LIVING BUILDING FINANCIAL STUDY
COST COMPARISON MATRIX

Total array size in kilo watts — 273 kw
Total water use in kilo gallons — 357k (blackwater greywater rainwater)
Resultant Energy Use Intensity in kbtu/sf/year — 36.8

Cost premium (%) — 15-20%
Payback period — 15-20 years
Direct Construction Cost — $146/sf

Site plan indicating PV, site and massing changes
Section indicating form changes

	UNIVERSITY CLASSROOM	SCHOOL K-8	LOW RISE OFFICE	MID RISE OFFICE	MIXED USE RENOVATION	SINGLE FAMILY RESIDENTIAL	MULTIFAMILY RESIDENTIAL	HIGH RISE MIXED USE	HOSPITAL
PORTLAND temperate	35.4 kbtu/sf/year 4-9% 2-7 years $337/sf 649 kw 301k	28.2 kbtu/sf/year 11-16% 10-15 years $247/sf 1013 kw 968k	30.3 kbtu/sf/year 29-34% 25-30 years $282/sf 273 kw 122k	36.0 kbtu/sf/year 24-29% 18-23 years $263/sf 851 kw 357k	37.2 kbtu/sf/year 17-22% 11-16 years $194/sf 1433 kw 357k	15.5 kbtu/sf/year 20-25% 27-32 years $234/sf 6 kw 9k 23k	23.2 kbtu/sf/year 26-31% 22-27 years $148/sf 825 kw 267k 1296k 959k	32.0 kbtu/sf/year 16-21% 13-18 years $215/sf 3143 kw 1866k 2525k 425k	123.9 kbtu/sf/year 21-26% 9-14 years $411/sf 4959 kw 2368k 4288k 1921k
ATLANTA hot humid	40.3 kbtu/sf/year 12-17% 8-13 years $304/sf 743 kw 301k	24.8 kbtu/sf/year 12-17% 8-13 years $207/sf 776 kw 968k	35.5 kbtu/sf/year 33-39% 21-26 years $239/sf 271 kw 122k	34.9 kbtu/sf/year 26-31% 15-20 years $222/sf 773 kw 357k	35.3 kbtu/sf/year 23-28% 12-17 years $168/sf 1143 kw 376k	17.1 kbtu/sf/year 35-40% 29-34 years $210/sf 7 kw 31k	21.8 kbtu/sf/year 31-36% 20-25 years $129/sf 654 kw 1180k 357k	30.6 kbtu/sf/year 20-25% 13-18 years $188/sf 2556 kw 1685k 2525k 633k	117.4 kbtu/sf/year 32-37% 11-16 years $363/sf 4465 kw 1601k 4288k 2688k
PHOENIX hot arid	38.4 kbtu/sf/year 16-21% 10-15 years $304/sf 981 kw 53k 72k 176k	23.0 kbtu/sf/year 19-24% 12-17 years $221/sf 569kw 445k 523k	34.3 kbtu/sf/year 35-40% 20-25 years $243/sf 205 kw 27k 95k	34.2 kbtu/sf/year 32-37% 16-21 years $231/sf 591 kw 195k 153k	33.6 kbtu/sf/year 21-26% 9-14 years $166/sf 855 kw 75k 119k 182k	11.5 kbtu/sf/year 39-44% 39-44 years $218/sf 4 kw 14k 17k	22.0 kbtu/sf/year 33-38% 19-24 years $129/sf 513 kw 999k 1296k 227k	30.9 kbtu/sf/year 20-25% 11-16 years $187/sf 1976 kw 1997k 2525k 321k	118.7 kbtu/sf/year 32-37% 10-15 years $368/sf 3439 kw 3903k 4288k 386k
BOSTON cool	48.6 kbtu/sf/year 16-21% 6-11 years $395/sf 1617 kw 301k	35.7 kbtu/sf/year 17-22% 6-11 years $272/sf 1224 kw 968k	43.6 kbtu/sf/year 44-49% 16-21 years $319/sf 330 kw 122k	43.4 kbtu/sf/year 36-41% 10-15 years $305/sf 930 kw 357k	45.5 kbtu/sf/year 26-31% 6-11 years $221/sf 1578 kw 376k	19.5 kbtu/sf/year 38-43% 22-27 years $277/sf 9 kw 5k 26k	28.5 kbtu/sf/year 32-37% 12-17 years $166/sf 912 kw 130k 1296k 1096k	40.5 kbtu/sf/year 23-28% 8-13 years $244/sf 3582 kw 1801k 2525k 517k	148.0 kbtu/sf/year 32-37% 6-11 years $469/sf 5666 kw 2093k 4288k 2196k

LIVING BUILDING FINANCIAL STUDY:

The effects of climate, building type and incentives on creating the buildings of tomorrow.

KEY VARIABLES

PORTLAND
temperate

ATLANTA
hot humid

PHOENIX
hot arid

BOSTON
cool

CLIMATES

temperate: This climate is milder with less extremes. Rainfall varies across the region depending on location.

hot-humid: This climate is characterized by hot humid days especially in the summer. Rainfall varies across the region depending on location.

hot-arid: This climate is characterized by hot dry days and cooler nights, although cold days are possible in the winter months. The average rainfall is very low.

cool: This climate typically has cold winter days, possible hot/humid summer evenings. Rainfall varies across the region depending on location, with snow fall adding to total precipitation.

BUILDING TYPES

University Classroom
School K-8
Low Rise Office
Mid Rise Office
Mixed Use Renovation
Single Family Residential
Multi Family Residential
High Rise Mixed Use
Hospital

PHOTOVOLTAIC CAPACITY

To achieve net zero energy, solar panels were first added to each building roof. If additional PV production was needed to achieve net zero energy, PV was added next to the site. For reference buildings that did not include additional site area, it was assumed that PV could be added to the rooftops of nearby parking garages, with the energy consumed by those parking garages also included in overall energy production of the PV array.

TOTAL WATER USE

All buildings were first upgraded to include the most water conserving fixtures available in the market today. The remaining water usage was offset first by rainwater collected from the building's roof, then through greywater and blackwater reclaim systems. Different building types required different levels of waste water treatment, depending if the water needed to be reused as potable or not. Tank size depends on both rainfall and water usage patterns.

24.8 kbtu/sf/year ENERGY USE INTENSITY

The baseline Energy Use Intensity (EUI) for each building type was determined using data from the 2003 Commercial Buildings Energy Consumption Survey (CBECS) and 2005 Residential Energy Consumption Survey (RECS). A target of 50-65% improvement over CBECS was set for each building type. Energy Conservation Measures (ECMs) were applied to each building (by climate city) until the goal or target EUI was reached.

15-20% COST PREMIUM (%)

The costs for Living Building premiums were priced as if they were part of the original design, not incremental changes. Similar to the Value Engineering process during design, changes were analyzed on a net-impact basis across disciplines.

$146/sf DIRECT CONSTRUCTION COST

The projects base estimates were normalized to January 2009 dollars so baseline costs could be established. Costs include the balance of a developer's proforma costs including survey, legal, SDC charges, building permits, furniture and fee. Land purchase costs are not included due to the high degree of variation from site to site. The cost model reflects a best net-value interpretation of strategies and systems necessary to achieve Living Building goals.

15-20 years PAYBACK PERIOD

The cost estimating team performed a simplified life cycle cost analysis, comparing the LEED Gold building baseline costs to the costs projected for the Living Building Modification to arrive at the present worth for each building. The total life cycle cost looked at both the annual cost and the present worth of the building to arrive at a present worth for the LEED Gold building. The Living Building does not have costs added to it as it has no water or energy usage.

WHY DO THIS STUDY?

The task of changing cultural and social paradigms falls to those who are willing to disprove what is perceived as impossible. In the two years since the Living Building Challenge was announced, there has been phenomenal interest from clients and design firms attracted by the simplicity of the concept and an appreciation for the new milestone it defines on the path to a restorative future. Often, the question that arises after clients begin to comprehend the magnitude of building a Living Building is "what is the cost premium and the payback?" This study commissioned by the Cascadia Chapter of the US Green Building Council takes direct aim at that very question. The results are enlightening and encouraging.

STUDY METHODOLOGY

For the study, a team led by SERA Architects, joined by Skanska USA Building, Gerding/Edlen Development, New Buildings Institute and Interface Engineering conceptually transformed existing LEED Gold buildings into Living Buildings – using real construction data and documents. Nine building types, ranging from residential to commercial and institutional, are in process of being evaluated in four different climate zone cities: mixed, temperate, hot humid, and hot arid. The preliminary results for the building types are shown on the reverse side of this sheet. A detailed report including the study's assumptions, process and back-up data are anticipated to be available by early March.

The team endeavored to employ the least expensive strategies initially for all prerequisites, only utilizing expensive systems when the climate conditions dictated they were required. First, each building design was analyzed to determine how the building could be reshaped to perform better in each climate zone – employing simple techniques like elongating the building in the west/east direction to maximize daylighting. Next, energy conservation measures (ECM's) were integrated to reduce demand. Mechanical systems were upgraded and optimized (and in some cases eliminated) for the building and climate. The final step in the path to Net-Zero Energy was incorporating photovoltaics in sufficient quantity to meet the remaining energy demand.

"Our work on the Living Building Challenge Cost Study has confirmed some assumptions and frankly surprised us on others. The type of building, location, available incentives, etc. all drive different results. What gives us confidence is that with a creative design and construction team and a driven client, it is possible to develop Living Buildings. This is not just good news, this is confirmation that we will soon see an array of building types achieve phenomenal results in not just the reduction of the environmental footprint but in their relationship with the building occupants. One thing is very clear, the best building in the world will achieve very little unless the occupants participate actively in making the building perform as intended."

Dennis Wilde
Gerding /Edlen Development

APPROACH TO THE COST MODEL

In order to put a price tag on an idea, it must be translated into a model, with form, place and quality defined. The entire study team engaged in a dialogue to identify and sketch out the characteristics of the projects using the Living Building Challenge so conceptual level cost estimates could be prepared. The estimating team took a considered approach to anticipating the complete scope of each project, adding allowances for full tenant build-out if it was not included in the base. Living Buildings demand an integrated approach to design; likewise, the estimate could not assume that features would be bolted-on in isolation of one another. Skanska worked with the study team throughout the process to define and estimate the design intent. The cost model reflects a best, net-value interpretation of strategies and systems necessary to achieve Living Building goals and incorporate industry-recognized contingencies, regional cost data derived from Skanska's cost database and soft costs adjusted to approximate January 2009 pricing.

Conceptual estimating is part science and part art. The cost models endeavor to establish a cost increment for Living Buildings, recognizing that every project will vary from these results in response to its unique requirements, location and market conditions. More important than the absolute numbers derived for the small sample of specific projects analyzed in this study are the general insights gained in what influences the costs of a Living Building.

Cascadia's mission is to promote the design, construction and operation of buildings in Alaska, British Columbia, Washington and Oregon that are environmentally responsible, profitable and healthy places to live, work and learn.