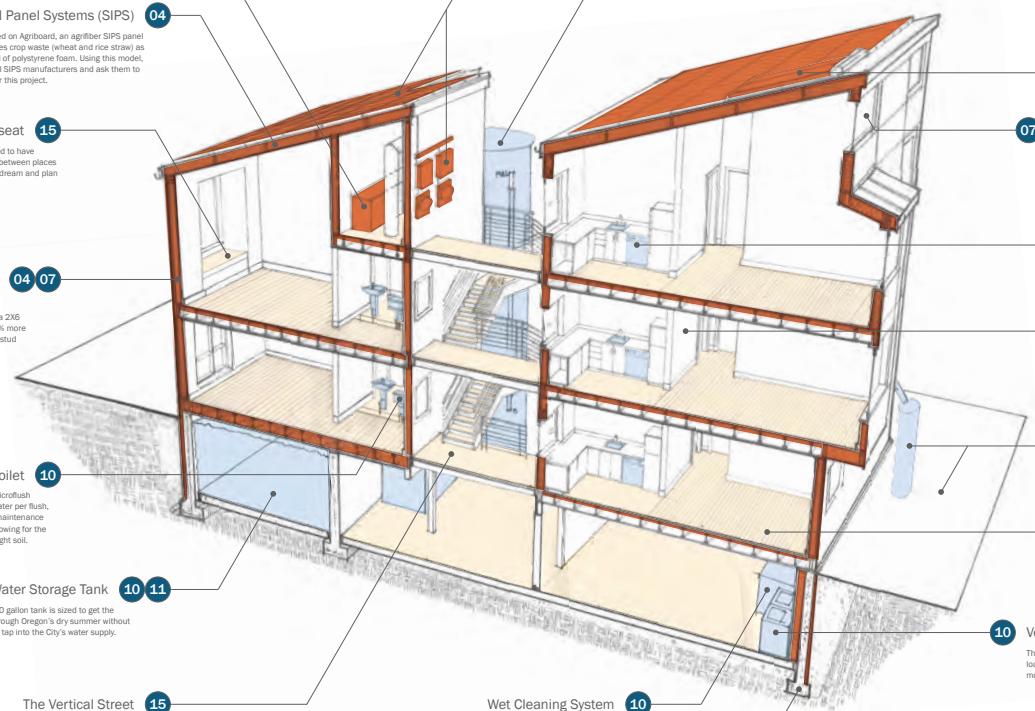
Net-zero energy will be achieved by concentrating on efficient use, storage and reuse of energy. The remaining energy will be produced by a 20kw solar photovoltaic array. Our building has been designed with an optimal south-facing roof slope to maximize the ability of the photovoltaic array to produce energy. We anticipate that the Kenton Living Building envelope will outperform the Oregon Energy Code by approximately 71%.



Roof Plan

Third Floor Plan

Second Floor Plan



Photovoltaic Array + Inverter (04 08 16)

The current Utility (PGE) allows for a grid-tied net-metering system, allowing annualized net-zero energy to be achieved in Portland's variable sky condition. The meter will also serve as an educational tool, alerting the tenants of their energy use.

Heat Recovery Ventilator (HRV) (14)

The HRV efficiently provides pre-tempered fresh air to the tenants all year round.

Gray Water Storage Tank + Visible Water Gauge (10 11 16)

Upon approval of a code appeal, we will recycle our gray water for non-potable purposes such as toilet flushing and clothes washing. The above-grade tank and gauge is a visible reminder to educate tenants and visitors about the ability to reduce potable water demand.

Structurally Insulated Panel Systems (SIPS) (04)

The proposed roof material is based on Agriboard, an agrifiber SIPS panel manufactured in Kansas which uses crop waste (wheat and rice straw) as its insulating core material instead of polystyrene foam. Using this model, we intend to approach our regional SIPS manufacturers and ask them to create a demonstration product for this project.

Solar Thermal (04)

Using the sun's energy to preheat our water is a valuable approach to saving energy.

Windowseat (15)

Buildings need to have undefined in-between places for people to dream and plan their futures.

Directionally Tuned Glazing (07 12)

The windows are HeatSmart by Loewen and are manufactured from regionally sourced FSC certified Doug Fir.

North: triple glazing for thermal protection
East: triple glazing to reduce acoustic impacts
South: double solar glazing with a high VLT value
West: double glazing with a high SC for thermal protection

Compact Dishwasher (10)

Ultra efficient at 4.5 gallons of water per use, the proposed dishwasher is an energy saving device as well.

Ladder Stud Framing + Blown-In Insulation (04 07)

The thermally broken stud (which combines a 2X2 interior stud and a 2X6 exterior stud on a 2X8 plate) is 37% more energy efficient than conventional stud framing.

Gypsum Board (08)

Interior walls are sheathed with G-P gypsum board, manufactured in Tacoma, Washington. The gypsum is a by-product of the Centralia power plant and is composed of 95%+ recycled content.

Dry Well and Pervious Surfaces (11)

Our site has well-draining soils that are well suited for on-site filtration of our excess water runoff in order to recharge the aquifer.

Composting Toilet (10)

The Phoenix Gravity Microflush Toilet uses 1 pint of water per flush, addressing potential maintenance concerns while still allowing for the central collection of night soil.

Salvaged Wood Floor (08)

The typical unit is finished with gym flooring discarded from a local school.

Rain Water Storage Tank (10 11)

The 50,000 gallon tank is sized to get the tenants through Oregon's dry summer without needing to tap into the City's water supply.

Ventless 2-in-1 Clothes Washer/Dryer (10)

The Splendide Comb-o-matic uses 9-16 gallons of water per load (a typical washer uses 30-40 gallons) and is at least 50% more energy efficient than a standard washer/dryer.

The Vertical Street (15)

Taking a cue from cohousing, the Kenton Living Building is organized around a "vertical street" to encourage social interaction and create community. Kitchens are placed adjacent to the "street" to foster connection while the living areas are located on the periphery in order to provide privacy.

Wet Cleaning System (10)

Using less water than its "dry"cleaning predecessor, this system is non-toxic and uses biodegradable detergents.

Basement Reuse (09)

The Kenton Living Building has been designed to sit directly on top of the existing foundation in order to eliminate basement demolition and reduce the embodied energy of the project.

Healthy Indoor Environment (13)

All materials will be low/no VOC and meet or exceed regulated standards.

Materials Red List (05)

The project will be void of all red-listed materials in accordance with the Living Building Challenge.

Construction Carbon Footprint (06)

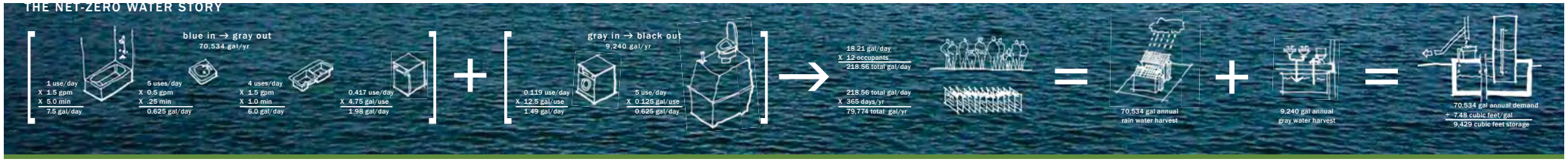
The Developer will purchase a carbon offset for the project in accordance with the Living Building Challenge's offset formula.

The germination of an idea

SERA

kenton living building

THE NET-ZERO WATER STORY



Site + First Floor Plan

Basement Floor Plan

0' 5' 5' 10'

The most difficult Living Building Challenge prerequisite for a project of this scale is net-zero water. The Kenton Living Building will comply through careful collection and reuse of rain and gray water. Further, storm water will never leave the site and black waste water will be eliminated by the installation of evaporating composting toilets. These innovations integrate multiple strategies that have been used in isolation in Portland, Oregon, but never before in aggregate.

Project Site
Kenton Living Building 01
N. Interstate Avenue + N. Watts Street
Portland, Oregon

Wood Framing 09
Construction Waste Recycling
American Compost & Recycling, 3.9 miles

Insulation 09
Construction Waste Recycling
Environmental Fibers, 3.2 miles

Interiors 09
Construction Waste Recycling
ReBuilding Center, 2.5 miles

Metals 09
Construction Waste Recycling
Schnitzer Steel, 4.8 miles

Drywall 09
Construction Waste Recycling
METRO, 4.5 miles

Previously Developed Site 02 09
The existing duplex will be relocated to make way for the construction of the Kenton Living Building. The developer is in discussions with Peninsula Community Development, a non-profit organization that manages affordable housing in Portland, to find a new home for the existing building, thus "upcycling" the building.

03 Habitat Exchange
The developer is negotiating with the Columbia Land Trust to acquire and preserve a piece of property that is otherwise developable and at least the size of the development (5,300 SF) along the lower Columbia River estuary.

09 Concrete
Construction Waste Recycling
Porter Yett Co., 4.8 miles

Columbia River

09 Carpet Pad
Construction Waste Recycling
Far West Fibers, 8.1 miles

11 Night Soil Placement
The developer is negotiating with the Columbia Land Trust to supply the night soil compost to an existing FSC certified forest.

09 Carpet
Contruction Waste Recycling
East County Recycling Co., 11.4 miles

Roofing 09
Construction Waste Recycling
Pacific Landclearing & Recycling, 14 miles

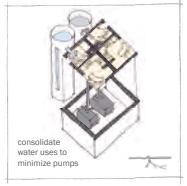
09 Vinyl
Construction Waste Recycling
NW Polymers, 39 miles

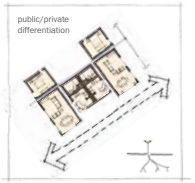
01 Surrounding Community
The site is predeveloped and not:
- Within 50' of wetlands
- On or adjacent to Sensitive Ecological Habitats
- Prime farmland
- Within the 100 year flood plain

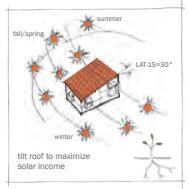
The Living Building Challenge Prerequisites

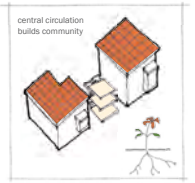
01 Responsible Site Selection	09 Leadership in Construction Waste
02 Limits to Growth	10 Net-Zero Water
03 Habitat Exchange	11 Sustainable Water Discharge
04 Net-Zero Energy	12 Civilized Environment
05 Materials Red List	13 Healthy Air: Source Control
06 Construction Carbon Footprint	14 Healthy Air: Ventilation
07 Responsible Industry	15 Beauty + Spirit
08 Appropriate Materials + Services Radius	16 Inspiration + Education

The germination of an idea









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