Strategies for Sustainability

Portland State University
School of Business Administration
Renovation and Expansion

Draft Revision 1.4

Report Prepared by
Brightworks Sustainability
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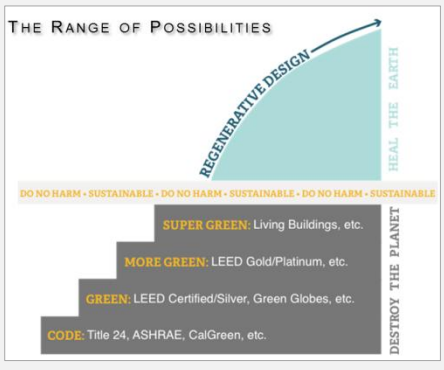

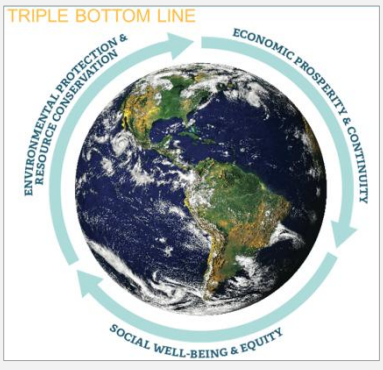

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INTRODUCTION

The Portland State University School of Business Administration (SBA) will design, build and occupy a new facility, consisting of a major renovation of two existing buildings and the construction of a new building. Through this process, the renovated buildings and the new building will be physically integrated as a single building.

The SBA faculty, administration, and the university Facilities and Planning department have come together, along with other stakeholders including students and members of the broader university community, to explore how an explicit, serious commitment to sustainability, expressed through the design, construction, and operation of the building, can reflect the values of the SBA and the university, support the SBA's mission, and help define the SBA's brand as a true leader and innovator in business education.

As part of that exploration, the SBA group retained Brightworks Sustainability to convene a Vision Statement development process and to conduct preliminary research on sustainability opportunities, challenges, case studies, and funding strategies. An additional goal of this effort was to create or enhance alignment and understanding among stakeholders regarding the potential benefits of an aggressive sustainability program for the building project.

SUMMARY OF RESULTS

Charrette and Vision Statement

An August 6, 2013, the SBA hosted a Sustainability Workshop (or "charrette") that included a broad group of stakeholders from across the university community.

- The Charrette Summary is attached as **Appendix 1** of this report. [1]
- The Vision Statement itself is attached as **Appendix 2** of this report.

SBA Faculty Briefing

On September 24th, 2013, this consultant team provided a sustainability briefing at the SBA faculty retreat, before 40-50 members of the SBA faculty. The briefing included a summarized version of the presentation from the Vision Charrette, and a discussion session for questions, answers and comments.

- A summary of the faculty and staff comments (in response to both the presentation and the draft vision statement, which was provided during the presentation, is included in **Appendix 2** of this report.

Case Studies & Lessons learned

Case studies of the potential for applying principles of sustainability to a building comparable to the future SBA have been referenced throughout the vision process, including:

- Summary of PSU's successful track record of 9 LEED certified buildings
- Summary & Highlights of U.S. Business Schools & LEED
- Bullitt Center, a Living Building Challenge office building project, in Seattle
- National Renewable Energy Lab, a Net Zero Energy Building office building project, in Boulder; and
- *The Living Building Financial Study: The Effects of Climate, Building Type and Incentives on Creating the Buildings of Tomorrow* (by CascadiaGBC, SERA, Skanska, Gerding Edlen Development, Interface and NBI) case study of "University Classroom," an analysis of the Oregon State University Kelley Engineering Center.

[1] Appendices to this report are enumerated instead of alphabetized to distinguish them from the appendices to the Charrette Report.

- The Case Studies are included as **Appendix 3** of this report.

Preliminary Analysis of Solar, Rainwater, and Incentives

The following information is provided in the Research Findings section of this report, below.

- Summary of certification program fees and associated costs
- Preliminary solar analysis
- Preliminary rainwater capture analysis
- Summary of potential incentive opportunities

RESEARCH FINDINGS

Green Building Program Fees and Associated Costs

This cost summary assumes that PSU will pursue for the entire SBA project, the renovated 100,000 SF and new construction 50,000 SF portions, LEED Platinum certification. The three options noted include LEED Platinum Certification with different variations of the Living Building Challenge Certification as add-ons, assuming the entire project is approximately 150,000 sf.

Please note the following:

Option 1 assumes LEED Platinum certification + LBC Full Certification. LBC Full Certification requires project compliance with requirements of all 7 Petals and associated 20 Imperatives.
Option 2 assumes LEED Platinum certification + LBC Petal Recognition. LBC Petal Recognition requires compliance with at least three Petals – at least one of which must be Water, Energy, and/or Materials; and Imperative 01 Limits to Growth and 20 Inspiration and Education.
Option 3 assumes LEED Platinum certification + LBC NZEB. LBC NZEB requires project compliance with the Imperatives: 01 Limits to Growth, 07 Net Zero Energy, 18 Rights to Nature and 19 Beauty & Spirit.

***Preliminary* Cost Estimates for Potential Certification Options**

		Option 1	Option 2	Option 3
Green Building Program Fees (Registration & Certification Review)	**LEED Platinum Certification**	$8,400	$8,400	$8,400
	LBC– Full Certification	$10,900	---	**---**
	LBC– Petal Recognition	---	$6,900	**---**
	LBC– Net Zero Energy Building (NZEB)	---	---	$7,900
	Total Cost, Reg.+Cert Fees	**$19,300**	**$15,300**	**$16,300**

		Option 1	Option 2	Option 3
Associated Professional Services	**LEED Project Management Services**	$52,000	$52,000	$52,000
	LBC Project Management Services *(Assumes in tandem with LEED Platinum, additional if pursue only LBC)*	$25,000	$15,000	$5,000
	Commissioning Services *(LEED EAp1: Fundamental & EAc3: Enhanced)*	$150,000	$150,000	$150,000
	Energy Modeling Services *(Assumes LEED Platinum and additional modeling analysis for NZEB)*	$55,000	$45,000 *(assuming LBC Energy Petal is not pursued)*	$55,000
	Healthy Materials Services *(Assumes some materials analysis. May be more for Full LBC analysis.)*	$15,000	---	---
	Total Cost, Prof. Services	**$297,000**	**$262,000**	**$262,000**

High Performance Strategies: Preliminary Solar Analysis

Throughout the vision process, the topic of energy strategies including the potential to pursue a Net Zero Energy Building (NZEB), surfaced repeatedly. As a starting point for understanding the potential and the limitations of energy efficiency and solar for the SBA project, preliminary analyses were performed for three scenarios. Each of the three scenarios assumes

1. a 100% electric building
2. the cost of the PV system for conceptual analysis is based on current industry standards for panels, racks, electrical and installation, but not any building structural upgrades, if needed.
3. two different building Energy Use Intensity (EUI) targets
    - Net Zero Energy and
    - the 2030 Challenge, which targets a 60% energy reduction from an Office Space[2] National Average.

The primary variables among the scenarios are

1. the size of the PV system and
2. the amount of square footage served by the PV system.

The three scenarios include (See **Appendix 4** – Energy Use Intensity & Renewable Energy Analysis):

Scenario 1: Preliminary Roof Plan with PV, from SBA Concept Report (below)

Scenario 2: Net Zero Energy – Entire SBA Building

Scenario 3: Net Zero Energy – New Portion Only of SBA Building

Solar Scenario Analysis Summary

	Scenario 1		Scenario 2		Scenario 3	
Rooftop PV Area (SF)	5,500		69,000		24,000	
PV System Size (kW)	66		828		288	
Annual PV Production (kWh)	69,432		871,056		302,976	
Building SF	147,200		147,200		48,000	
Cost of PV System (after ETO incentive)	$230,200		$3,426,000		$1,051,600	
Value of Annual PV Production	$5,555		$69,684		$24,238	
Simple Payback – Net Metering (years)	41		49		43	
Simple Payback – PGE Solar Payment Option (years)	14		17		15	
Energy Usage Intensity (kBTU/sf / year)	20	44	20	44	20	44
Building Load (kWh/year)	862,801	1,898,162	862,801	1,898,162	281,348	618,966
PV production (% of Building Load)	8%	4%	101%	46%	108%	49%

Solar Scenario Analysis Conclusions

1. Achieving Net Zero Energy for the SBA project will require:

- Aggressive energy-saving strategies targeting an EUI in the range of 20 kBTU/sf – year.
    - This is possible; the Bullitt Center was designed to this target.
    - An EUI of 20, however, is considered an aggressive target, representing a small portion of the current national average EUI of 110 for office spaces. In addition, meeting the 2030 Challenge EUI of 44 for the renovated portion of the future SBA is possible. This is based on PSU's current estimated EUI 63 for the School

2 The "Office Space" category was selected rather than "College/University" since the School of Business/Education program is assumed to align more closely with a typical office more so than the more complex category of "College/University" buildings including more energy intensive research labs, computer labs, etc.

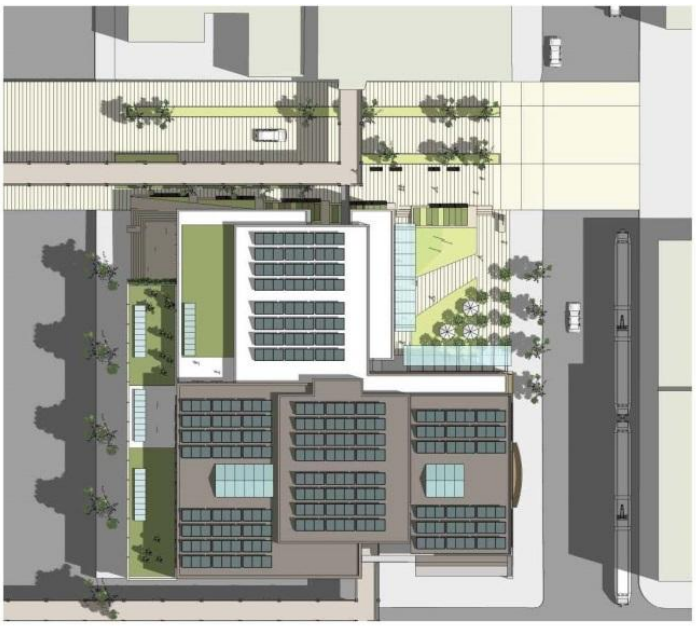
of Business and EUI 69 for the School of Education, and the planned renovation improvements to replace the air handling systems and lighting, which are expected to improve significantly the EUI.

- Approximately 1 square foot of solar PV: 2 square feet of building.
  - With the SBA planned as a six-story, 147,000-square foot building, the available area of roof proper is relatively limited. The estimated 24,000 SF of solar PV needed in Scenario 3, however, is in line roughly with the total roof SF of the future SBA renovation and expansion.
  - Additional area for PV beyond the roof proper may be borrowed from other PSU buildings, covered walkways and/or building integrated solar.

2. PGE's Solar Payment Option has a favorable payback in the range of 15 years. The program pays system owners for the kWh generated over a 15 year period, at a rate set at the time a system is initially enrolled in the program. This analysis assumed a payment rate of $0.23 kWh produced.

3. Scenario 3: Net Zero Energy for the New Portion Only of the SBA may be the most promising.

The new construction portion of the future SBA holds the most potential for high-performance energy design. With an EUI of 20 for the new portion and a 288 kW PV system, Net Zero Energy for the new portion is feasible; and for the renovated portion, targeting an EUI of 44 is more realistic. Combined, an EUI of 20 for new 48,000 SF and an EUI of 44 for the 100,000 renovated SF, it is very feasible that the future 150,000 SF SBA will use less energy than the current 100,000 SF of the School of Business & School of Education.



VIEW OF ROOF AND SITE
The roof space will be covered with mechanical equipment penthouses, photovoltaic panels, skylights, and greenroofs., as appropriate. This illustration indicates potential uses for the roof which will be further developed in Schematic Design.

ZIMMER·GUNSUL·FRASCA ARCHITECTS·LLP

High Performance Strategies: Preliminary Rainwater Analysis

The Portland State School of Business Administration is considering non-potable water usage. Through aggressive water efficiency measures and a rainwater harvest and reuse system, it is possible to accomplish this ambitious goal. Brightworks completed a preliminary analysis to gain a better understanding of the system requirements and limitations for rainwater harvesting and reuse. The assumptions made for the preliminary analysis include:

- Full time equivalency of 495 (faculty & students)[3]
- Reduced summer occupancy and usage (June to August)
- Averaged three years of historical precipitation data from Portland Metro area used for analysis (January 2010 to December 2012)

The fixture flush and flow rates for the future SBA renovation and expansion are assumed to state-of-the-art efficient (0.8 gpf toilets, 0.35 gpm lavs and 1.75 gpm showerheads). Compared to the water usage of the current School of Business & School of Education totaling approximately 2 million gallons per year and fixture efficiency rates typical of the 1980s-era, the future SBA is expected use about 70% less water.

RAINWATER CAPTURE & REUSE CALCULATOR - PROJECT INFORMATION		
Project:		PSU SBA
Location:		Portland, Oregon
Cistern Size :	*gallons*	25,000
Roof Area: *(based on 147,200 gsf, 6-story building)*	*square feet*	25,000
Capture Efficiency:	*after first flush*	90%
Total Users:	*full-time equivalency*	495
Lavatory Usage:	*uses per person per day*	3
Faucet Flow Rate:	*gallons per minute*	0.35
Duration:	*seconds*	15
Lavatory Usage:	*gallons per use*	0.088
Total Daily Lavatory Usage:	*gallons*	130
Shower Duration:	*minutes*	5
Shower Frequency:	*per person per day*	0.04
Shower Fixture Flowrate:	*gallons per minute*	1.75
Total Daily Shower Usage:	***gallons***	173
Toilet Flush Volume:	*gallons per flush*	0.80
Toilet Flush Frequency:	*flushes per person per day*	2.75
Urinal Flush Volume:	*gallons per day per person*	0.125
Urinal Flush Frequency:	*flushes per person per day*	0.25
Total Daily Building Flush Volume:	***gallons***	1,104

[3] Full time equivalency (FTE) was calculated from the ZGF SBA 2011 Report, Program Analysis information.

RAINWATER HARVEST & REUSE ANALYSIS, MONTH BY MONTH						
Month	**Monthly Rainfall** (inches)	**Total Roof Rainfall** (gallons)	**Average Captured Rainwater** (gallons)	**Available Captured Rainwater (3-yr average)** (gallons)	**Total Usage** (gallons)	**Percent Reduction of Total Usage** (%)
January	6.43	100,201	90,181	30,030	30,030	100%
February	4.97	77,449	69,704	28,622	28,622	100%
March	4.51	70,281	63,253	31,907	31,907	100%
April	2.91	45,348	40,813	30,030	30,030	100%
May	2.16	33,660	30,294	30,699	30,699	100%
June	1.56	24,310	21,879	13,674	14,077	97%
July	0.53	8,259	7,433	6,622	13,000	51%
August	0.75	11,688	10,519	6,698	14,408	46%
September	1.76	27,427	24,684	24,803	30,030	83%
October	3.33	51,893	46,703	30,499	30,499	100%
November	6.26	97,552	87,797	30,897	30,968	100%
December	6.94	108,148	97,334	30,968	30,968	100%
totals	42.11	656,214	590,593	295,450	315,239	**93.7%**

Rainwater Analysis Conclusions:

- The majority of the load is non-potable usage, which was calculated for the expected toilet flush volume of 1,104 gallons per day.
- With a 25,000-gallon rainwater capture and reuse system, the total percent reduction of onsite water usage is 93.7% for the entire year.
- The potable water usage (i.e. lavatories and showers) is nominal in comparison to the non-potable water usage (i.e. toilet flush). Considering the potential costs to install a rainwater purification system, an analysis was also completed to exclude the potable water usage. This analysis resulted in an insignificant increase of less than 1% increase in the percent reduction of total water usage.

Usage rates will need to be confirmed during the 'summer' months to gain further insight as to whether achieving non-potable water usage for the entire year is feasible. Confirm water demands for the project.

High Performance Strategies: Vision- Based Planning

As a complement to the aspirational goals expressed both in the public AE team RFP, and those expressed by various stakeholders in the vision process and documented in the vision statement, we recommend a deliberate program to support the pursuit of those aspirational goals. While articulating and creating alignment around aspirational outcomes is an essential step in the pursuit of high performance innovation, visions and goals without practical strategies to support them often lead to disappointing results. Once a vision and goals are defined, a systematic program is needed to ground those goals in actions, create accountability, track details, prioritize, evaluate tradeoffs, and document the process. In The Natural Step framework for sustainability planning, the term "backcasting" has been adopted to represent a planning process aimed at transformative change. A description of this process can be found at the following web site: http://www.naturalstep.org/backcasting.

For built environment projects, Brightworks has developed a variation of the backcasting program we refer to as Vision Based Planning. Following is a very high-level description of the VBP approach, just to help share the concept, not to suggest this is the one, only, right approach for the project. The point is that *some* model, some approach, to this challenge – grounding an aspirational vision and goals in a practical methodology – is essential. This is not simply an "integrated design process." Integrated design is necessary, but not sufficient. VBP applies integrated design to specific sustainability strategies and has a very deliberate response to barriers and obstacles not generally used in a typical integrated design process. Our approach is only given as an example; any approach that covers these key points would be equally appropriate. How Vision Base Planning works:

1. Start with a high-level, highly aspirational North Star goal – something like "A Fully Regenerative Building" or "Positive Environmental Footprint." You get to this goal through an inclusive process, ideally at the front end of a charrette process. PSU has done this.

2. Next, for each major area of design consideration on the project, one creates a statement of intention, a high level vision, that will support the overall project vision. An example would be "one hundred percent renewable energy," or "zero toxics." Again, aspirational, knowing it might be not-achievable, but at least points at the real sustainability outcome you would like to achieve if you could. [For the division of major areas, one can follow the LEED sections, though we sometimes blend the site-related water strategies with the water section, and split the IEQ strategies into the energy section and a human factors section.]

3. Next, within each section, we work from the general to the specific, looking at what kinds of solutions could achieve the vision, from idea-level ("lower the envelope loads") to technology or system ("super-insulate the foundation") to specific products ("use blown polystyrene foam") down to responsible parties and time frames. Templates and forms are used for tracking the details, and a couple of key elements are that specific measurable desired outcomes are defined, time frames and milestones selected, and responsible parties assigned to each task.

While this may all sound simplistic and obvious, we have observed after work on hundreds of built environment sustainability projects that many elements of such a program are often taken for granted – people assume "one of the other members of the team has it covered." Because sustainability tracking is not always the given responsibility of any one team – the owner, the architect, the MEP or civil or structural engineers, etc. – the detailed, careful observation of the principles of Vision Based Planning, regardless of what you call it, ensures the highest chances of achieving the greatest sustainability performance in your project outcomes.

Offsetting Development Costs: *Incentive & Program Opportunities*

1. Utility Incentives/Programs

Energy Trust of Oregon – Early Design Assistance

Description: An incentive available for projects that enroll during very beginning of project (schematic or prior) to commit to addressing specific energy or gas-related topics.

Maximum possible incentive: $2,500

Terms/Qualifications: Project need to apply during schematic design or earlier and commit to exceeding Oregon code requirements by a minimum of five percent. If project is considering including solar electric or solar water heating systems, possible to also qualify for additional design assistance and incentives. Must include the owner, architect, mechanical engineer, energy analyst and meeting facilitator.

More information at http://energytrust.org/public-sector/incentives/construction-renovation-improvements/custom/early-design-assistance

Energy Trust of Oregon – Energy Modeling Assistance

Description: Energy Modeling Assistance incentives are calculated per-kWh and per-therm, based on the estimated annual energy savings, as approved by Energy Trust. Incentives will cover a minimum of 50 percent of approved costs for the energy analysis.

Maximum possible incentive: Maximum $25,000

Terms/Qualifications: To be eligible to receive incentives a project must meet ALL of the following criteria:

- The project must be served by Portland General Electric or Pacific Power to receive incentives for electric measures and NW Natural or Cascade Natural Gas to receive incentives for gas measures.
- The project must pay or plan to pay the public purpose charge.
- The project site must be located in Oregon.
- The project must be new construction, an addition to an existing structure or a major renovation to an existing structure.
- The project must be a commercial, industrial, manufacturing or institutional building.

Eligible building types may include office, retail, healthcare and hospitals, warehouse or storage, restaurant, manufacturing, grocery, hotels and motels, public and private schools or colleges, mixed-use, high-rise multifamily residential (more than 3 stories) and parking garages.

More information at http://energytrust.org/public-sector/incentives/construction-renovation-improvements/custom/energy-modeling-assistance

Energy Trust of Oregon – Modeled Savings

Description: Energy trust provides incentives for installing systems and equipment that achieve energy savings beyond the 2010 Oregon Energy Efficiency Specialty Code, as estimated through a whole-building energy model.

Maximum possible incentive: Based on per-project installation incentive cap.

Terms/Qualifications: Modeled savings are based on the percentage of annual energy savings that a project achieves beyond code. Refer to the Modeled Savings Incentive Application for a detailed breakdown of incentive calculations. Incentives are subject to per-project installation incentive caps.

To be eligible to receive incentives a project must meet ALL of the following criteria:

- The project must be served by Portland General Electric or Pacific Power to receive incentives for electric measures and NW Natural or Cascade Natural Gas to receive incentives for gas measures.
- The project must pay or plan to pay the public purpose charge.
- The project site must be located in Oregon.
- The project must be new construction, an addition to an existing structure or a major renovation to an existing structure.
- The project must be a commercial, industrial, manufacturing or institutional building.

Eligible building types may include office, retail, healthcare and hospitals, warehouse or storage, restaurant, manufacturing, grocery, hotels and motels, public and private schools or colleges, mixed-use, high-rise multifamily residential (more than 3 stories) and parking garages.

More information at http://energytrust.org/public-sector/incentives/construction-renovation-improvements/custom/modeled-savings

Energy Trust of Oregon – Commissioning

Description: Electrical and mechanical systems that have variable performance or controls (e.g. lighting systems with automatic controls, HVAC systems and controls, and building energy management systems) are eligible for commissioning incentives.

Maximum possible incentive: $40,000

Terms/Qualifications: All equipment to be commissioned must have been approved by and received an installation incentive from Energy Trust. Commissioning incentives are calculated per-kWh and per-therm, based on the annual energy savings approved by Energy Trust during installation, not to exceed $40,000.

To be eligible to receive incentives a project must meet ALL of the following criteria:

- The project must be served by Portland General Electric or Pacific Power to receive incentives for electric measures and NW Natural or Cascade Natural Gas to receive incentives for gas measures.
- The project must pay or plan to pay the public purpose charge.
- The project site must be located in Oregon.
- The project must be new construction, an addition to an existing structure or a major renovation to an existing structure.
- The project must be a commercial, industrial, manufacturing or institutional building.

Eligible building types may include office, retail, healthcare and hospitals, warehouse or storage, restaurant, manufacturing, grocery, hotels and motels, public and private schools or colleges, mixed-use, high-rise multifamily residential (more than 3 stories) and parking garages.

More information at http://energytrust.org/public-sector/incentives/construction-renovation-improvements/custom/commissioning

Energy Trust of Oregon – LEED/Installation Incentives

Description: Energy Trust offers incentives to projects that achieve any level of LEED certification and save energy beyond the 2010 Oregon Energy Efficiency Specialty Code.

Maximum possible incentive: $499,999

Terms/Qualifications: LEED incentives are calculated on a per-kWh and per-therm basis and are based on the total annual energy savings claimed in the project's submittal to the Green Building Certification Institute (GBCI), as approved by Energy Trust. Projects are eligible for additional incentives for achieving Energy & Atmosphere credits 3 and 5 (Enhanced Commissioning and Measurement & Verification). Incentives cannot to exceed $499,999 per project.

To be eligible to receive incentives a project must meet ALL of the following criteria:

- The project must be served by Portland General Electric or Pacific Power to receive incentives for electric measures and NW Natural or Cascade Natural Gas to receive incentives for gas measures.
- The project must pay or plan to pay the public purpose charge.
- The project site must be located in Oregon.
- The project must be new construction, an addition to an existing structure or a major renovation to an existing structure.
- The project must be a commercial, industrial, manufacturing or institutional building.

Eligible building types may include office, retail, healthcare and hospitals, warehouse or storage, restaurant, manufacturing, grocery, hotels and motels, public and private schools or colleges, mixed-use, high-rise multifamily residential (more than 3 stories) and parking garages.

More information at http://energytrust.org/public-sector/incentives/construction-renovation-improvements/custom/leed

Energy Trust of Oregon – Net Zero (Pilot)

Description: Net Zero is a pilot program for Commercial Projects. If pursuing the Net Zero Energy path, ETO launched a pilot program in 2009 and is providing incentives and technical assistance for:

- Early Design
- Energy Modeling
- Additional energy-related design studies
- Energy-efficient equipment
- Renewable technologies
- Commissioning

Maximum possible incentive: Unknown

Terms/Qualifications: Need to contact Energy Trust for more information or visit http://energytrust.org/commercial/pilot-programs/path-to-net-zero.aspx

Energy Trust of Oregon – Solar Electric

Description: Solar Electric

0-35 KW: $1.20/watt
36-200 KW: $1.20-$0.60/watt
201-500 KW: $0.60/watt

Maximum possible incentive: $300,000

Terms/Qualifications: Energy Trust's solar electric incentives are limited and are subject to change. These incentive rates apply to business, public, nonprofit, industry and agriculture customers and to systems owned by a third-party entity offering a lease or power purchase agreement to a non-residential utility customer.

For all solar electric systems receiving Energy Trust incentives, the system owner will own the Renewable Energy Certificates (RECs) during the first five years of operation; Energy Trust will own RECs during years six through twenty.

To be eligible to receive incentives a project must meet ALL of the following criteria:

- You must be an Oregon customer of Portland General Electric or Pacific Power.
- Solar electric systems must be grid-tied.
- Systems must be installed by an approved Energy Trust trade ally contractor.
- Incentive applications must be pre-approved by Energy Trust prior to installation.
- All system components must be new.

- Large commercial electricity users who "self-direct" the renewable energy portion of their public purpose charge may receive a reduced incentive.

More information at http://energytrust.org/public-sector/incentives/equipment-upgrades-remodels/SolarElectric/SolarElectric2

Energy Trust of Oregon – Solar Water Heating

Description: PGE or Pacific Power customer using electric water heating will receive $0.40 per first-year kWh savings; NW Natural or Cascade Natural Gas customer using gas water heating will receive $6.00 per first-year therm savings.

Maximum possible incentive: 35% of project cost (typically 10-15%)

Terms/Qualifications:

- You must be an Oregon customer of Portland General Electric, Pacific Power, NW Natural or Cascade Natural Gas.
- All projects must be approved by Energy Trust prior to installation.
- Systems must be installed by a qualified Energy Trust trade ally contractor. Self-installed systems do not qualify.
- All system components must be new.

More information at http://energytrust.org/public-sector/incentives/equipment-upgrades-remodels/SolarWaterHeating/SolarWaterHeating2

Portland General Electric – Net Metering Program

Description: PGE's Net Metering Service the utility customers to generate their own electricity and reduce their electricity bills. A bidirectional net meter is installed to read the power acquired by the utility and what you supply to the grid. Each month, the power you used from your utility is offset by the power you send to the utility and you are only charged for the difference or the "net." If you generate more power than you use in a given month, you will only pay the basic utility service charges. The surplus energy will generate kWh credits that will be applied to your future bills.

Maximum Possible Incentive: Varies

Terms/Qualifications: There are three types of Net Metering options:

- Level 1: Inverter-based systems with <25 kW capacity. No application fees.
- Level 2: Larger commercial systems with <2 MW capacity. Application fee is $50 plus $1/kW of capacity.
- Level 3: This is for systems that do not use lab-tested equipment. Application fee is $100 plus $2/kW of capacity.

Must use an ETO listed licensed solar contractor and solar technician.

Learn more at http://www.portlandgeneral.com/renewables_efficiency/generate_power/business/net_metering/default.aspx

Portland General Electric – Solar Payment Option (Oregon Solar Incentive Program)

Description: The Solar Payment Option is an alternative (Pilot Program) to the PGE Net Metering program. In 2009, Oregon established the pilot solar volumetric incentive rate and payment program with legislation. Under this program, systems are paid for the kWh generated over a 15 year period, at a rate set at the time a system is initially enrolled in the program. The Public Utility Commission (PUC) was left with the discretion to establish rates and rules, where rates established will be re-evaluated periodically.

Mid-sized systems are paid for the amount of electricity generated, up to the amount of electricity consumed – basically, customers are paid for the amount of utility electric load consumption that is offset by on-site solar PV generation. Unlike typical feed-in tariffs, customers can consume the electricity generated on-site and receive a production incentive for the amount of electricity generated and consumed.

Maximum Possible Incentive:

Small-scale: $0.39/kWh (10 kW or less)

Medium-scale: $0.23/kWh (>10 kW to 100 kW)

Terms/Qualifications: Must be a PGE customer and the system must be a permanently installed PV energy system. The qualifying system cannot be purchased with state or ETO incentives with installed nameplate generating capacity greater than 10 kW up to and including 100 kW DC where the output is not paid for pursuant to another tariff schedule, that meet the eligibility requirements in OAR 860-084-0120, and where the monthly generation does not exceed Total Monthly Use pursuant to a Solar Photovoltaic Pilot Program and Interconnection Services Agreement. Although the Solar Payment Option precludes for PSU any ETO solar incentives, this approach has no other known funding limitations. Learn more at the following websites:

http://www.portlandgeneral.com/renewables_efficiency/generate_power/solar_payment/default.aspx?business

http://www.dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=OR134F&re=0&ee=0

Oregon Department of Energy – Opportunity Announcement

Description: The Oregon Department of Energy periodically releases Opportunity Announcements for tax credits for energy conservation projects. Energy conservation projects include projects with investments for which the first year energy savings yields a simple payback period of greater than three years. Projects must intend to begin construction within 12 months of the award. Project applicants propose a tax incentive structure.

This may or may not be an option for the PSU School of Business Administration. It is not a consistent annual program like some of the others. Instead, these credits are based on “periodic releases” when a specific amount of funding is available. The window of opportunity may be quite small in relation to the project schedule and application due dates.

Maximum Possible Incentive: Varies

Terms/Qualifications: The qualifying project costs include:

- Project components
- Fees to design or engineer the project
- Title searches, escrow fees, permits, licenses
- Materials and supplies needed for erection, construction, installation and acquisition of the project
- Work performed by employees or contractors that meet certain requirements
- Certain legal fees related to the development of the project

Interested parties must submit a preliminary certification application. Projects that are determined to meet all qualifications and deadlines will be reviewed as part of a competitive process. Preference is given to those projects that have the highest energy savings over the five-year credit allowance period per tax credit dollar. Other review criteria may include:

- The amount of energy saved over the equipment lifetime
- The project's expected lifespan compared to simple payback period
- The incentive structure and whether the energy savings benefit a party other than the owner
- Benefit-to-cost ratio over the lifetime of the project

- The project implementation plan
- The project financial plan
- Jobs created and sustained
- Local economic conditions of the site location
- Agreement to accept a reduction to the requested tax incentive
- Agreement to a voluntary measurement and verification plan

Projects that advance beyond the competitive process must undergo a technical review before receiving final certification. Check the program web site for Opportunity Announcements and associated application materials and requirements.

More information at http://www.oregon.gov/energy/BUSINESS/Incentives/Pages/EIP-Conservation.aspx

Oregon Department of Energy – State Energy Loan Program (SELP)

Description: The purpose of the Energy Loan Program (also known as SELP) is to promote energy conservation and renewable energy resource development. The program offers competitive fixed interest rate loans for projects that:

- Save energy
- Produce energy from renewable resources such as water, wind, geothermal, solar, biomass, waste materials or waste heat
- Use recycled materials to create products
- Use alternative fuels

More information at http://www.oregon.gov/ENERGY/LOANS/Pages/selphm.aspx

2. System Development Charges

System Development Charges (SDCs) may be applied to the project from the following City of Portland divisions:

- Bureau of Environmental Services – charges applied when the project will bring an increased use to city infrastructure.
- Portland Parks and Recreation – charges cover a portion of the cost to maintain parks and recreation facilities for new development.
- Portland Bureau of Transportation – charges cover the cost for transportation facilities needed to serve new development.
- Portland Water Bureau – charges applied when new development increases the water system capacity.

There may be opportunities to reduce specific SDCs due to the strategies pursued for the new School of Business Administration. Further discussion will be needed to determine which SDCs will apply.

APPENDICES

1. Charrette Summary
2. Vision Statement & Faculty Briefing Notes
3. Case Studies
4. Energy Use Intensity & Renewable Energy Analysis
    a. CONCEPT STUDY REPORT -- ROOF DESIGN with 66 kW PV System
    b. NET ZERO ENERGY -- ENTIRE SBA (Renovated SF & New SF)
    c. NET ZERO ENERGY -- Only New Construction Portion of SBA
5. Rainwater Capture and Reuse Calculator

REPORT AUTHORS

This report was produced by Rita Haberman, Cindy Sundborg, Josh Hatch and Scott Lewis; Brightworks Sustainability, in September/October 2013. www.brightworks.net

Portland State University School of Business Administration
New Building/Building Renovation Vision Charrette – Meeting Notes
12 August 2013
By Scott Lewis, Rita Haberman, Cindy Sundborg | **Brightworks** Sustainability

INTRODUCTION

On August 6, 2013 the PSU School of Business Administration administrators and facilities team convened a brainstorming charrette to bring together a group of future building occupants, current and recent students, other PSU stakeholders and sustainability experts, to explore the possibilities for making the new SBA facility an exmplary showcase of sustainbaility in a way that enhances and supports the core use and mission of the building and of PSU and the SBA.[1]

Brightworks, a Portland-based sustainability consulting firm which has worked extensively with PSU in the past, was asked to facilitate and document the meeting. These are our notes.

The meeting was held on campus in a three-hour session on August 6th, 2013. The format or agenda of the meeting was as follows:

- Introductory comments by Scott Dawson, Dean of the SBA
- Personal introductions
- Overview of some sustainability concepts and frameworks including (but not limited to) The Natural Step, LEED and the Living Building challenge
- Survey of past and ongoing sustainability efforts in PSU's building program
- Review of some case study projects – the Bullitt Center in Seattle, net-zero energy buildings, etc.
- 90-minute discussion of what PSU could and perhaps should do for the SBA

The intention was to keep the discussion "high level," to start establishing or shaping a "vision" for the project as it moves forward, not to define specific strategies or technologies to achieve that vision.

MEETING PURPOSE

- Develop or reinforce some common fluency around sustainability-related concepts and terminology
- Create a context for a discussion of what is possible and what PSU *should* do or attempt for the SBA project.
- Facilitate and document that discussion about what PSU should do or attempt for the SBA project.
- Enable a diverse group of stakeholders to feel heard and to hear each other
- Capturing from those stakeholders their priorities and concerns

[1] A full list of attendees can be found in Appendix A to these notes.

MEETING NOTES, SUMMARIZED

Scott Dawson, intro:
Want to already know what sustainability means to us BEFORE the design team comes together.

Givens about the Building/Non-negotiable:[2]
- Footprint: 100,000 sf
- Addition of another 40-50K
- Relocation of staff during construction
- Keep in mind that 2/3 of the building already exists
- State Building has minimum certification of LEED Silver
- $60 million project
- Elevator system
- Meeting fire codes
- Relocating the school of education
- Has to have a 'unified look' the new and old have to be coherent
- Note this is PSUs' first new academic in a decade – it is high visibility. The building identity is central to PSU's institutional identity.
- Good sustainability fact: two-thirds of building is renovation of an existing building; lower climate impact than new construction!

Unknowns:
Retail space & partners

Inspirations/Goals:
- Architectural integrity & inspiring
- Hallmark program of educational enterprises
- Building should be coherent so it looks like one building

Why do LEED/LBC (or other framework)? [Brightworks comment:]
1. Introduces rigor into the process. Otherwise, might not pursue anything.
2. You can get some PR for this achievement – national/international, 3rd party recognition; provides more credibility than just self-declaring.

[2] Also see PSU's list of additional "givens" in Appendix B.

BRAINSTORMING SESSION

For this session, participants broke into two groups for approximately one hour to discuss the questions listed below. They were then asked to prioritize among the answer for the top few in order of importance. Then the two groups met and reported to each other, and discussed, their results.

PRIORITIES, SUMMARIZED FROM THE "REPORT OUT"

Consensus Point

LEED Platinum minimum, pursue some petals of LBC, Stretch goal: Net Zero Energy Building (NZEB)

Group A

1. Mission-centric vision – when you walk into the building, you should Feel the mission/values of the SBA (Leadership, Innovation, Sustainability). Should be looked at as a lens to determine which route we want to go and pursue (i.e. water, energy – if these are some core mission alignment, maybe these are the best to pursue…) – core mission is learning, how do you facilitate good learning environment, etc. toxicity vs. learning, there are barriers here – can we meet this first, then move on to other agendas (i.e. energy, water, etc.).
2. Beauty
3. Flexibility/Adaptability
    a. Space should not just be for not, should be able to morph.
    b. Current spaces are not good
    c. Standing areas
4. Community space – for students, enterprises, faculty, etc.

Group B

Vision for the whole MBA program. Change, Build, Serve.

1. Design of the building to reflect our NW values, compelling and simple
2. People-centered – make sure we hit this first before moving on to other ideas…
3. Visibility (but not intrusive) & Education – can the building be used as an education tool for students – have lots coming and going over the years, how can sustainability of building be built into the environment (i.e. ROI analysis)
4. LEED Platinum as minimum & maybe achieve petals of LBC. Net Zero Energy as a stretch goal.

Notes from General Discussion

- Fulfill the mission as sustainably as possible. First – Meet SBA mission-centric vision (MBA values: leadership, innovation, sust) – lense for evaluation what sust strategies are pursued. Must align with core mission (every learning space as productive as possible, standing option, no toxicity in materials…) SBA Values: Change, build, serve.
  Second – Integrate Sust. Strategies.
    - What is SBA really trying to accomplish?
    - What is the filter to be used for decision-making?

- Welcoming, inviting and engaging – build a community on campus. Make it socially-regenerative.
- Interface with community
- Flex space for gathering, meeting, hanging out
- Beauty
- Unique
- Adaptability – now and future, able to morph
- PSU passion for sustainability. Make SBA a community, student, faculty space.
- Iconic: "iconic" is scary.
- Design should reflect NW values, compelling and simple on surface and systems.
- Invite, educate and inspire (now missing).
- People centric – students and community.
- Demonstrate ROI. Business case for Sustainable SBA. A core class – living lab: ROI, marketing, operations, entrepreneurs, student-run
- Tell the story, visible design and operations, to current and future
- Legacy opportunities for SBA. "PSU – whow! That place is awesome."

ADDITIONAL COMMENTS FROM THE BREAKOUT MEETINGS

Group A

VALUES (business school): leadership, innovation and sustainability
LEED Platinum at MINIMUM

Options: New Construction for new 50,000 sf = LBC?; and Renovation = non-LBC, LEED Platinum? Put PV on renovation to serve new (LBC).

Question: What do we need out of this building as a university, institution, etc.?

Currently, people have a hard time finding the correct building.
Portland is known for non-corporate mentality – want to reflect this.

What is the **purpose/vision** of the project?
- A place where the business community wants to be
- A place where they feel comfortable, can network, it is seamless
- A place where business community and partners feel connected
- Want a building that welcomes them, not corporate (keeps the Portland identity)
- A space where communication between enterprises and students is available
- Want people to walk through this building and have things stick to people (values, etc.)
- A forum for broader civic discussions
- Must be beautiful and welcoming.
- Must be unique – **strong and distinct identity**.
- Can students be a part of the sustainability programs at the campus or bigger research initiatives – design an open lab or area to facilitate

- Need **flexibility** of the space for future adaptabilities and accommodate current needs

Retail – let's do this in a different way… open markets.
Community areas – inviting everyone area, even the public:
- Roof top garden area
- Courtyard with open space

What is the risk of NOT doing an innovative design:
- Might lose money

Campus integration

What green building certifications, if any, do you think SBA should pursue?

- Must commit to the minimum standard – LEED Silver.
- Like the idea of the pursuing a petal with LBC (faculty meeting previously – will not happen. Reason, educational work is insular, singular, etc. Work requires a lot of concentration – having open offices will not work with this) – can we do a survey to understand what the faculty wants and needs.
- Can we pursue BOTH?
- Design the building as a more integrated building – have offices on upper floors, classrooms on lower floors, and maybe some open space, student businesses, food/retail in the middle floors.

- Plan for a living building – plan for the BEST building achievable. Might not be able to achieve now, but can the building adapt in the future.

- Need to spend every dollar to the best of our ability – technology changes, so might not make sense

<u>What is the most sustainable approach to fulfilling the mission of the organization??</u>

Sustainability decisions are important, AND smart business choices are imperative
What do we want to focus on for the PSU SBA school? We need to focus on what the MISSION of PSU is all about to decide how to make decisions – maybe we won't focus on water or energy, but something new to be a leader of…*i.e. Standing areas in classrooms, instead of sitting areas – allow students to stretch legs – be a leader in this area (social sustainability)*

<u>Group B</u>

1. **LEED Silver required, would like to achieve LEED Platinum at MINIUM**

LBC – achieve some petals (ones with less maintenance) – "net positive", rain cover over sky bridge to collect rainwater for reuse?

2. **Partner with Engineering, Real Estate, ISS.**

- Can we put digester in Cramer Hall after boiler room completed?

- Students vs. tenants – how do we teach/educate student behavior?
- Montgomery – green street/water treatment. What will that look like
- Corner of Broadway & Montgomery is the welcome site

3. Iconic (?) – change, build, serve (mission) – reflect NW values, shown in simple/compelling way, memorable/reflective…
4. Should be throughout the building

- Make #'s from energy usage visible – labs use power, larger user in SBA?
- Should be throughout building what are the functions of the bldg. and how is it reflected through design? (Future business leaders)
- Educate through design – use building as opportunity to educate – allocate $ to educate.
- Invite, inspire, education – we currently don't invite/inspire as well as we educate.
- Energy efficient and comfortable – fresh air
- We want people to want to be in the building and want to learn. Social center (sustainability) – if it is sustainable, that's great too.

NEXT STEPS

- Scott D – Take outcomes from this charrette to a bigger ring of faculty and staff to "buy-in"
- Architect to come in and facilitate larger group and get options and costs put together

  - A&E RFP first, Nov. on board, then larger kick-off; then pre-construction CM/GC RFP and selection.
  - Scott D.: Language, goals, messages around sustainable. Clear. This is the "wish list." (started today and to be refined, f-r, cost estimates)
  - Take message to SBA faculty and staff – build consensus with broader audience. Better understand how SBA faculty and students like to work, want to work.

Appendices:

A Attendee List
B Known Knowns
C Case Study Notes from Bullitt Center
D Powerpoint pdf
E National Renewable Energy Lab (NREL) case study (Net Zero Class A office building @ $260/gsf)

ATTENDEE LIST

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Overall - State or Code Mandates
- 1% for Art
- LEED Silver or equivalent.
- Seismic stabilization

School of Business Administration - Deferred Maintenance Items
- Additional fire alarm devices in egress areas.
- Replace sprinkler heads.
- Upgrade door hardware to meet accessibility requirements.
- Replace the entire HVAC system including air handlers, ductwork, terminal units, and electrical controls.
- Demo the existing air cooled chiller and connect cooling to the Campus Loop chilled water system.
- Replace electrical switches and receptacles and replace faulty breakers where required.
- Replace carpet.
- Upgrade ceilings

School of Education - Deferred Maintenance Items
- Additional fire alarm devices in egress areas.
- Roof repairs for known leaks.
- Replace sprinkler heads.
- Upgrade handrails and guardrails to meet current code requirements.
- Upgrade door hardware to meet accessibility requirements.
- Replace the entire HVAC system including air handlers, ductwork, terminal units and electrical controls.
- Emergency generator and automatic transfer switch replacement.
- Replace the main electrical switchboard.
- Replace electrical switches and receptacles and replace faulty breakers where required.
- Replace floor finishes.
- Comprehensive elevator modernization.
- Replace drinking fountains to meet accessibility standards.
- Replace acoustical ceilings.
- Replace chrome faucet assemblies with automated.
- Replace domestic water heaters.

Assumed Requirements
- 150 seat auditorium.
- 11 new classrooms.
- 42,000 square foot expansion.

Case Study: Bullitt Center in Seattle

Noteworthy case study on many fronts

- First LBC project of significant scale – 52,000 SF; completed April 2013; "Class A" office space (but not technically, just outside central downtown), market rate office space
- Comparable in many aspects for PSU's SBA: office, classroom, seminar; Pacific Northwest region
- Construction Costs: $18.5 million or $355/SF.

Sustainability Targets, Strategies & Accomplishments -- LBC

- Net Zero Energy Features
    - Energy efficiency 83% greater than a typical Seattle office building
    - Predicted EUI rating of 16kBTU/SF/yr
    - 242kW photovoltaic array
    - Ground source geothermal heat exchange system
    - Radiant floor heating and cooling system
    - Retractable external blinds to block heat before it warms the building
    - Reduced plug loads
- Net Zero Water
    - Water efficiency 80% greater than a typical Seattle office building
    - 56,000 gallon rainwater collection cistern
    - Greywater reclamation
    - Composting foam flush toilets (save 96% more water than traditional flush toilets) – World's only six-story composting toilet system.
    - Rainwater filtration for potable uses
    - Green roof and constructed wetland
- No toxic materials (checked against the 'Red List' of materials forbidden by the Living Building Challenge). Met LBC's "Red List" of substances with known negative human health effects. Researched thousands of materials

Some insights from the project's design team (Paul Schwer of PAE Engineers and Maragret Spruc of Miller Hull Architect

- "Set the Stage & Select the Cast" -- Project design kick-off was a 2-day intensive charrette
    - Denis Hayes, CEO of the Bullitt Foundation, opened the charrette with the clear statement:"This will be a Living Building." This allowed and forced the team to focus on solving the LBC puzzle. After the two-day design charrette, "90% of solution defined."
    - A truly Integrated Design Process is essential to meet major stretch goals:
        - General Contractor played critical role, especially in pre-construction decision-making
        - Building operators must be involved early (by 50% CDs), as they are responsible for "adjusting the sails" of a high-performance building
- City of Seattle's "LBC Pilot" Program
    - The pilot allowed the project to try some strategies without them becoming precedent for the City, for example:
        - PV "hat" extends beyond roof proper. 30% of PVs extend beyond the roof
        - Stormwater onsite infiltration into surrounding parking strips
- Emphasis on low-tech, off-the-shelf technologies

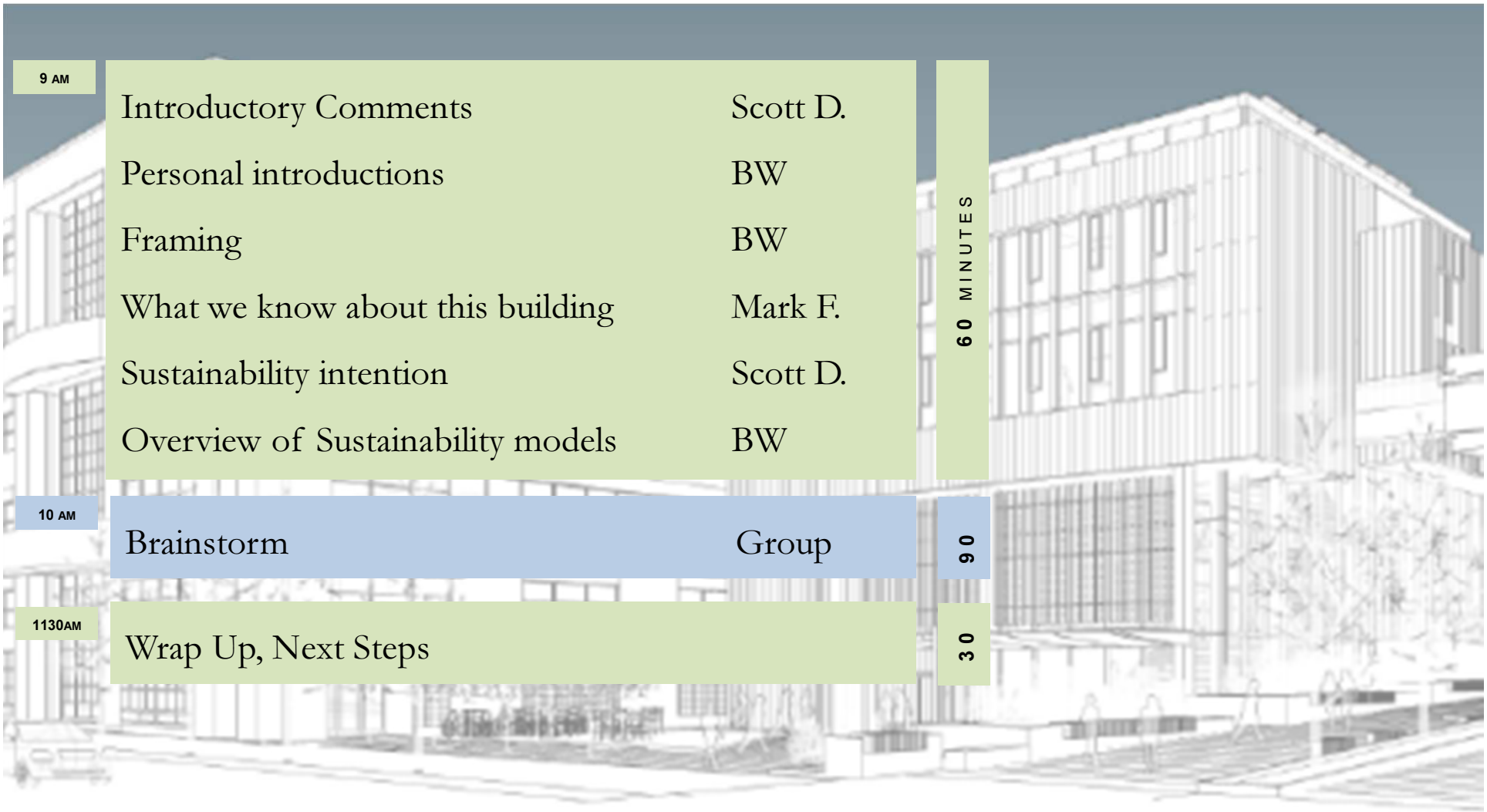
    - "Irresistible Stair" – Simple, low tech, good design, and encourages occupants to get out of the elevator box and instead walk up and down (health benefits), see each other (social interactions), enjoy the Seattle skyline, and minimize elevator energy use.
- Don't Underestimate the volume and the value of PR exposure –
    - Bullitt Center has been featured extensively (NY Times, TIME Magazine, LA Times, NPR and many others)
    - Attract students/faculty, funding; walk the talk of "sustainability" (It's been valuable for the visionary Bullitt Foundation and other Bullitt Center tenants; and could play out similarly for PSU SBA)
    - Web sites of both the Miller Hull Architects and PAE Engineers feature the Bullitt Center project

SUSTAINABILITY VISION WORKSHOP

BRIGHTWORKS

Portland State UNIVERSITY | School of Business Administration

AGENDA



9 AM	Introductory Comments	Scott D.	60 MINUTES
	Personal introductions	BW	
	Framing	BW	
	What we know about this building	Mark F.	
	Sustainability intention	Scott D.	
	Overview of Sustainability models	BW	
10 AM	Brainstorm	Group	90
1130AM	Wrap Up, Next Steps		30

BRIGHTWORKS

Portland State UNIVERSITY | School of Business Administration

INTRODUCTORY COMMENTS – SCOTT DAWSON

Personal Introductions

FRAMING

WHY?

5/10/2013

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

Carbon Dioxide at NOAA's Mauna Loa Observatory reaches new milestone: Tops 400 ppm

ABC NEWS

The world's glaciers lost 260 gigatons of water each year between 2003 and 2009, making these rivers of ice responsible for almost a third of sea-level rise in that time, new research finds.

The polar ice caps have melted faster in last 20 years than in the last 10,000. A comprehensive satellite study confirms that the melting ice caps are raising sea levels at an accelerating rate.

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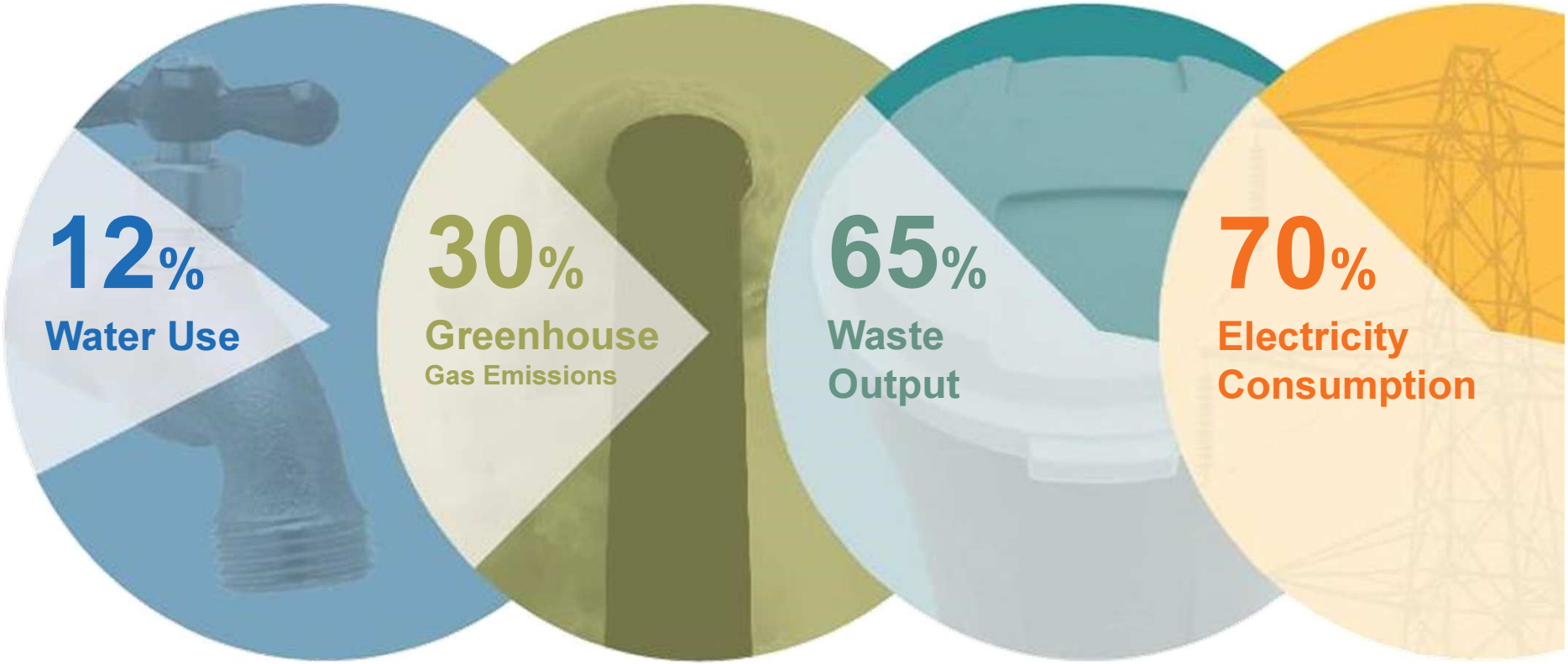
Portland State UNIVERSITY | School of Business Administration

BUILDINGS MAKE A DIFFERENCE

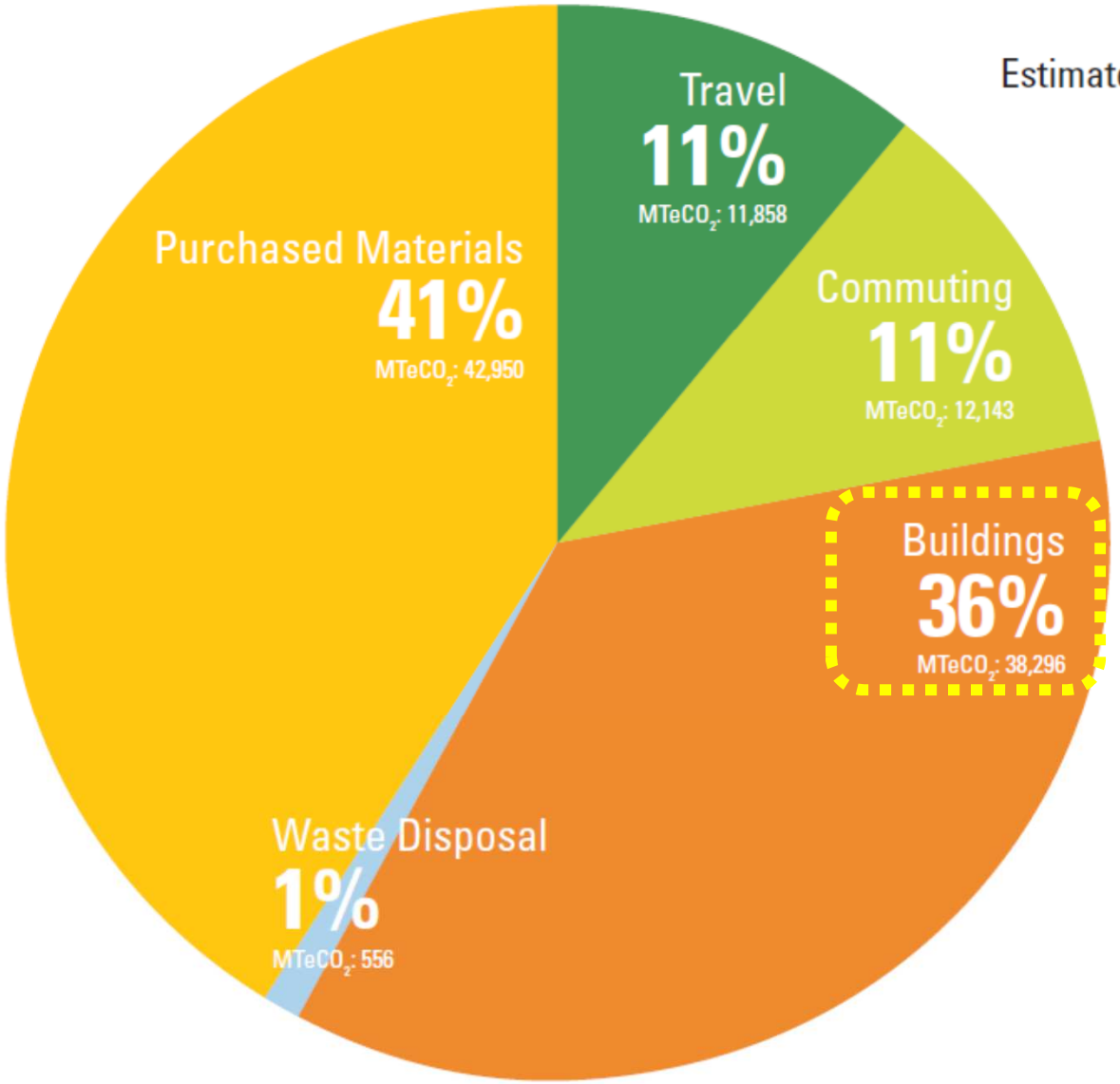


...total societal use

BRIGHTWORKS

Portland State UNIVERSITY | School of Business Administration

Portland State University | Finance & Administration: Campus Planning & Sustainability



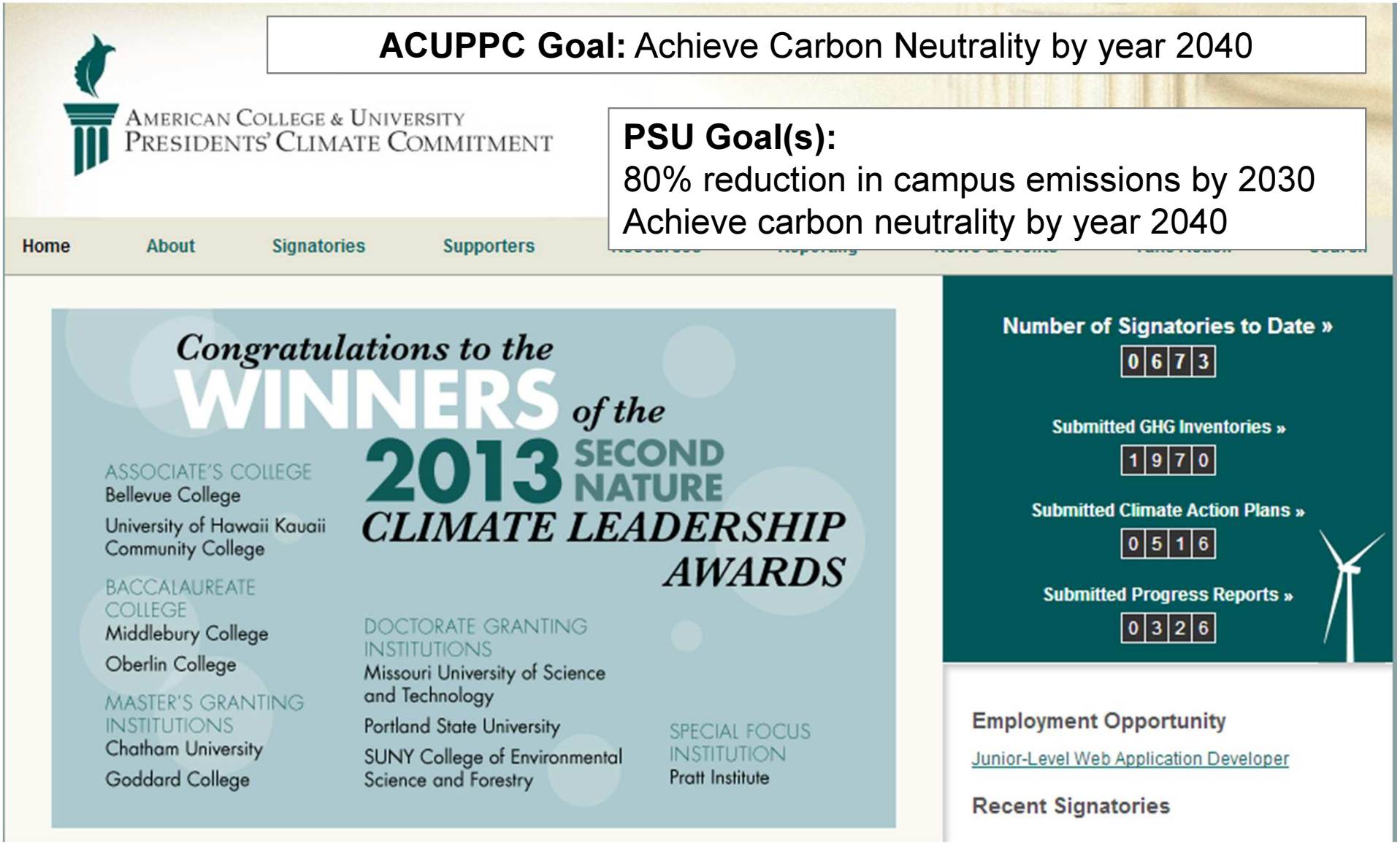
Portland State University
Estimated Greenhouse Gas Emissions
Fiscal Year 2008

Total $MTeCO_2$:

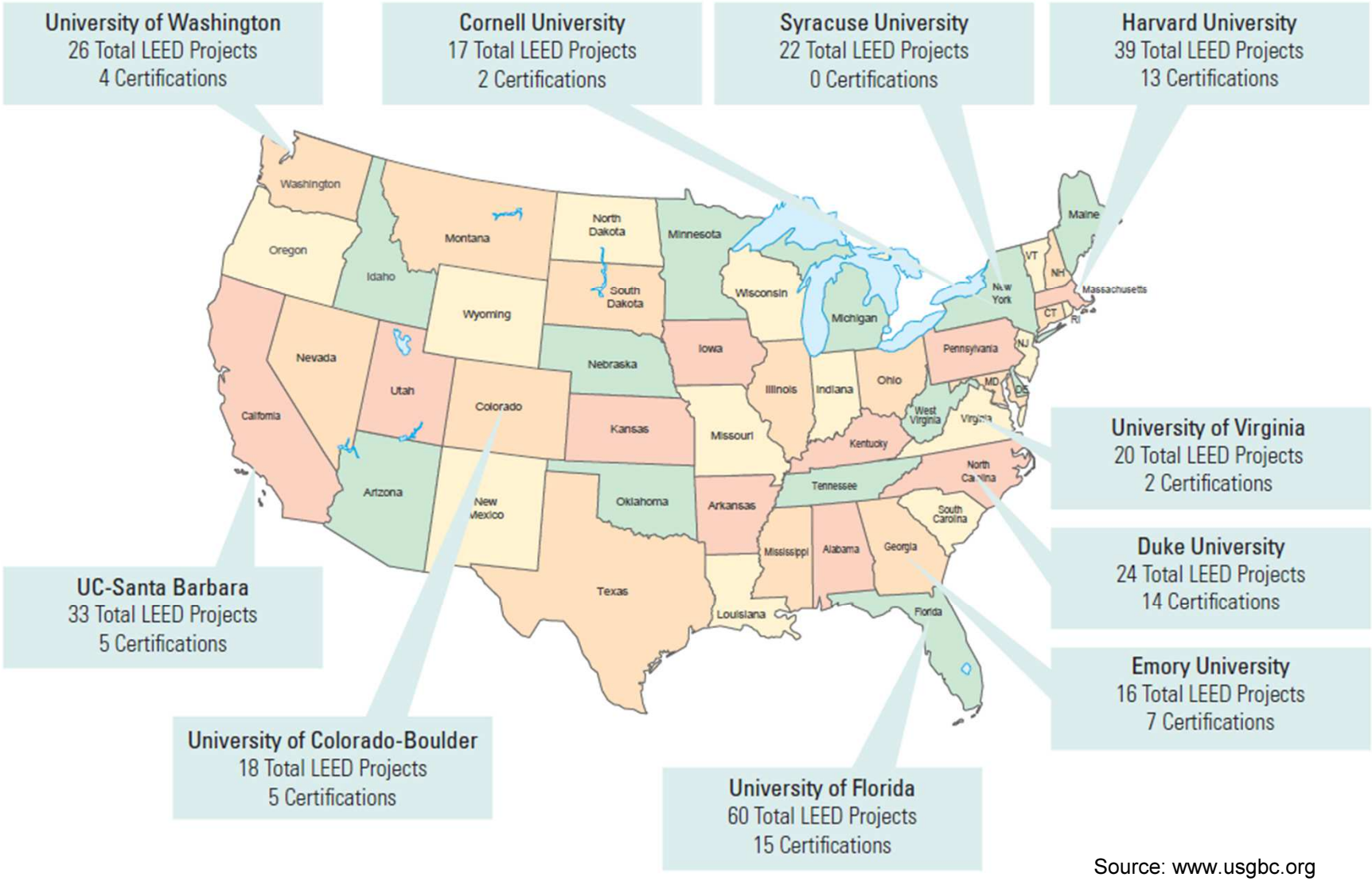
105,803

ACUPPC Goal: Achieve Carbon Neutrality by year 2040

PSU Goal(s):
80% reduction in campus emissions by 2030
Achieve carbon neutrality by year 2040



Top Ten Universities in Terms of LEED Projects



Source: www.usgbc.org

Epler Hall

- 2003 New Construction
- Over 90% of original building reused or recycled
- Natural ventilation

The Broadway

- 2004 New Residence Hall
- 20% less potable water demand over code
- Largest eco-roof in city

Research Greenhouse

- 44% reduction in water use
- More than 90% of work areas access outside views
- FSC certified cabinetry

Engineering Building

- 2004 New Construction
- 45% reduction in energy use
- Geothermal heating and cooling

Acedemic and Student Recreation Center

- 2009 New Construction
- $114,370 in annual energy savings
- Rainwater captured for reuse

Shattuck Hall

- 19% better than national energy code
- Radiant heating and cooling panels
- Extensive daylighting

Science Research & Teaching Center

- 2011 Major Renovation
- 50% less conditioned air than before renovation
- Non-toxic finishes

Lincoln Hall

- 2011 Historic Renovation
- $41,341 in annual energy savings
- Rooftop solar array

BRIGHTWORKS

Portland State UNIVERSITY | School of Business Administration

Epler Hall

LEED SILVER

The Broadway

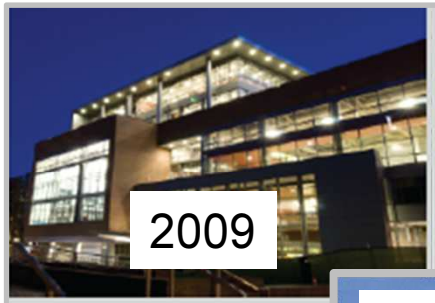
LEED SILVER

Research Greenhouse

LEED SILVER

Engineering Building

LEED GOLD



Acedemic and Stud
Recreation Cente

LEED GOLD

rch & Teaching
nter

LEED GOLD

Lincoln Hall

LEED PLATINUM

Collaborative Life Sciences Center (in construction)
Targeting Platinum

LEED PLATINUM

BRIGHTWORKS

Portland State UNIVERSITY | School of Business Administration

The final section of this review highlights institutions that had multiple sustainability achievements in 2012 and were most-mentioned in the AASHE Bulletin.

Most-Mentioned Colleges & Universities – by Institution Type

4-year Research Institutions	4-year Non-Research Institutions	2-year Institutions
Harvard University	Appalachian State University	Johnson County Community College
University of Michigan	Unity College	Portland Community College
University of California, Berkeley	Maharishi University of Management	Austin Community College
University of Colorado, Boulder	Rochester Institute of Technology	Bellevue College
Portland State University	Chatham University	

Source: AASHE Higher Education Sustainability Review 2012

THE RANGE OF POSSIBILITIES

The Staircase of Sustainability

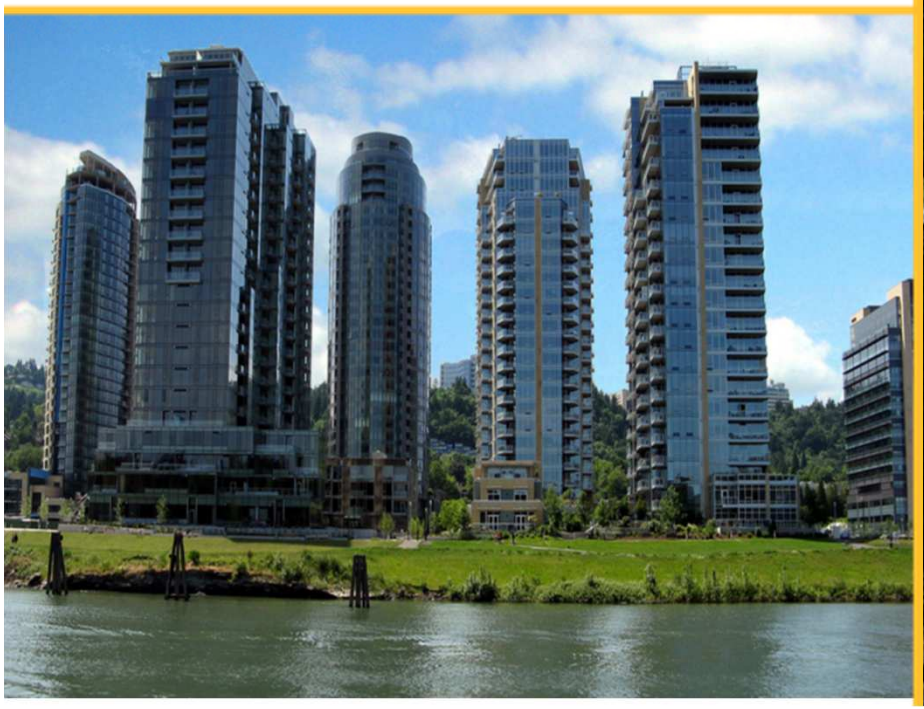
PORTLAND'S SOUTH WATERFRONT REDEVELOPMENT

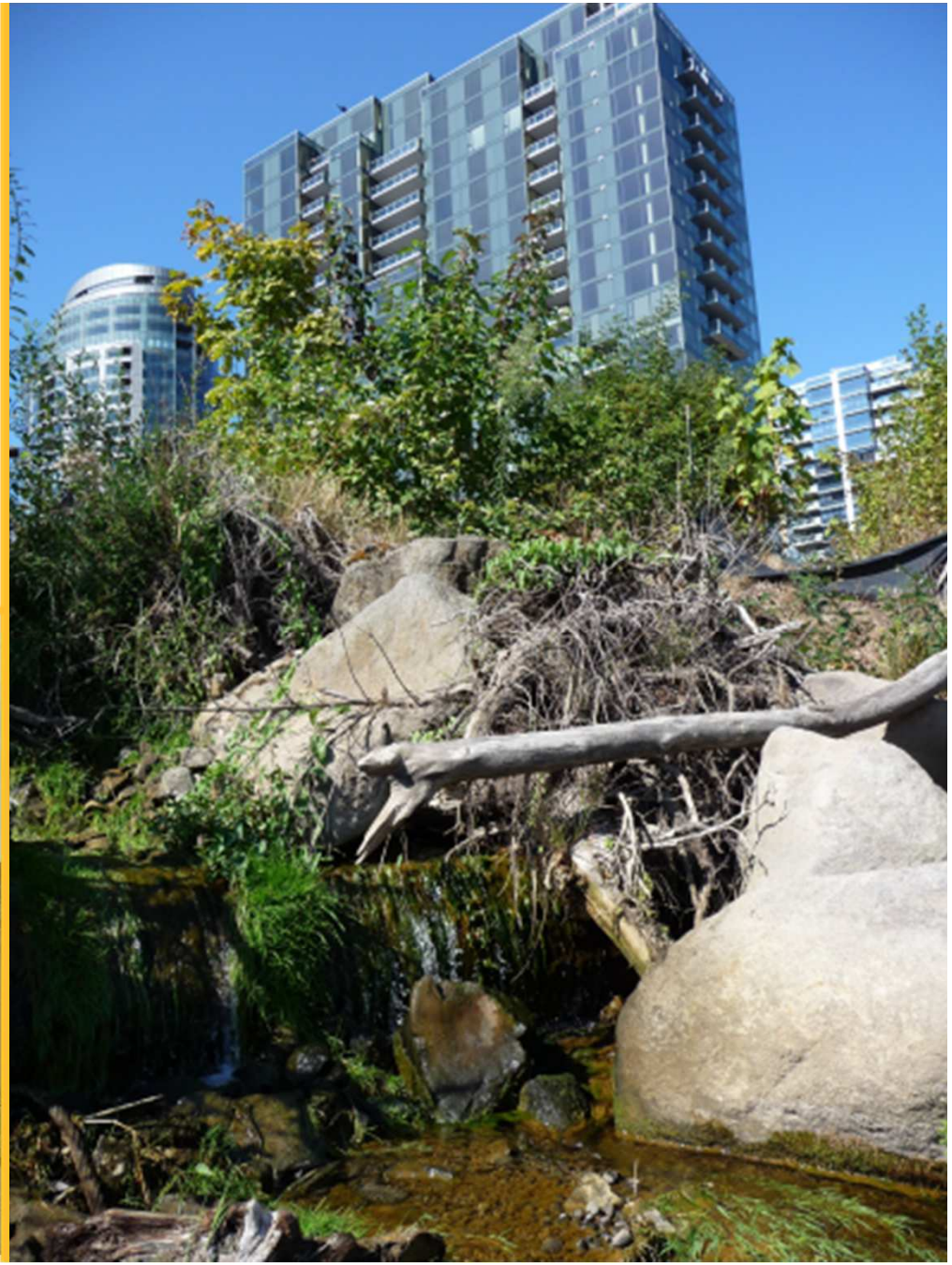
2002

REGENERATIVE DESIGN: EXAMPLE

PORTLAND'S SOUTH WATERFRONT REDEVELOPMENT

2010





REGENERATIVE DESIGN: EXAMPLE

REGENERATIVE DESIGN: EXAMPLE

SUSTAINABLE DEVELOPMENT

Is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

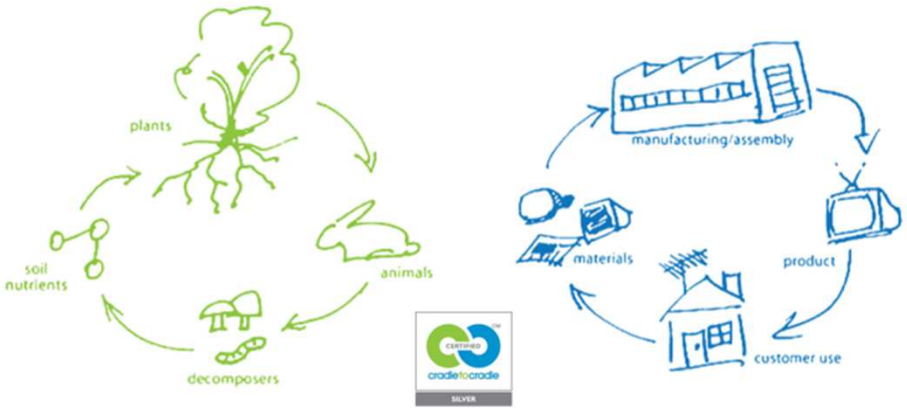
— World Commission on Environment and Development
The Bruntland Report, 1987

TRIPLE BOTTOM LINE

"People, Planet, Profit" or "Economy, Environment, Equity"

CRADLE TO CRADLE

Biological and Technical Nutrient Cycles



www.mbdc.com

THE NATURAL STEP

Four "System Conditions" of Sustainability

In a sustainable society, nature is not subject to systematically increasing…

- concentrations of substances extracted from the Earth's crust,
- concentrations of substances produced by society,
- degradation by physical means,

And, in that society…

- people are not subject to conditions that systematically undermine their capacity to meet their needs.

LEED-NC 2.2 Scorecard

Lincoln Hall Renovation 06/17/11

LEED-NC FOR NEW CONSTRUCTION

Yes	No	Certified 26 to 32 points	Silver 33 to 38 points	Gold 39 to 51 points	Platinum 52 or more points
54	16	**Total Project Score**			

Y	N	Sustainable Sites		
12	2			
Y		C	Prereq 1	Construction Activity Pollution Prevention
1			Credit 1	Site Selection
1			Credit 2	Development Density & Community Connectivity
1			Credit 3	Brownfield Redevelopment
1			Credit 4.1	Alternative Transportation, Public Transportation Access
1			Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms
1			Credit 4.3	Alternative Transportation, Low Emitting & Fuel Efficient Vehicles
1			Credit 4.4	Alternative Transportation, Parking Capacity
1		C	Credit 5.1	Site Development, Protect or Restore Habitat
1			Credit 5.2	Site Development, Maximize Open Space
	1		Credit 6.1	Stormwater Design, Quantity Control
	1		Credit 6.2	Stormwater Design, Quality Control
1		C	Credit 7.1	Heat Island Effect, Non-Roof
1			Credit 7.2	Heat Island Effect, Roof
1			Credit 8	Light Pollution Reduction

Y	N	Water Efficiency		
4	1			
1			Credit 1.1	Water Efficient Landscaping, Reduce by 50%
1			Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation
	1		Credit 2	Innovative Wastewater Technologies
1			Credit 3.1	Water Use Reduction, 20% Reduction
1			Credit 3.2	Water Use Reduction, 30% Reduction

Y	N	Energy & Atmosphere		
12	6			
Y		C	Prereq 1	Fundamental Commissioning of the Building Energy Systems
Y			Prereq 2	Minimum Energy Performance
Y			Prereq 3	Fundamental Refrigerant Management
2			Credit 1.1	Optimize Energy Performance, 14% New / 7% Existing
2			Credit 1.2	Optimize Energy Performance, 21% New / 14% Existing
2			Credit 1.3	Optimize Energy Performance, 28% New / 21% Existing
1	1		Credit 1.4	Optimize Energy Performance, 35% New / 28% Existing
	2		Credit 1.5	Optimize Energy Performance, 42% New / 35% Existing
1			Credit 2.1	On-Site Renewable Energy, 2.5%
	1		Credit 2.2	On-Site Renewable Energy, 7.5%
	1		Credit 2.3	On-Site Renewable Energy, 12.5%
1		C	Credit 3	Enhanced Commissioning
1			Credit 4	Enhanced Refrigerant Management
1		C	Credit 5	Measurement & Verification
1		C	Credit 6	Green Power 35%

Y	N	Materials & Resources		
8	5			
Y			Prereq 1	Storage & Collection of Recyclables
1		C	Credit 1.1	Building Reuse, Maintain 75% of Existing Walls, Floors & Roof
	1	C	Credit 1.2	Building Reuse, Maintain 95% of Existing Walls, Floors & Roof
	1	C	Credit 1.3	Building Reuse, Maintain 50% of Interior Non-Structural Elements
1		C	Credit 2.1	Construction Waste Management, Divert 50%
1		C	Credit 2.2	Construction Waste Management, Divert 75%
	1		Credit 3.1	Materials Reuse, Specify 5%
	1		Credit 3.2	Materials Reuse, Specify 10%
1		C	Credit 4.1	Recycled Content, 10% (POST-CONSUMER + 1/2 PRE-CONSUMER)
1		C	Credit 4.2	Recycled Content, 20% (POST-CONSUMER + 1/2 PRE-CONSUMER)
1		C	Credit 5.1	Regional Materials, 10% Extracted, Processed & Manufactured Regionally
1		C	Credit 5.2	Regional Materials, 20% Extracted, Processed & Manufactured Regionally
1		C	Credit 6	Rapidly Renewable Materials 2.5%
	1	C	Credit 7	Certified Wood

Y	N	Indoor Environmental Quality		
13	2			
Y			Prereq 1	Minimum IAQ Performance
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control
1			Credit 1	Outdoor Air Delivery Monitoring
1			Credit 2	Increased Ventilation
1		C	Credit 3.1	Construction IAQ Management Plan, During Construction
1		C	Credit 3.2	Construction IAQ Management Plan, Before Occupancy
1		C	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants
1		C	Credit 4.2	Low-Emitting Materials, Paints & Coatings
1		C	Credit 4.3	Low-Emitting Materials, Carpet Systems
1		C	Credit 4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products
1			Credit 5	Indoor Chemical & Pollutant Source Control
1			Credit 6.1	Controllability of Systems, Lighting
	1		Credit 6.2	Controllability of Systems, Thermal Comfort
1			Credit 7.1	Thermal Comfort, Design
1			Credit 7.2	Thermal Comfort, Verification
1			Credit 8.1	Daylight & Views, Daylight 75% of Spaces
	1		Credit 8.2	Daylight & Views, Views for 90% of Spaces

Y	N	Innovation & Design Process		
5	0			
1		C	Credit 1.1	Innovation in Design: Green Power 70%
1		C	Credit 1.2	Innovation in Design: Comprehensive Transp. Mgmt. Plan
1		C	Credit 1.3	Innovation in Design: Green Housekeeping
1		C	Credit 1.4	Innovation in Design : WEc3 Exemplary Performance, 40%
1		C	Credit 2	LEED™ Accredited Professional

Water Use Reduction

20% Reduction

SS	WE	EA	MR	EQ	ID
Credit 3.1					

1 Point

Intent

Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Requirements

Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks.

SS	WE	EA	MR	EQ	ID
Credit 3.2					

1 Point
in addition to
We Credit 3.1

Water Use Reduction

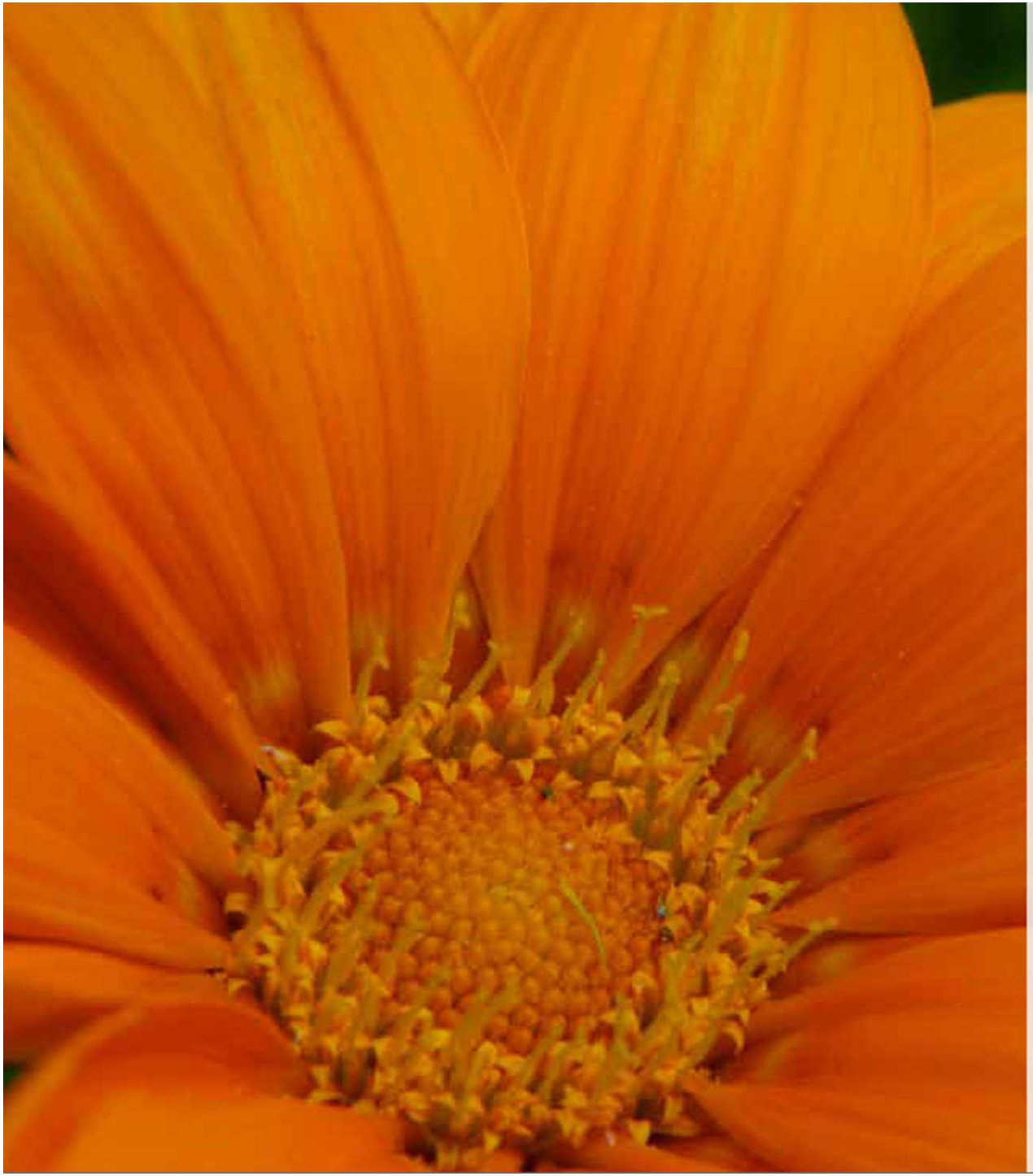
30% Reduction

Intent

Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Requirements

Employ strategies that in aggregate use 30% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks.



LIVING BUILDING CHALLENGE℠ 2.1

A Visionary Path to a Restorative Future

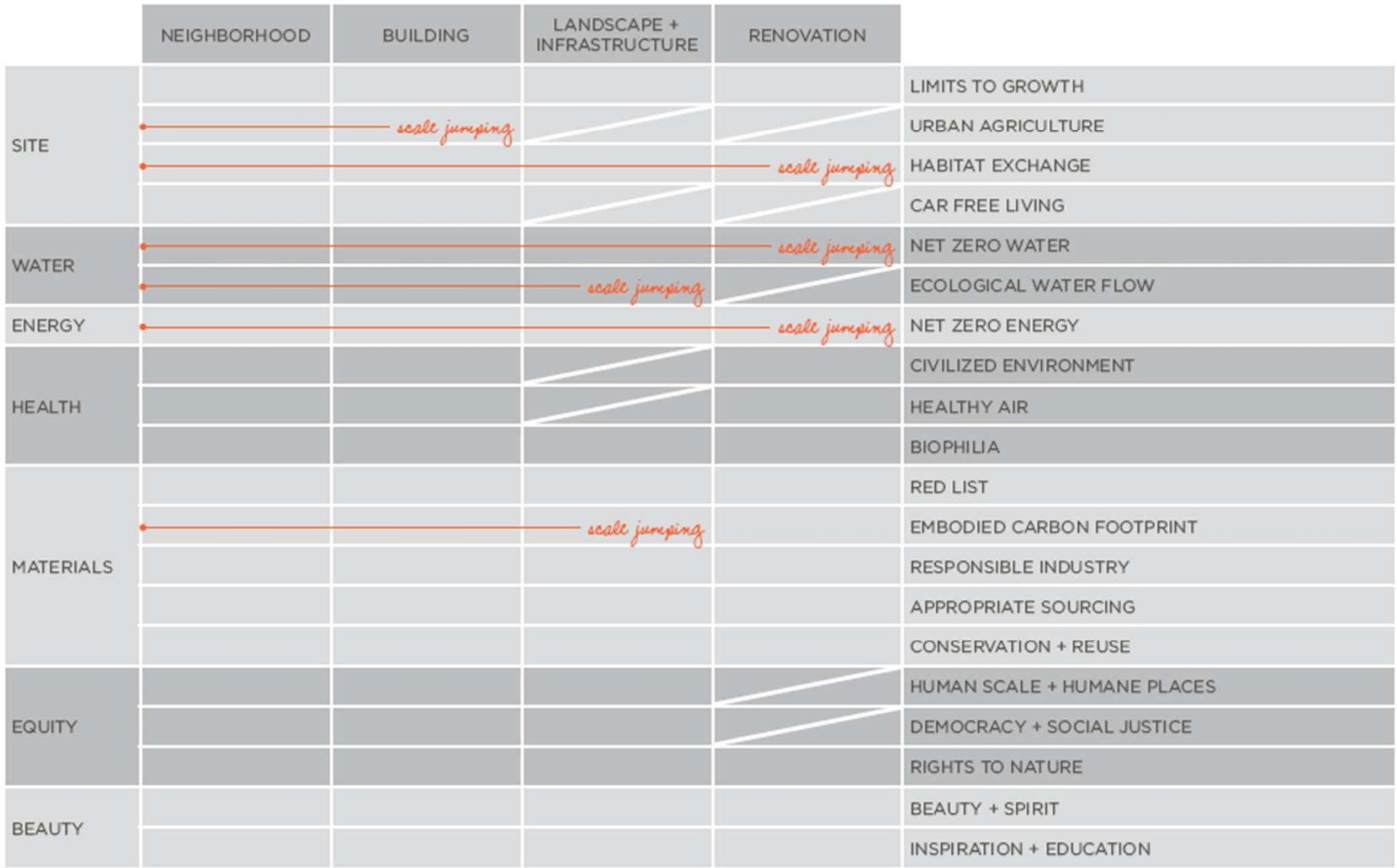
INTERNATIONAL LIVING FUTURE INSTITUTE℠

May 2012

SUMMARY MATRIX

Imperative is optional for corresponding Typology

scale Solutions beyond project area are permissible



05

NET ZERO WATER[28]

One hundred percent of the project's water needs[29] must be supplied by captured precipitation or other natural closed loop water systems[30] that account for downstream ecosystem impacts, or by re-cycling used project water. Water must be appropriately purified without the use of chemicals.

28 This Imperative may be attempted using the Scale Jumping design overlay, which endorses the implementation of solutions beyond the individual project scale that maximize ecological benefit while maintaining self-sufficiency at the city block, neighborhood, or community scale. For more information on Scale Jumping, refer to page 9.

29 There is a temporary exception for water that must be from potable sources due to local health regulations, including sinks, faucets and showers but excluding irrigation, toilet flushing, janitorial uses and equipment uses. However, due diligence to comply with this Imperative must be demonstrated by filing an appeal(s) with the appropriate agency (or agencies).

30 There is an allowance for an initial water purchase to get cisterns topped off. A Living Building Challenge project only buys water once.

SCALE JUMPING

This Imperative may be attempted using the Scale Jumping design overlay, which endorses the implementation of solutions beyond the building scale that maximize ecological benefit while maintaining self-sufficiency at the city block, neighborhood, or small community scale (from Footnote 28 of the Standard).

Where Scale Jumping is implemented, it is important to note that any new water systems, including storage cisterns, pipes and pumps, located off the project property but serving only the Living Building Challenge project must also meet all other Imperatives.

If the project is tapping into an existing water system that serves other buildings that are not pursing the Living Building Challenge, then only the new components added to the existing system, such as conveyance pipes and pumps to supply water to the Living Building Challenge project, need to meet the Challenge as described in this section.

All pumping energy needed to convey water to the project site must be included in the project's energy budget and taken into consideration for Imperative 07: Net Zero Energy. If the project is part of a larger scale system, only the apportioned energy serving the Living Building Challenge project needs to be included and the project must install adequate submetering of energy to demonstrate compliance.

Examples of Scale Jumping:

- A building that harvests rainwater from the rooftop of a neighboring property to serve the Living Building Challenge project
- A residential development that collects rooftop-harvested rainwater from multiple buildings into a common cistern where the water is then pumped back to each home for use
- A project in a campus setting that taps into a surface water or groundwater source located off the project site but within the campus boundary

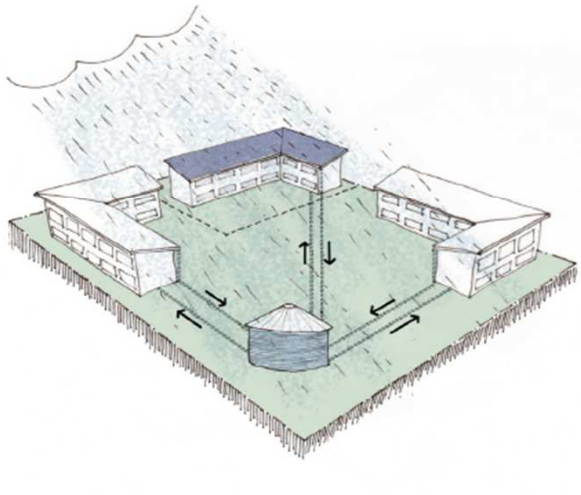


Figure 2. Net Zero Water Scale Jumping

11

The project cannot contain any of the following Red List materials or chemicals[42].

- Asbestos
- Cadmium
- Chlorinated Polyethylene and Chlorosulfonated Polyethlene[43]
- Chlorofluorocarbons (CFCs)
- Chloroprene (Neoprene)

41 This list is composed of items that have been identified to be phased out of production due to health/toxicity concerns and will be updated as new science emerges. A key intention for this Imperative transcends targeting specific ingredients, and aims to broadly influence the industry's procurement process through proactive and constructive communication between manufacturers and consumers. Ultimately, the shifted mindset that results from an increased awareness can affect all product decisions.

A list of CAS Registry Numbers that correspond with each Red List item is available in the Dialogue; CAS is a division of the American Chemical Society: www.cas.org.

42 Because of manifold manufacturing processes, there is a Small Component exception for complex products made from more than ten ingredients. A 'small component' is discrete and contained in its form as introduced into the product's assembly, and must also be less than ten percent of a product by both weight and volume. (e.g., Despite the quantity, a drop of food coloring added to a bucket of water impacts all of the liquid in such a way that would be difficult, if not impossible, to separate later. It is therefore not considered to be a 'small component'.)

It is acceptable to jump one Zone, as defined in Imperative 14: Appropriate Sourcing, if compliant materials or products are not procurable within apportioned Zones. Once a compliant product is available within the Zone as originally designated in this standard, the exception will be removed.

Each exception request must be submitted in writing to the Dialogue with explanation. Final documentation for granted exceptions must be accompanied by a copy of a letter sent to the manufacturer stipulating that the product purchase does not constitute an endorsement, together with a statement that requests that the company stops using the Red List material/chemical. Letters to the manufacturer are required for all exceptions, including those already acknowledged in the Standard and Dialogue. Sample letter templates are posted online in the Living Building Challenge Community.

43 HDPE and LDPE are excluded.

44 Halogenated flame retardants include PBDE, TBBPA, HBCD, Deca-BDE, TCPP, TCEP, Dechlorane Plus and other retardants with bromine or chlorine.

45 To attain "Living" status, petrochemical fertilizers and pesticides may not be used for the duration of the certification period or be needed for subsequent operations and maintenance.

UNITED STATES DEPARTMENT OF LABOR

OSHA

This Appendix contains a listing of toxic and reactive highly hazardous chemicals which present a potential for a catastrophic event at or above the threshold quantity.

Acetaldehyde
Acrolein (2-Propenal)
Acrylyl Chloride
Allyl Chloride
Allylamine
Alkylaluminums
Ammonia, Anhydrous
Ammonia solutions (greater than 44 percent ammonia by weight)
Ammonium Perchlorate
Ammonium Permanganate
Arsine (also called Arsenic Hydride)
Bis(Chloromethyl) Ether
Boron Trichloride
Boron Trifluoride
Bromine
Bromine Chloride
Bromine Pentafluoride
Bromine Trifluoride
3-Bromopropyne (also called Propargyl Bromide)
Butyl Hydroperoxide (Tertiary)
Butyl Perbenzoate (Tertiary)
Carbonyl Chloride (see Phosgene)
* Carbonyl Fluoride
Cellulose Nitrate (concentration greater than 126 percent nitrogen
Chlorine
Chlorine Dioxide
Chlorine Pentrafluoride
Chlorine Trifluoride
Chlorodiethylaluminum (also called Diethylaluminum Chloride)
1-Chloro-2,4-Dinitrobenzene
Chloromethyl Methyl Ether
Chloropicrin
Chloropicrin and Methyl Bromide mixture
Chloropicrin and Methyl Chloride mixture
Commune Hydroperoxide
Cyanogen
Cyanogen Chloride
Cyanuric Fluoride
Diastole Peroxide
Diazomethane
Dibenzoyl Peroxide
Diborane
Dibutyl Peroxide (Tertiary)
Dichloro Acetylene
Dichlorosilane
Diethylzinc
Diisopropyl Peroxydicarbonate
Dilauroyl Peroxide
Dimethyldichlorosilane
Dimethylhydrazine, 1,1-
Dimethylamine, Anhydrous
2,4-Dinitroaniline
Ethyl Methyl Ketone Peroxide (also Methyl Ethyl Ketone Peroxide; concentration greater than 60 percent)
Ethyl Nitrite
Ethylamine
Ethylene Fluorohydrin
Ethylene Oxide
Ethyleneimine
Fluorine
Formaldehyde (Formalin)
Furan
Hexafluoroacetone
Hydrochloric Acid, Anhydrous
Hydrofluoric Acid, Anhydrous
Hydrogen Bromide
Hydrogen Chloride
Hydrogen Cyanide, Anhydrous
Hydrogen Fluoride
Hydrogen Peroxide (52 percent by weight or greater)
Hydrogen Selenide
Hydrogen Sulfide
Hydroxylamine
Iron, Pentacarbonyl
Isopropylamine
Ketene
Methacrylaldehyde
Methacryloyl Chloride
Methacryloyloxyethyl Isocyanate
Methyl Acrylonitrile
Methylamine, Anhydrous
Methyl Bromide
Methyl Chloride
Methyl Chloroformate
Methyl Ethyl Ketone Peroxide (concentration greater than 60 percent)
Methyl Fluoroacetate
Methyl Fluorosulfate
Methyl Hydrazine
Methyl Iodide
Methyl Isocyanate
Methyl Mercaptan
Methyl Vinyl Ketone
Methyltrichlorosilane
Nickel Carbonly (Nickel Tetracarbonyl)
Nitric Acid (945 percent by weight or greater)
Nitric Oxide
Nitroaniline (para Nitroaniline)
Nitromethane
Nitrogen Dioxide
Nitrogen Oxides (NO; NO(2); N2O4; N2O3)
Nitrogen Tetroxide (also called Nitrogen Peroxide)
Nitrogen Trifluoride
Nitrogen Trioxide
Oleum (65 percent to 80 percent by weight; also called Fuming Sulfuric Acid)
Osmium Tetroxide
Oxygen Difluoride (Fluorine Monoxide)
Ozone
Pentaborane
Peracetic Acid (concentration greater 60 percent Acetic Acid; also called Peroxyacetic Acid)
Perchloric Acid (concentration greater than 60 percent by weight)
Perchloromethyl Mercaptan
Perchloryl Fluoride
Peroxyacetic Acid (concentration greater than 60 percent Acetic Acid; also called Peracetic Acid)
Phosgene (also called Carbonyl Chloride)
Phosphine (Hydrogen Phosphide)
Phosphorus Oxychloride (also called Phosphoryl Chloride)
Phosphorus Trichloride
Phosphoryl Chloride (also called Phosphorus Oxychloride)
Propargyl Bromide
Propyl Nitrate
Sarin
Selenium Hexafluoride
Stibine (Antimony Hydride)
Sulfur Dioxide (liquid)
Sulfur Pentafluoride
Sulfur Tetrafluoride
Sulfur Trioxide (also called Sulfuric Anhydride)
Sulfuric Anhydride (also called Sulfur Trioxide)
Tellurium Hexafluoride
Tetrafluoroethylene
Tetrafluorohydrazine
Tetramethyl Lead
Thionyl Chloride
Trichloro (Chloromethyl) Silane
Trichloro (dichlorophenyl) Silane
Trichlorosilane
Trifluorochloroethylene
Trimethvoxvsilane

BRIGHTWORKS

Portland State UNIVERSITY | School of Business Administration

THE NATURAL STEP

Four “System Conditions” of Sustainability

In a sustainable society, nature is not subject to systematically increasing…

concentrations of substances extracted from the Earth’s crust,

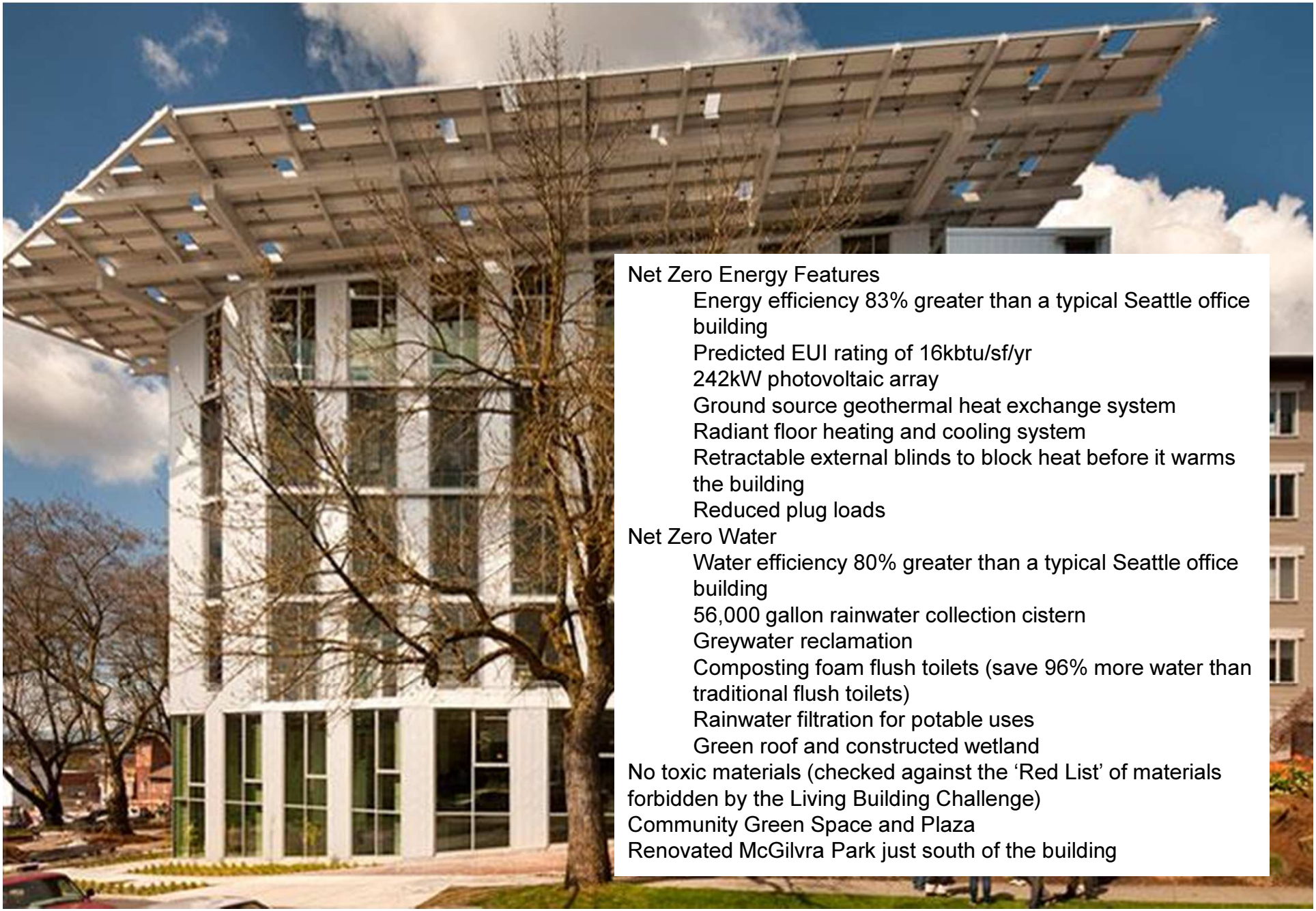
concentrations of substances produced by society,

degradation by physical means,

And, in that society…

people are not subject to conditions that systematically undermine their capacity to meet their needs.

CASE STUDIES – THE BULLITT CENTER



Net Zero Energy Features
- Energy efficiency 83% greater than a typical Seattle office building
- Predicted EUI rating of 16kbtu/sf/yr
- 242kW photovoltaic array
- Ground source geothermal heat exchange system
- Radiant floor heating and cooling system
- Retractable external blinds to block heat before it warms the building
- Reduced plug loads

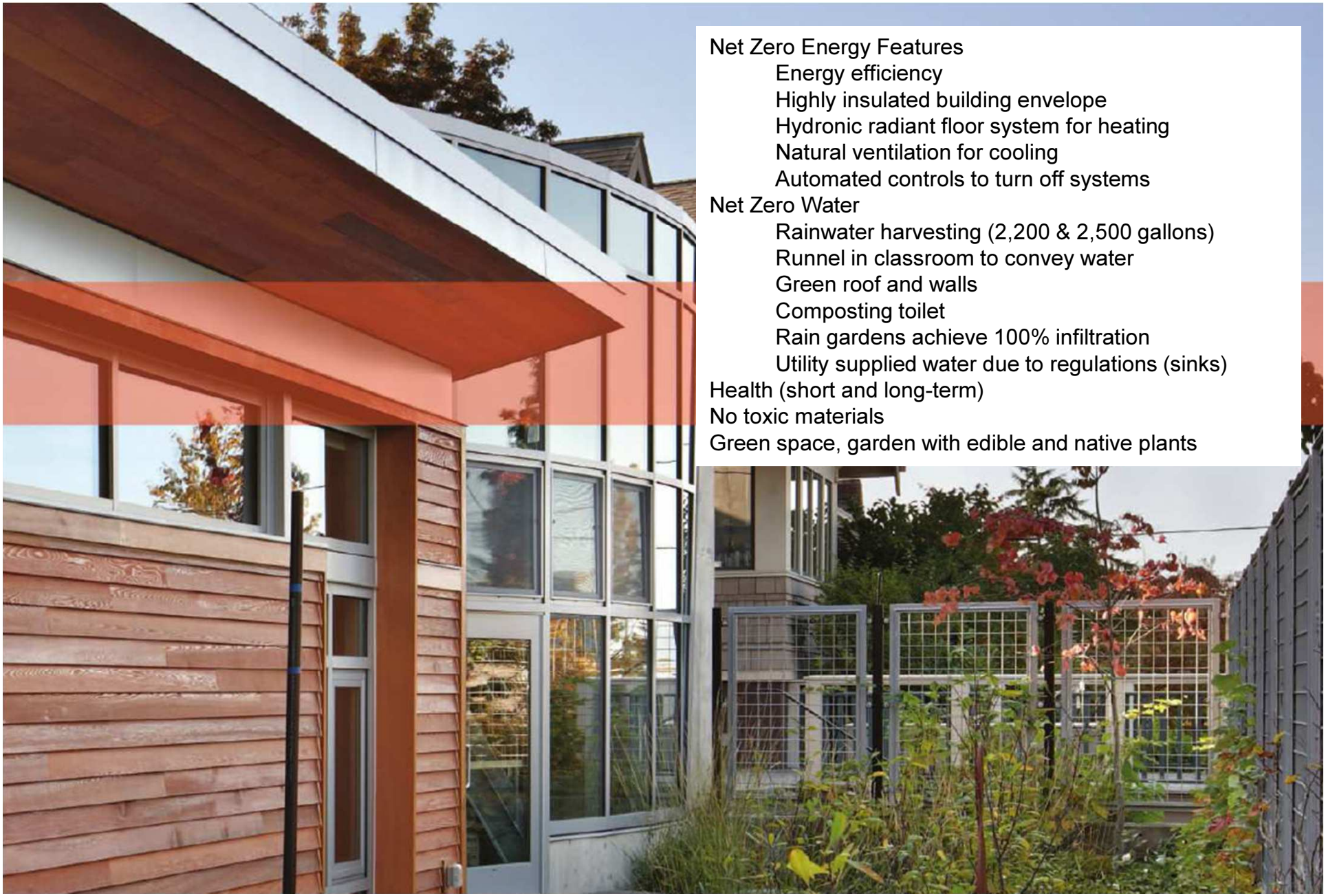
Net Zero Water
- Water efficiency 80% greater than a typical Seattle office building
- 56,000 gallon rainwater collection cistern
- Greywater reclamation
- Composting foam flush toilets (save 96% more water than traditional flush toilets)
- Rainwater filtration for potable uses
- Green roof and constructed wetland

No toxic materials (checked against the 'Red List' of materials forbidden by the Living Building Challenge)

Community Green Space and Plaza

Renovated McGilvra Park just south of the building

CASE STUDIES – THE BERTSCHI SCHOOL SCIENCE WING



Net Zero Energy Features
- Energy efficiency
- Highly insulated building envelope
- Hydronic radiant floor system for heating
- Natural ventilation for cooling
- Automated controls to turn off systems

Net Zero Water
- Rainwater harvesting (2,200 & 2,500 gallons)
- Runnel in classroom to convey water
- Green roof and walls
- Composting toilet
- Rain gardens achieve 100% infiltration
- Utility supplied water due to regulations (sinks)

Health (short and long-term)

No toxic materials

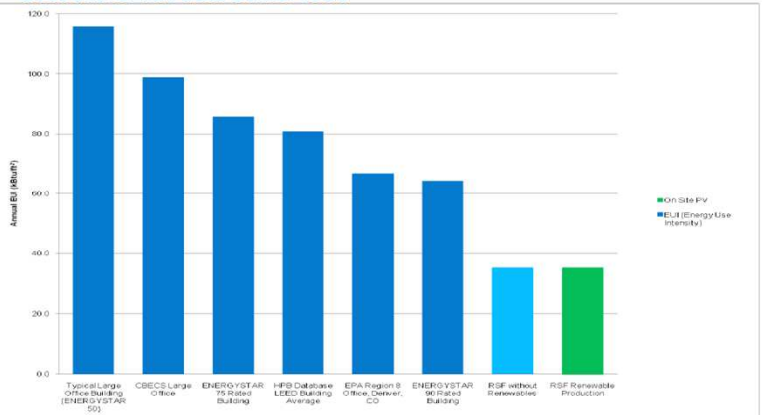
Green space, garden with edible and native plants

CASE STUDIES – NREL RESEARCH SUPPORT FACILITY

For a building with an EUI similar to the Bullitt Center (EUI = 16kbtu/sf/yr) here are some numbers for Portland:
A 1 story bldg would require ~30% roof coverage
A 2 story bldg would require ~60% roof coverage
A 3 story bldg would require ~90% roof coverage
A 4 story bldg would require ~120% roof coverage (cantilevers)
A 5 story bldg would require ~150% roof coverage (cantilevers)
Source: Paul Schwer, PAE Consulting Engineers

Design Requirements

- 25 kBtu/ft²/yr for standard office space occupant density and data center loads
- Normalized up to 35.1 kBtu/ft²/yr for better space efficiency and to account for full data center load



CBECS – Commercial Buildings Energy Consumption Survey
HPB – High Performance Building
EPA – Environmental Protection Agency

How Did We Do?

What We Wanted

- 800 employees
- LEED Platinum
- 50% better than ASHRAE 90.1-2004
- Net zero energy goal
- Replicable whole building design process
- Competitive cost for Class A space
- As many Mission, Desirable, and If Possible goals as achievable

What We Got

- 825 employees
- LEED Platinum (59 Points)
- 50% better than ASHRAE 90.1-2007
- Net zero site energy using photovoltaics
- Documented design process
- 220K gsf @ $259/gsf of Class A space
- Every Mission Critical, Highly Desirable, and If Possible performance goal achieved

Building completed 130 days early

WHAT DO WE ALREADY KNOW ABOUT THE PSU SBA BUILDING?

Mark Fujii, Scott Dawson

FRAMING

DECIDING

WHAT WILL WE **TRY** TO DO?

WHAT ARE WE **ABSOLUTELY COMMITTED** TO DOING?

WHAT ***SHOULD*** WE DO?

"SEED QUESTIONS"

What green building certification(s), if any, do you think SBA should pursue, and why?
(LEED Silver/Gold/Platinum, LBC, NZEB, other?)

How does the building's connection to the campus come into play (opportunites, challenges)?

What does a Sustainable Building look like to you?

What sustainable design strategies do you think should be showcased in SBA, and why?

What do we want to think and feel when we look at the building?

It has been stated that this building should be Iconic. What does that mean to you?

How Do we Link this project to learning opportunities at PSU?

Next Steps??

TO Scott Dawson (Portland State University)
FR Scott Lewis, Rita Haberman, Cindy Sundborg (Brightworks)
DT September 25, 2013
RE Faculty Meeting Sustainability Presentation Notes – 9.24.2013

SBA Design Vision & Objectives – DRAFT: Comments from faculty and staff

- Beautiful – it must be beautiful
- Childcare services are important
- Enhances faculty interaction
- Portland doesn't yet have a great business school; we need something "iconic." "Iconic" is a trigger word that must be defined as applied to SBA
- Form Factor – have to go into the building to see what's inside, the outside should be a tease to make people interested and draw them in. Like Apple, come for the form, and stay for the experience. "Not Case Western" and "Not Best Western"
- Raise the bar from just "meeting the needs" of the students to inviting, engaging, inspiring
- Include and define objectives for healthy indoor environment, including air quality. (This may be more appropriate as a Sustainability Objective, below.)
- Transformational – many students come stating the school experience has been transformational on their lives – can we create a school to reflect this?
- Strike the terms "unpretentious" and "understated" – not aiming high enough.
- Tranquility – acoustic performance must be addressed
- Engagement & discussion with students should be a focus
- Students tend to shoot too low with their goals and aspirations – how can we design SBA to inspire and build confidence to achieve more.
- The allocation of space usage must be efficient, with a focus on spaces for collaboration, meeting, social gatherings and interactions – not offices.
- Instructors can work from anywhere, when they are at school they should be interacting with students and colleagues
- The building should demonstrate and exemplify the collaborative and open culture of businesses today (like Google)

- Will need to be an element of both "office/work" space and "open/collaborative" space – we can meet the needs of everyone within the building.
- Occupant experience -- more emphasis on the occupant experience is needed
- Reflect our city's values – what does this mean?
- Safety issues – Building users must feel safe and secure, during all hours. This is major concerns with all that has happened at schools.

SBA Sustainability Vision & Objectives – DRAFT: Comments from faculty and staff:

- Embedded carbon – How will embedded carbon in the building (existing and new) be addressed for SBA?
- Materials selection and sourcing, durability, on-going energy use, etc.
- Consider opportunities and challenges at different scales – the building, the campus, the community. PSU is part of a system – how do we leverage this? Bio reactor to treat waste from other buildings on campus?
- Zero waste operations, includes recycling
- Currently, there are 110 work stations in the computer lab (desk tops uses approx. 6 times the amount of energy as laptops – should be a consideration in the design)
- Occupant engagement and education – Building design and systems only go so far; Occupant behavior is essential. Will there be training for building users? Faculty and staff need to understand how to live in a "sustainable" building.
- Sustainability should be visible – with dashboards, monitors, signage
- Occupant participation – for example, at the Bullitt Center, volunteers turn composter
- Connection to outside and nature – for example, at the Bertschi School, rainwater visibly flows (intentionally) through a "streambed" feature creatively integrated into the floor.
- Timeless design, function and performance -- Will the building meet the "test of time"? How will the building perform over time? Will the systems be outdated in 5, 10, 15–years? Be modern? Initial commissioning and retro-commissioning will be conducted to ensure and maintain high performance.
- Occupant Experience -- Nothing is mentioned about the occupants in the building – this should be a key component for the design! (This is addressed to some extent but needs elaboration in the Design Objectives section.)

ATTACHMENT: DRAFT SBA Design & Sustainability Vision & Objectives

SBA Building Design and Sustainability Visions

DRAFT 09.24.2013

Design Vision

Serves the broad needs of all students, staff, and the business community in a building that reflects and operates in harmony with one of the world's most livable and sustainable cities.

Design Objectives

- Adaptable and flexible
- Unified
- Reflects Pacific NW values: elegant, respectful of the earth, in harmony with the urban landscape, unpretentious, understated, pioneering, elemental, rustic simplicity, unadorned
- Welcoming, inviting, engaging, inspiring, compelling
- Quality education while meeting student and staff needs for career, community, food services, data, childcare support (cognizant of current and future target markets)
- Distinct design reflective of core ethos (change, build, serve, sustainability, leadership, innovation, community engagement)

Sustainability Vision

Incorporates best in class sustainability design, construction and operational practices as a means to reduce operating costs, increase flexibility for future needs, demonstrate the business case for sustainability, and profoundly reducing the ecological impact of the building's lifecycle.

Sustainability Objectives

- Platinum LEED
- Demonstrates the business model for sustainability
- Visible indicators tell inhabitants the story about energy and water use
- Provides opportunity for students to study the business case for sustainability
- On-site waste water treatment
- Leverage opportunities from green street (Montgomery)
- Maximize use of renewable energy with goal of net-zero carbon footprint
- Zero potable water used for non-potable use (toilet flushing, irrigation, exterior cleaning, etc.)
- Zero waste in operations
- Reduce and to the degree possible eliminate toxic materials in construction process (or, "maximize reliance on Healthy Building Materials")
- Maximize use of local materials that are either recycled or from rapidly renewable sources
- To the degree possible, replicate pre-development ecological function of the site

Epler Hall

- 2003 New Construction
- Over 90% of original building reused or recycled
- Natural ventilation

The Broadway

- 2004 New Residence Hall
- 20% less potable water demand over code
- Largest eco-roof in city

Research Greenhouse

- 44% reduction in water use
- More than 90% of work areas access outside views
- FSC certified cabinetry

Engineering Building

- 2004 New Construction
- 45% reduction in energy use
- Geothermal heating and cooling

Acedemic and Student Recreation Center

- 2009 New Construction
- $114,370 in annual energy savings
- Rainwater captured for reuse

Shattuck Hall

- 19% better than national energy code
- Radiant heating and cooling panels
- Extensive daylighting

Science Research & Teaching Center

- 2011 Major Renovation
- 50% less conditioned air than before renovation
- Non-toxic finishes

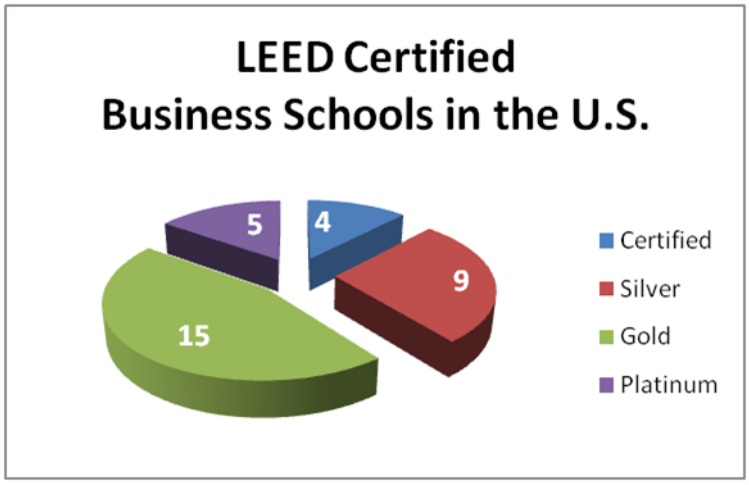
Lincoln Hall

- 2011 Historic Renovation
- $41,341 in annual energy savings
- Rooftop solar array

U.S. Business Schools and LEED
(Source: Association to Advance Collegiate Schools of Business, August 2013)

Overall Statistics:

- 31 business schools in the U.S. have LEED certified buildings (Harvard has multiple)
    - Majority of the buildings are LEED Gold (15 Gold, 9 Silver, 5 Platinum, 4 Certified)



- 34 business schools are currently seeking LEED certification in U.S.

Source: The Association to Advance Collegiate Schools of Business
http://www.aacsb.edu/resources/facilities/green-us.asp

Select West Coast Business Schools: Highlights of LEED Programs

Stanford Graduate School of Business -- Stanford, California

- PLATINUM, 2012, NC v2.2
- Knight management Center, 8 buildings, 360,000 SF
- PV- generates at least 12.5% of electricity use on site
- 90% Daylighting
- Reduced potable water usage for sewer conveyance by 80% by using grey water and rainwater
- Fifty percent of the site is open space (courtyards and plazas)
- Radiant floors, Heat recovery in rooftop mechanical units
- All parking (900 spaces) underground
- 75,000 gallon holding tank for rainwater capture from building downspouts and gutters offsets water use for plant and tree irrigation.

Lorry I. Lokey Graduate School of Business, Mills College -- Oakland, California

- GOLD, 2010, NC v2.2
- 28,000-square-foot, 2-story building
- No PV
- Radiant floor heating, operable windows
- Roof rainwater collection, grey water toilet fixtures
- Living green roof, bioswale stormwater management

UC Davis, Gallagher Hall -- Davis, California

- PLATINUM, 2012, NC v2.2
- first business school building in California to be certified Platinum
- Opened September 2009
- 40,000-square-foot 3-story facility, consisting of Gallagher Hall and an adjoining Conference Center
- Conference center has space for a restaurant
- $34 million
- Reduces storm water runoff by 25%
- 75 percent of construction waste recycled

University of Oregon, Lundquist College of Business, Lillis Business Complex -- Eugene, Oregon

- SILVER, 2005, NC v2.0
- 196,500 square feet
- $41 million
- One of the largest installed arrays of architectural solar glass (PV cells embedded in atrium glass)
- Natural day-lighting, recycled materials,
- 42.5% energy cost savings
- ID Credits: Green Education, MRc2 Construction Waste Management, MRc4 Recycled content

List of LEED Certified Business School Buildings in the US

- **Carnegie Mellon University**
  Tepper School of Business, Posner Hall (Certified)
- **College of William and Mary**
  Mason School of Business
  Alan B. Miller Hall (Gold)
- **Colorado State University**
  Rockwell Hall (Gold)
- **Duke University**
  Fuqua School of Business building (Silver)
- **Emory University—Multiple Buildings**
  Goizueta Business School building, Goizueta Foundation Center (GFC) building (Gold)
- **Furman University**
  Herman Hipp Hall (Gold)
- **Georgetown University**
  McDonough School of Business building (Silver)
- **Georgia Institute of Technology**
  Management Building in Technology Square (Silver)
- **Harvard University**
  Harvard Business School
  Gallatin Hall, Hamilton Hall, McCollum Hall, Shanghai, and Wyss House (Gold)
  Aldrich Hall (Silver)
  McCulloch Hall (Platinum)
- **Ithaca College**
  School of Business
  Park Center for Business and Sustainable Enterprise (Platinum)
- **Miami University**
  Farmer School of Business building (Silver)
- **Mills College**
  Lokey Graduate School of Business building (gold)
- **Northern Arizona University**
  College of Business Administration building (Gold)
- **Pennsylvania State University**
  Worthington Scranton, Business Classroom building (Certified)
- **Simmons College**
  School of Management building (Gold)
- **Stanford University**
  Graduate School of Business Knight Management Center (Platinum)
- **Stetson University**
  School of Business Administration
  Lynn Business Center (Certified)
- **University of California—Davis**
  Graduate School of Management
  Gallagher Hall (Platinum)

- **University of Colorado—Boulder**
  Leeds School of Business building (Gold)
- **University of Evansville**
  Schroeder Family School of Business Administration Building (Certified)
- **University of Illinois, Urbana-Champaign**
  College of Business
  Business Instructional Facility (Platinum)
- **University of Maine**
  Foster Center for Student Innovation (Silver)
- **University of Nebraska at Omaha**
  College of Business Administration, Mammel Hall (Gold)
- **University of Maryland University College**
  Graduate School of Management & Technology
  Center of Academic Operations building (Gold)
- **University of Michigan**
  Ross School of Business building (Silver)
- **University of Minnesota Duluth**
  Labovitz School of Business and Economics building (Gold)
- **University of Oregon**
  Lundquist College of Business, Lillis Business Complex (Silver)
- **University of Richmond**
  Robins School of Business
  Queally Hall (Silver)
- **University of Washington**
  Foster School of Business, PACCAR Hall (Gold)
- **University of Wyoming**
  College of Business
  New COB Building (Gold)
- **Yale University School of Management**
  Amistad St. building (Gold)

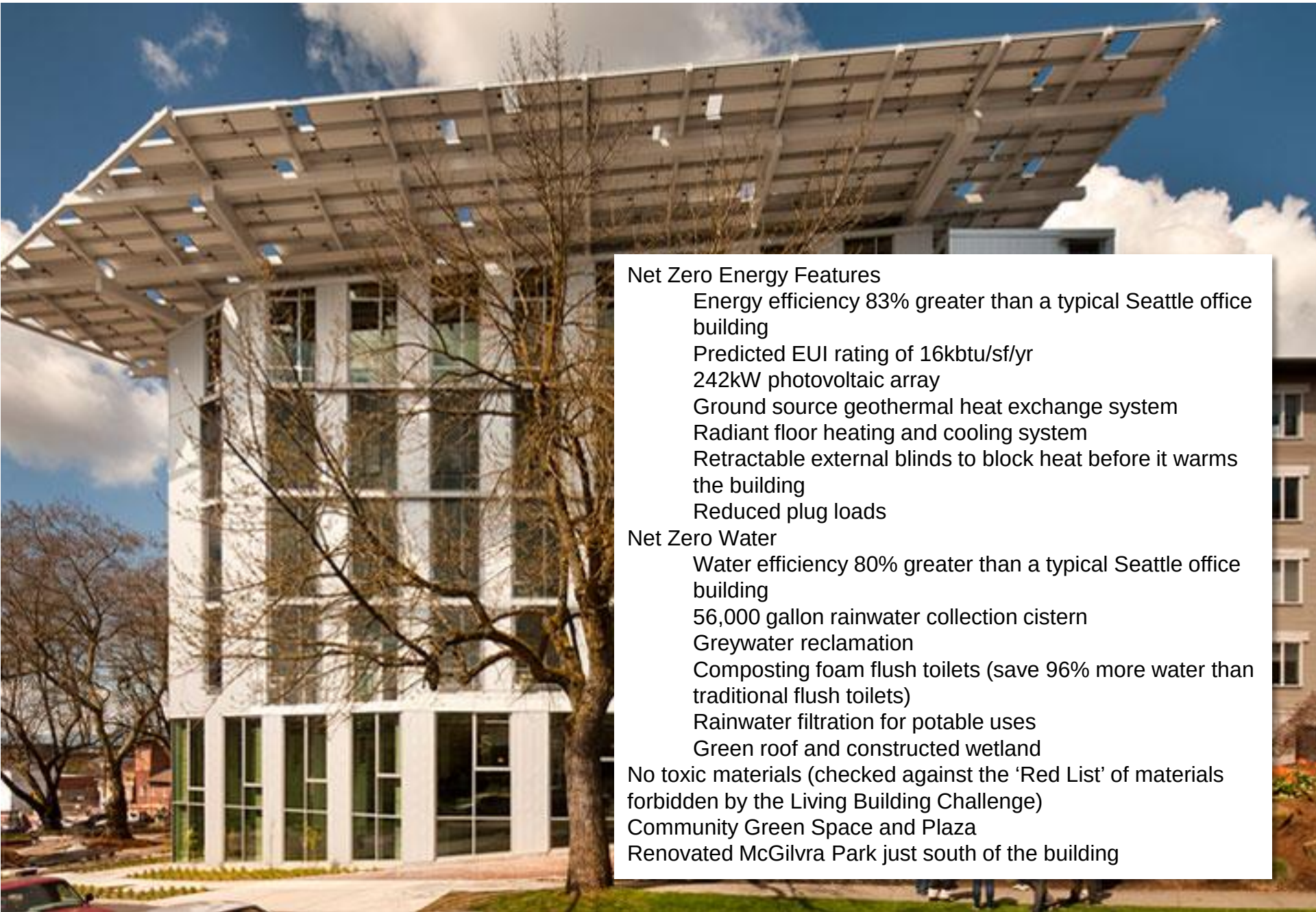
List of Business Schools in the U.S. Currently Pursuing LEED Certification

- **American University**
  Kogod School of Business building (seeking certification)
- **Bowie State University**
  College of Business, Center for Business and Graduate Studies (seeking certification)
- **California Baptist University**
  School of Business building (under construction, seeking certification)
- **California State Polytechnic University, Pomona**
  College of Business Administration building (under construction, seeking Silver)
- **University of California—Irvine**
  Merage School of Business (under construction, seeking Gold)

- **Christopher Newport University**
  Luter School of Business building (seeking certification)
- **Concordia College**
  School of Business building (seeking certification)
- **Harvard University**
  Harvard Business School, Shad Hall (seeking certification)
- **Indiana State University**
  Scott College of Business
  Federal Building (under renovation, seeking Silver)
- **Indiana University, Bloomington/Indianapolis**
  Kelley School of Business building (seeking Certified)
- **Johns Hopkins University**
  Carey Business School building (seeking Certified)
- **Massachusetts Institute of Technology**
  Sloan School of Management, E60 building (seeking certification)
- **Montclair State University**
  School of Business building (seeking certification)
- **New York University**
  Stern School of Business, Concourse Renovation Project (under construction, seeking certification)
- **Salisbury University**
  School of Business building (seeking certification)
- **Syracuse University**
  School of Management building (seeking certification)
- **Texas A&M University-Corpus Christi**
  College of Business building (seeking certification)
- **Texas Tech University**
  Rawls College of Business building (seeking certification)
- **University at Albany, SUNY**
  School of Business building (under construction, seeking certification)
- **University of California, Merced**
  Social Sciences and Management Building (under construction, seeking Silver)
- **University of California, San Diego**
  Rady School of Management building (seeking certification)
- **University of Colorado Denver**
  Business School building (seeking certification)
- **University of Florida**
  Warrington College of Business Administration
  Hough Hall (seeking Gold)
- **University of Illinois at Chicago**
  College of Business Administration
  Douglas Hall (seeking Gold)
- **University of Louisville**
  College of Business, Henry Frazier Hall (seeking certification)

- **University of Mississippi**
  School of Business Administration, Mississippi Small Business Development Centers (seeking certification)
- **University of New Hampshire**
  Paul College of Business building (seeking certification)
- **University of North Texas**
  College of Business, Business Leadership building (seeking certification)
- **University of South Carolina**
  Darla Moore School of Business
  Innovista district (under construction, seeking Platinum)
- **University of Toledo**
  College of Business and Innovation, Savage & Associates Complex for Business Learning and Engagement (seeking certification)
- **University of Utah**
  David Eccles School of Business building (seeking certification)
- **University of West Florida**
  College of Business building (seeking certification)
- **Wake Forest University**
  Schools of Business, Farrell Hall (seeking certification)
- **Youngstown State University**
  College of Business Administration building (seeking certification

Case Studies – The Bullitt Center



Net Zero Energy Features
- Energy efficiency 83% greater than a typical Seattle office building
- Predicted EUI rating of 16kbtu/sf/yr
- 242kW photovoltaic array
- Ground source geothermal heat exchange system
- Radiant floor heating and cooling system
- Retractable external blinds to block heat before it warms the building
- Reduced plug loads

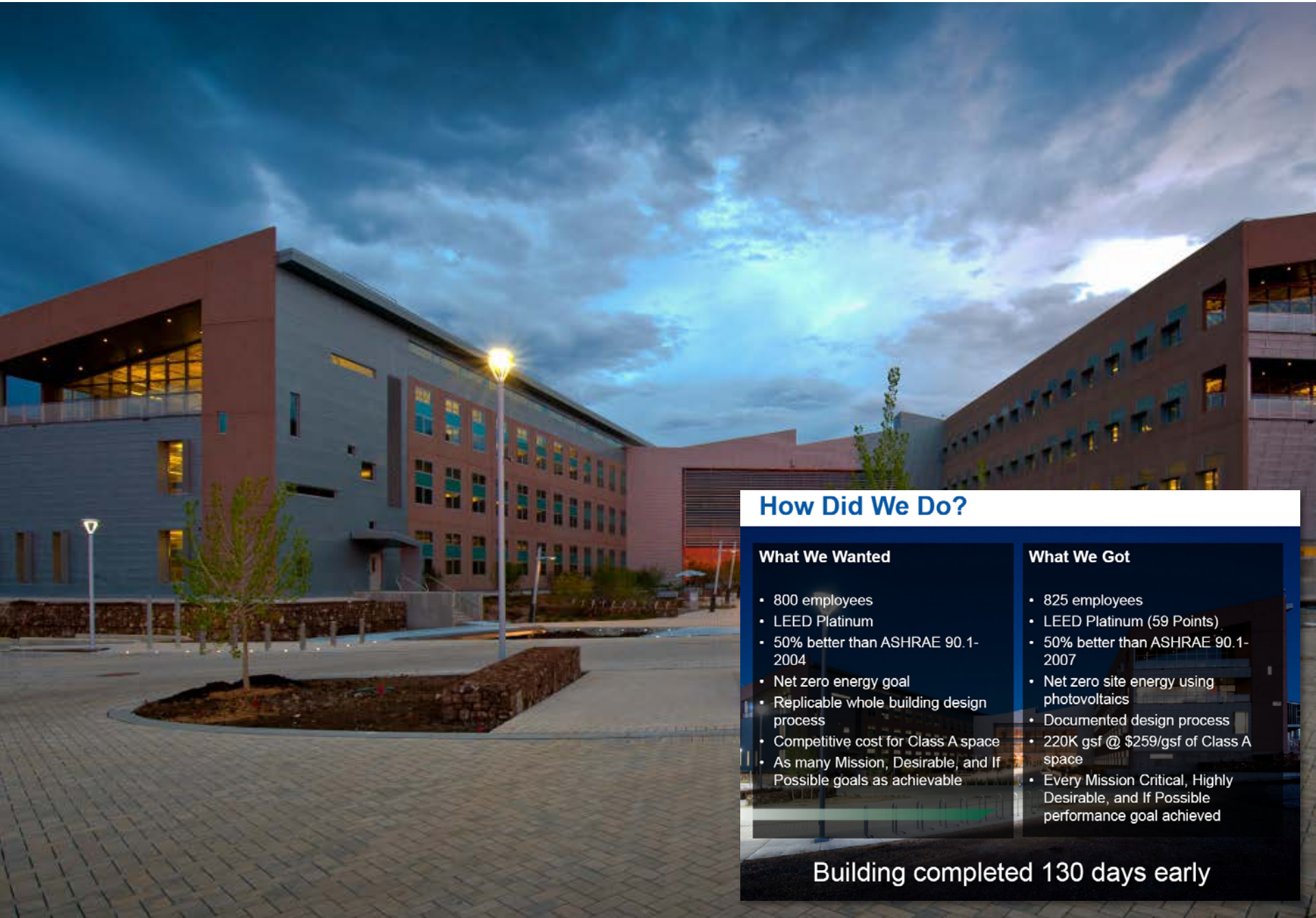
Net Zero Water
- Water efficiency 80% greater than a typical Seattle office building
- 56,000 gallon rainwater collection cistern
- Greywater reclamation
- Composting foam flush toilets (save 96% more water than traditional flush toilets)
- Rainwater filtration for potable uses
- Green roof and constructed wetland

No toxic materials (checked against the ‘Red List’ of materials forbidden by the Living Building Challenge)

Community Green Space and Plaza

Renovated McGilvra Park just south of the building

Case Studies – NREL Research Support Facility



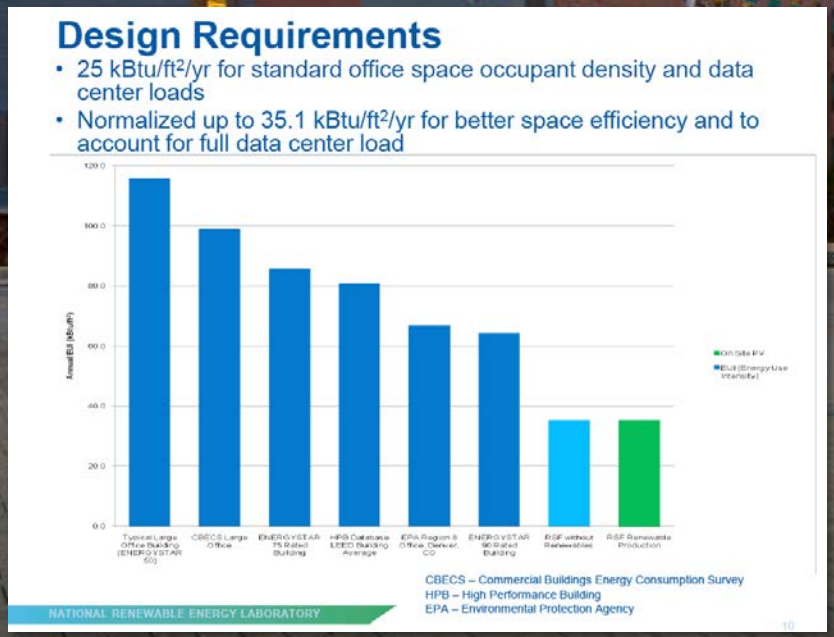
How Did We Do?

What We Wanted	What We Got
• 800 employees	• 825 employees
• LEED Platinum	• LEED Platinum (59 Points)
• 50% better than ASHRAE 90.1-2004	• 50% better than ASHRAE 90.1-2007
• Net zero energy goal	• Net zero site energy using photovoltaics
• Replicable whole building design process	• Documented design process
• Competitive cost for Class A space	• 220K gsf @ $259/gsf of Class A space
• As many Mission, Desirable, and If Possible goals as achievable	• Every Mission Critical, Highly Desirable, and If Possible performance goal achieved

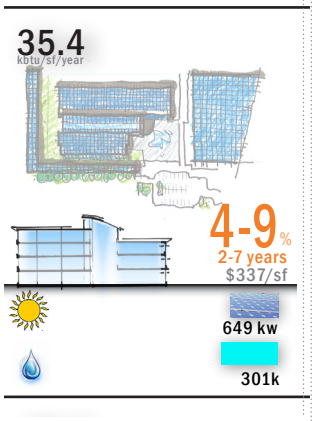
Building completed 130 days early

CASE STUDIES – NREL RESEARCH SUPPORT FACILITY

For a building with an EUI similar to the Bullitt Center (EUI = 16kbtu/sf/yr) here are some numbers for Portland:
A 1 story bldg would require ~30% roof coverage
A 2 story bldg would require ~60% roof coverage
A 3 story bldg would require ~90% roof coverage
A 4 story bldg would require ~120% roof coverage (cantilevers)
A 5 story bldg would require ~150% roof coverage (cantilevers)
Source: Paul Schwer, PAE Consulting Engineers



UNIVERSITY CLASSROOM
PORTLAND temperate



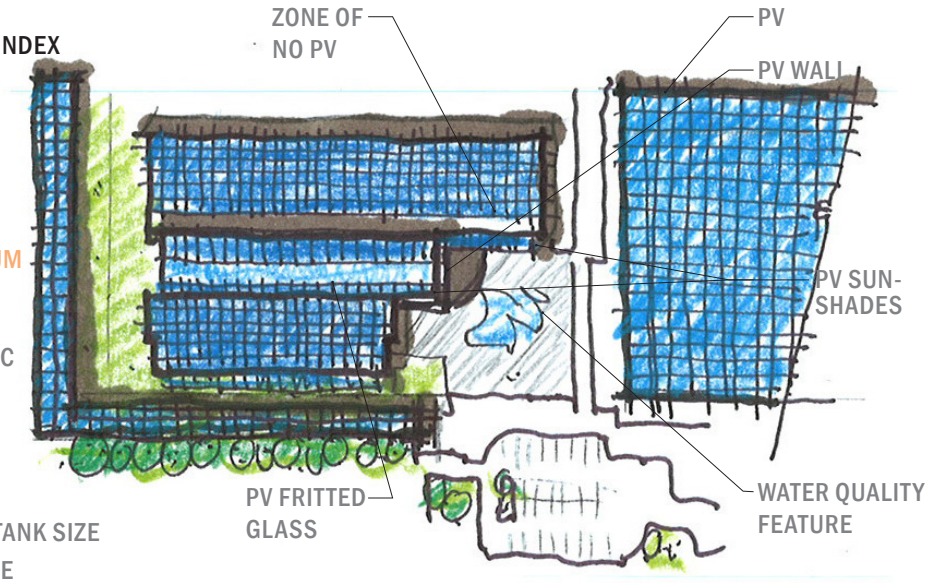
ENERGY USE INDEX

COST PREMIUM PAYBACK

COST PER SF

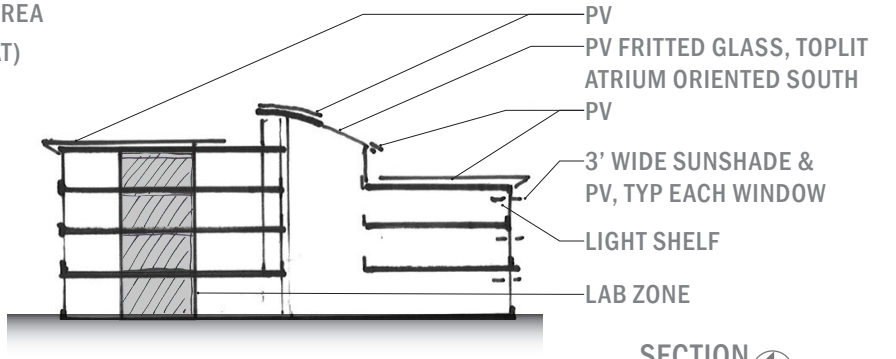
PHOTOVOLTAIC CAPACITY

WATER USE



SITE PLAN NTS

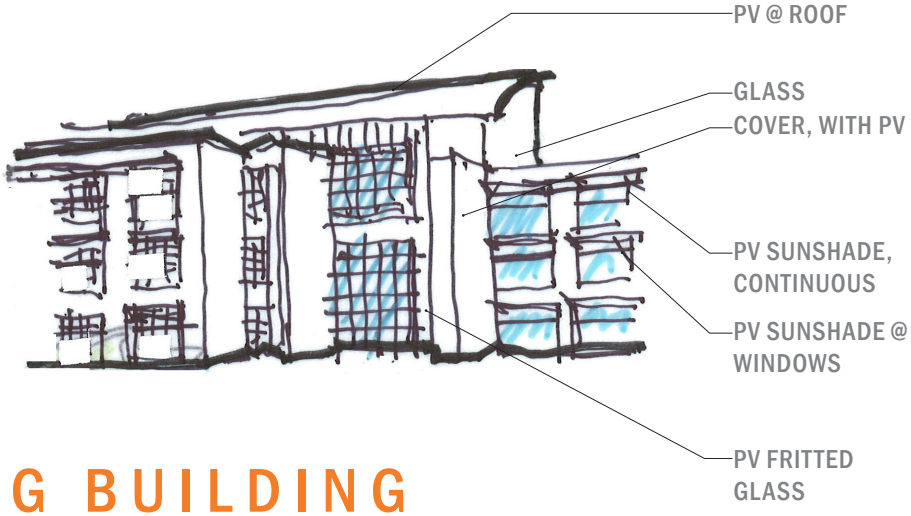
RAIN WATER TANK SIZE	65,000 gal
BUILDING SIZE	153,531 sf
BUILDING HEIGHT	4 floors
SITE AREA	2.75 acres
PHOTOVOLTAIC AREA	89,510 sf
ROOF AREA (FLAT)	38,755 sf



SECTION

MAJOR DESIGN STRATEGIES:

- ✓ Reorient building 180 degrees from current.
- ✓ Clip PV to Metal Roof
- ✓ Add fritted PV to glass at Atrium.
- ✓ Add PV sunshades to each south window.
- ✓ Provide additional PV at walkway canopy and on adjacent parking area



LIVING BUILDING
DESIGN MODIFICATION

BUILDING TYPE: **UNIVERSITY CLASSROOM**
BUILDING LOCATION: **PORTLAND, OR**

SKANSKA

Base Building Gross SF = 153,531
Living Building Gross SF = 153,531
Site Gross Acreage = 2.75

	Division Premium (%)	Building Premium (%)	LEED™ Gold Baseline		Living Building	
			Total	Cost/SF	Total	Cost/SF
CONSTRUCTION COST						
A Substructure	**2.6%**	**0.1%**	**$2,123,369**	**$13.83**	**$2,179,470**	**$14.20**
Baseline Building			$2,123,369	$13.83	$2,123,369	$13.83
W2 Rainwater Containment - 41,000 gal Rainwater Tank					$56,101	$0.37
B Shell	**7.0%**	**0.8%**	**$4,959,353**	**$32.30**	**$5,306,177**	**$34.56**
Baseline Building			$4,959,353	$32.30	$4,959,353	$32.30
E1A Improved Glazing (reduce solar heat gain)					$35,324	$0.23
E1B Exterior Shading Devices (outriggers for PV panels on south only)					($132,000)	($0.86)
D3B Change Roof at Atrium to Fritted PV Glass					$443,500	$2.89
C Interiors	**-3.8%**	**-1.4%**	**$16,495,934**	**$107.44**	**$15,868,139**	**$103.35**
Baseline Building			$16,495,934	$107.44	$16,495,934	$107.44
M2D Carpet Reduction (remove carpet and retroplate concrete)					$96,071	$0.63
M2A Topping Slab / Stair Premium for Underfloor Radiant System (3" concrete)					$153,531	$1.00
L1A Exposed Ceilings (white matte surfaces)					($160,397)	($1.04)
D3 Eliminate Raised Access Floor					($717,000)	($4.67)
D.1 Services - Conveying Systems	**0.0%**	**0.0%**	**$297,968**	**$1.94**	**$297,968**	**$1.94**
Baseline Building			$297,968	$1.94	$297,968	$1.94
D.2 Services - Plumbing Systems	**5.3%**	**0.4%**	**$2,968,571**	**$19.34**	**$3,124,871**	**$20.35**
Baseline Building			$2,968,571	$19.34	$2,968,571	$19.34
W6 Low-Flow Fixtures / Optical Sensors					$6,300	$0.04
W2 Rain Harvesting (piping & pumps and filtration)					$150,000	$0.98
D.3 Services - HVAC Systems	**-1.1%**	**-0.1%**	**$5,646,851**	**$36.78**	**$5,586,171**	**$36.38**
Baseline Building			$5,646,851	$36.78	$5,646,851	$36.78
Baseline HVAC System Reduction (2/3 reduction in Air Handler and Ducting)					($2,941,435)	($19.16)
M2A In-Slab Radiant Heating and Cooling					$767,655	$5.00
M3A Ground Source Heat Pump					$1,940,600	$12.64
M2B Energy Recovery Wheel / Plate & Frame/Dedicated Outside Air System(DOAS)					$172,500	$1.12
M2C Carbon Dioxide Sensors (in base building)					$0	
D.4 Services - Fire Protection Systems	**0.0%**	**0.0%**	**$425,840**	**$2.77**	**$425,840**	**$2.77**
Baseline Building			$425,840	$2.77	$425,840	$2.77
D.5 Services - Electrical Systems	**2.9%**	**0.4%**	**$6,000,852**	**$39.09**	**$6,174,252**	**$40.22**
Baseline Building			$6,000,852	$39.09	$6,000,852	$39.09
PA Occupancy Sensor to Outlets					$14,100	$0.09
PE High Efficiency Transformers					$67,000	$0.44
L2E Occupancy Sensor for Transient and Egress Lighting					$37,500	$0.24

BUILDING TYPE: **UNIVERSITY CLASSROOM**
BUILDING LOCATION: **PORTLAND, OR**

SKANSKA

Base Building Gross SF = 153,531
Living Building Gross SF = 153,531
Site Gross Acreage = 2.75

		Division Premium (%)	Building Premium (%)	LEED™ Gold Baseline		Living Building	
				Total	Cost/SF	Total	Cost/SF
L2F	Dimmable Direct/Indirect Fixtures					$54,800	$0.36
E	**Equipment and Furnishings**	**0.0%**	**0.0%**	**$257,958**	**$1.68**	**$257,958**	**$1.68**
	Baseline Building			$257,958	$1.68	$257,958	$1.68
F	**Special Construction**	**0.0%**	**0.0%**	**$79,247**	**$0.52**	**$79,247**	**$0.52**
	Baseline Building			$79,247	$0.52	$79,247	$0.52
G	**Sitework**	**2.0%**	**0.1%**	**$2,460,261**	**$16.02**	**$2,510,261**	**$16.35**
	Baseline Building			$2,460,261	$16.02	$2,460,261	$16.02
W4	Stormwater Retention / Building Water Discharge					$50,000	$0.33
W1	Remove Storm Drainage Connection to Public/Add sewer meter					$0	
H	**Logistics**	**0.0%**	**0.0%**	**$2,108,417**	**$13.73**	**$2,108,417**	**$13.73**
	Baseline Building			$2,108,417	$13.73	$2,108,417	$13.73
	Living Building Prerequisites			**$0**	**$0.00**	**$856,439**	**$5.58**
	PR5 - Materials Red List	**100.0%**	**0.8%**			$350,657	$2.28
	PR7 - Responsible Industry	**100.0%**	**0.2%**			$101,591	$0.66
	PR8 - Appropriate Materials / Services Radius	**100.0%**	**0.9%**			$404,191	$2.63
	PR9 - Leadership in Construction Waste	**0.0%**	**0.0%**			$0	
	Subtotal Direct Costs		2.2%	$43,824,622	$285.44	$44,775,212	$291.64
	General Conditions	8.0%	**2.2%**	**0.2%**	$3,512,022	$22.88	$3,588,200	$23.37
	Fee, Construction Contingency, Insurance	7.0%	**2.2%**	**0.2%**	$3,328,586	$21.68	$3,400,786	$22.15
	Location Modifier for PORTLAND, OR	1.00	**0.0%**	**0.0%**	$0		$0	
	TOTAL MODIFIED CONSTRUCTION COST		**2.2%**	**$50,665,230**	**$330.00**	**$51,764,198**	**$337.16**

BUILDING TYPE: **UNIVERSITY CLASSROOM**
BUILDING LOCATION: **PORTLAND, OR**

SKANSKA

Base Building Gross SF = 153,531
Living Building Gross SF = 153,531
Site Gross Acreage = 2.75

					Division Premium (%)	Building Premium (%)	LEED™ Gold Baseline		Living Building	
							Total	Cost/SF	Total	Cost/SF
OWNER & DESIGN-BUILD COSTS										
Design/Build Owner Items										
W3	Biological Bio-Reactor				100.0%	0.1%			$50,000	$0.33
PV1	Photovoltaic Panels and Infrastructure	649,000	Watts		100.0%	11.1%			$4,867,500	$31.70
LB Prerequisite Items										
	PR3 - Habitat Exchange	2.75482	acres		100.0%	0.0%			$13,774	$0.09
	PR6 - Construction Carbon Footprint	6,800	tons		100.0%	0.2%			$74,800	$0.49
	PR15 - Beauty and Spirit (included in A/E fees below)				0.0%	0.0%			$0	
	PR16 - Inspiration and Education				100.0%	0.2%			$73,750	$0.48
Development Costs			LEED	LBC						
	Develoment Costs		28.00%	31.00%	13.1%	4.2%	$14,186,264	$92.40	$16,046,901	$104.52
	Architecture & Engineering		7.00%	9.00%	31.4%	2.5%	$3,546,566	$23.10	$4,658,778	$30.34
Credits / Rebates / Incentives										
	BETC	35%			66.0%	-0.3%	($173,152)	($1.13)	($287,365)	($1.87)
	ETO - Energy Trust of Oregon				559.3%	-0.8%	($59,000)	($0.38)	($389,000)	($2.53)
	PV Credits-(state, city, utility)	80%			-100.0%	-8.9%	$0		($3,894,000)	($25.36)
	SDC Credits	50%			-100.0%	-0.8%	$0		($349,890)	($2.28)
TOTAL OWNER & DESIGN-BUILD COSTS						**19.2%**	**$17,500,679**	**$113.99**	**$20,865,249**	**$135.90**
						TOTAL CONCEPTUAL COST:	**$68,165,909**	**$443.99**	**$72,629,447**	**$473.06**

LIVING BUILDING CONCEPTUAL PREMIUM RANGE: **4%** **TO** **9%**
UNIVERSITY CLASSROOM IN PORTLAND, OR

INCLUDING HIGH PERFORMING GREEN BUILDINGS OF PORTLAND (HPGBP): **2%** **TO** **7%**

University Classroom
Portland

Normalized Baseline Energy Use Intensity (kBtu/SF)	**85.0**	Normalized Baseline Energy Use (kWh)	3,612,251
Impact of Design Changes (see sketches)	0.97		
Adjusted Baseline EUI (kBtu/SF)	**82.5**		

		LIGHTING	HEATING	COOLING	DOM. HOT WATER	FANS & PUMPS	MISC. EQUIP	TOTAL BLDG
percent of load		20%	20%	18%	2%	10%	30%	100%
calc'd EUI		16.5	16.5	14.8	1.6	8.2	24.7	82.5
Energy Conservation Measures:								
Glazing	**E1**		3.0%	7.5%		2.9%		2.2%
Improve Glazing	E1a							
Add effective shading devices	E1b							
Walls & Roof	**E2**		6.0%	3.0%		2.1%		2.0%
Shaded roof from solar panels	E2a							
Optimize insulation to core performance guide	E2b							
Daylighting (incorporates tuned glazing/shading)	**L1**	50.0%	-3.8%	5.0%		0.8%		10.2%
Daylight controls (continuous dimming)	L1c							
Orient windows to allow for illumination of teaching wall	L1f							
Top daylighting from Atrium	L1g							
Lighting	**L2**	20.0%	-1.5%	2.0%		0.3%		4.1%
Individual occupancy sensors & dimming controls: closed offices/low occucpanc	L2b							
Individual light level control (dimming) at open office areas	L2c							
Light colors on walls, ceiling surfaces	L2d							
Occupancy sensors: transient lighting (corridors/stairs/bathrms)	L2e							
Dimmable direct / indirect fixtures	L2f							
Occupancy sensor / time clock for corridor lighting	L2j							
Plug Loads	**P**		-1.9%	2.5%		0.4%	25.0%	7.6%
Occupancy sensor controlled plug loads	Pa							
EnergyStar appliances	Pb							
Optimize printer layout/use	Pc							
Remove phantom load / transformers	Pd							
Energy efficient main transformer	Pe							
Occupant buy-in / personal energy budget	Pf							
Centralized power management	Pg							
Mechanical - Schedule	**M4**			7.0%				
Change of work hours (summer hours)	M4a							
Shift uses for time of day in summer (east vs west)	M4b							
Widen Set Point Temperatures	**M1**		5.0%	5.0%		2.5%		2.2%
Widen Set Point Temperatures (expand ASHRAE 55)	M1a							
Subtotal from above Load Reduction strategies (percentage)		*70.0%*	*6.9%*	*32.0%*	*0.0%*	*8.9%*	*25.0%*	*29.5%*
Subtotal Reduced EUI (kBTU/SF)		*4.9*	*15.4*	*10.1*	*1.6*	*7.5*	*18.6*	*58.1*
Mechanical - Distribution & Ventilation	**M2**		20.0%	100.0%		60.0%		21.4%
Radiant heating w/ dedicated outside air system (DOAS)	M2p							
Energy recovery ventilation	M2b							
Demand-based ventilation	M2c							
Minimize carpet (insulates against radiant system)	M2d							
Natural ventilation: operable windows	M2e							
Fan assisted natural ventilation	M2f							
Night flush	M2g							
High mass - concrete block on inside of insulation	M2h							
Eliminate cooling	M2j							
Cascading make-up air	M2x							
Subtotal from Mechanical Distribution strategies (percentage)		*0.0%*	*20.0%*	*100.0%*	*0.0%*	*60.0%*	*0.0%*	*21.4%*
Subtotal Reduced EUI (kBTU/SF)		*4.9*	*12.3*	*0.0*	*1.6*	*3.0*	*18.6*	*40.4*
Mechanical - Plant Systems	**M3**		20.0%			13.4%		3.5%
Ground source heat pump system	M3a							
Domestic Hot Water	**W**				50.0%			1.0%
Low flow fixtures (showers, lavs, sinks)	Wb							
Water heating from tankless electric water heater	Wd							
Subtotal from Mechanical Plant and DHW systems (percentage)		*0.0%*	*20.0%*	*0.0%*	*50.0%*	*13.4%*	*0.0%*	*4.5%*
Reduced EUI from Energy Conservation Measures (kBTU/SF)		**4.9**	**9.8**	**0.0**	**0.8**	**2.6**	**18.6**	***36.8***
Final Energy Use Breakdown as Percentage of Baseline Use		**6%**	**12%**	**0%**	**1%**	**3%**	**23%**	**55%**

Building Operating Factor	0.90	100.0	CBECS Baseline EUI (kBTU/sf)
Impact of Interactive ECM effects	1.06	60%	target reduction from CBECS
		Achievement:	
Total Reduced EUI (kBTU/sf)	**35.4**	65%	percent reduction from CBECS
		58%	percent reduction from Normalized Baseline Bldg
Total reduced energy use (kWh)	1,502,333	Incentives:	
		$ 400,884	ETO incentive for reduced EUI
Number of crystaline panels needed	3,164	$ 59,043	Estimated ETO incentive for original design bldg
Total kW of PV array	649	$ 114,213	BETC for Platinum (minus Gold), pass-thru

PV Panel Analysis:

From RETScreen 4-1: method 2, 2% misc losses, 90% inverter efficiency, assumes Sanyo-205 panel, facing South (azimuth 0°)

	angle	kWh per panel	Total panels needed at °	Input Area (SF)	# of Panels	
	0°	227.042	6617	35,840	2874	Panels at Parking lot + sunshade + covered walkwa
	15°	244.678	6141		0	
optimal angle:	32.5°	281.857	5331	2,400	192	Panels at sloping roof less atrium
	45°	247.953	6059		0	
	90°	175.198	8576	1,230	98	
				Total kWh =	**723,805**	
Cover Adjacent parking lot with PV			Additional area	50,040	4012	**panels at parking lot**
			Additional kWh Produced		**910,893**	1,634,697

Energy Use Intensity (EUI) & Renewable Energy Analysis

PSU School of Business Administration

10.14.2013

BRIGHTWORKS

SUMMARY OF ANALYSIS

CONCEPT STUDY REPORT -- ROOF DESIGN with 66 kW PV System

This preliminary solar analysis is based on the solar PV rooftop scenario presented in the PSU SBA Concept Study (ZGF, 2011), in which an estimated 66 kW solar PV system is installed on approximately 5,500 SF of roof.

The analysis assumes a 100% electric building and consideres two different energy use intensities (EUIs) for the SBA:
1.) Targeting Net Zero Energy, calling for an EUI of 20; and
2.) Targeting 2030 Challenge, calling for an EUI of 44, a 60% reduction in energy use compared to the national average for an office space.

Our analysis indicates that with an aggressive NZE EUI target, the solar PV production will account for only 8% of the building's total energy load, and with a less aggressive 2030 Challenge EUI target, the solar PV production will account for just 4% of the building's total energy load.

Simple payback for net metering (including Energy Trust incentives) is 41 years, and simple payback for PGE's Solar Payment Option is 14 years.

BUILDING CHARACTERISTICS

5,500	**Available Roof Area**, (sf) - Based on the ~ 65-kW PV system indicated in Concept Study (ZGF)
$0.08	**Electricity Cost,** ($/kWh) Portland General Electric

ENERGY USE & EUI TARGETS

147,200	**Total Building Area**, (sf)
20	**Net Zero EUI Target** (kBTU/sf-yr) -- Based on Bullitt Center designed EUI = 18
44	**2030 Challenge Energy Use Intensity (EUI) Target** (Office, 60% Reduction from National Average of 110 kBTU/sf-yr)
862,801	Net Zero Target - **Total Annual Energy Use, 100% Electric Building**, (kWh)
1,898,162	2030 Target - **Total Annual Energy Use, 100% Electric Building**, (kWh)

SOLAR CHARACTERISTICS

$4.50	**Solar Cost**, *$/watt, based on the industry rule-of-thumb. Typically this cost includes the materials, installation, basic rack support, but not building structural upgrades, if needed.*
12	**Solar Density**, *watt/sf* (Based on Sunpower X-Series, Derated for spacing, Actual Panel = 19 watt/sf)
3.94	**Average Daily Solar Radiation,** (kWh/m2-day)
1,052	**Estimated Production**, *kWh/yr per installed kW* (PVwatts, Portland, South-facing, flat)

Source: *PVwatts - http://mapserve3.nrel.gov/PVWatts_Viewer/index.html*

SOLAR SYSTEM SIZE & PRODUCTION

66	**Maximum System Size**, *kW*
69,432	**System Electricity Production**, *kWh*
8%	**Building Energy Served by Solar, % of Building Load (Net Zero EUI Target)**
4%	**Building Energy Served by Solar, % of Building Load (2030 Challenge EUI Target)**

COST ANALYSIS

$297,000	**Total System Cost**, Based on System Size and Installation Cost $/watt

Year 0

$66,800	**Energy Trust of Oregon, Solar Cash Incentives,** (0-35 KW: $1.20/watt, 36-200 KW: $1.20-$0.60/watt, 201-500 KW: $0.60/watt; maximum of $300,000)
$0.230	**Portland General Electric Solar Payment Option (Feed-in Tariff Rate)**, Medium-Scale Systems 10-100 kW, $0.23kWh
	Accelerated Depreciation, Assumes 50% taken in year 0 (2012), 35% tax bracket
$230,200	**Net Cost**, $

Years 1-15

$5,555	**Net Metering - Value of Electricity Produced**, $/yr
$15,969	**PGE Solar Payment Option - Value of Annual Payment**, $/yr

Results - Net Meter		Results - Net Meter	
41.4	**Simple Payback**, Years	-$146,881	**Net 15-yr Cash Flow**
OR		OR	
Results - Solar Payment Option		**Results - Solar Payment Option**	
14.4	**Simple Payback**, Years	$9,341	**Net 15-yr Cash Flow**

Energy Use Intensity (EUI) & Renewable Energy Analysis

PSU School of Business Administration

10.14.2013

BRIGHTWORKS

SUMMARY OF ANALYSIS

NET ZERO ENERGY -- ENTIRE SBA (Renovated SF & New SF)

This preliminary solar analysis estimates the size of a solar PV system needed to serve the energy load of the entire future SBA building.

The analysis assumes a 100% electric building and consideres two different energy use intensities (EUIs) for the SBA:
1.) Targeting Net Zero Energy, calling for an EUI of 20; and
2.) Targeting 2030 Challenge, calling for an EUI of 44, a 60% reduction in energy use compared to the national average for an office space.

Our analysis indicates that with an aggressive NZE EUI target, the solar PV production will account for 101% of the building's total energy load, and with a less aggressive 2030 Challenge EUI target, the solar PV production will account for 46% of the building's total energy load.

Securing 69,000 SF for the installation of solar PV will require roof top area well beyond that available on the future SBA building. Roof area on other PSU building(s), covered walkways and/or building integrated solar will be needed.

Simple payback for net metering (including Energy Trust incentives) is 49 years, and simple payback for PGE's Solar Payment Option is 17 years.

BUILDING CHARACTERISTICS

69,000	**NEEDED Available Roof Area**, (sf)
$0.08	**Electricity Cost,** ($/kWh) Portland General Electric

ENERGY USE & EUI TARGETS

147,200	**Total Building Area**, (sf)
20	**Net Zero EUI Target** (kBTU/sf-yr) -- Based on Bullitt Center designed EUI = 18
44	**2030 Challenge Energy Use Intensity (EUI) Target** (Office, 60% Reduction from National Average of 110 kBTU/sf-yr)
862,801	Net Zero Target - **Total Annual Energy Use, 100% Electric Building**, (kWh)
1,898,162	2030 Target - **Total Annual Energy Use, 100% Electric Building**, (kWh)

SOLAR CHARACTERISTICS

$4.50	**Solar Cost**, *$/watt, based on the industry rule-of-thumb. Typically this cost includes the materials, installation, basic rack support, but not building structural upgrades, if needed.*
12	**Solar Density**, *watt/sf* (Based on Sunpower X-Series, Derated for spacing, Actual Panel = 19 watt/sf)
3.94	**Average Daily Solar Radiation,** (kWh/m2-day)
1,052	**Estimated Production**, *kWh/yr per installed kW* (PVwatts, Portland, South-facing, flat)

Source: *PVwatts - http://mapserve3.nrel.gov/PVWatts_Viewer/index.html*

SOLAR SYSTEM SIZE & PRODUCTION

828	**Maximum System Size**, *kW*
871,056	**System Electricity Production**, *kWh*
101%	**Building Energy Served by Solar, % of Building Load (Net Zero EUI Target)**
46%	**Building Energy Served by Solar, % of Building Load (2030 Challenge EUI Target)**

COST ANALYSIS

$3,726,000	**Total System Cost**, Based on System Size and Installation Cost $/watt

Year 0

$300,000	**Energy Trust of Oregon, Solar Cash Incentives,** (0-35 KW: $1.20/watt, 36-200 KW: $1.20-$0.60/watt, 201-500 KW: $0.60/watt; maximum of $300,000)
$0.230	**Portland General Electric Solar Payment Option (Feed-in Tariff Rate)**, Medium-Scale Systems 10-100 kW, $0.23kWh; 500 kW Max.
$3,426,000	**Net Cost**, $

Years 1-15

$69,684	**Net Metering - Value of Electricity Produced**, $/yr
$200,343	**PGE Solar Payment Option- Value of Annual Payment**, $/yr

Results - Net Meter		Results - Net Meter	
49.2	**Simple Payback**, Years	-$2,380,733	**Net 15-yr Cash Flow**
OR		OR	
Results - Solar Payment Option		**Results - Solar Payment Option**	
17.1	**Simple Payback**, Years	-$420,857	**Net 15-yr Cash Flow**

Energy Use Intensity (EUI) & Renewable Energy Analysis

PSU School of Business Administration

10.14.2013

BRIGHTWORKS

SUMMARY OF ANALYSIS

NET ZERO ENERGY -- Only New Construction Portion of SBA

This preliminary solar analysis estimates the size of a solar PV system needed to serve the energy load of only the 48,000 SF of new construction portion of the future SBA building.

The analysis assumes a 100% electric building and considers two different energy use intensities (EUIs) for the SBA:
1.) Targeting Net Zero Energy, calling for an EUI of 20; and
2.) Targeting 2030 Challenge, calling for an EUI of 44, a 60% reduction in energy use compared to the national average for an office space.

Our analysis indicates that with an aggressive NZE EUI target, the solar PV production will account for 108% of the building's total energy load, and with a less aggressive 2030 Challenge EUI target, the solar PV production will account for 49% of the building's total energy load.

Securing the estimated 24,000 SF of roof area for a solar PV system is roughly in line with the total roof SF of the future SBA expansion and renovation. Additionally, roof area on other PSU building(s), covered walkways and/or building integrated solar can be used to achieve the needed area.

Simple payback for net metering (including Energy Trust incentives) is 44 years, and simple payback for PGE's Solar Payment Option is 15 years.

BUILDING CHARACTERISTICS

24,000	**NEEDED Available Roof Area**, (sf)
$0.08	**Electricity Cost,** ($/kWh) Portland General Electric

ENERGY USE & EUI TARGETS

48,000	**Total Building Area**, (sf)
20	**Net Zero EUI Target** (kBTU/sf-yr) -- Based on Bullitt Center designed EUI = 18
44	**2030 Challenge Energy Use Intensity (EUI) Target** (Office, 60% Reduction from National Average of 110 kBTU/sf-yr)
281,348	Net Zero Target - **Total Annual Energy Use, 100% Electric Building**, (kWh)
618,966	2030 Target - **Total Annual Energy Use, 100% Electric Building**, (kWh)

SOLAR CHARACTERISTICS

$4.50	**Solar Cost**, *$/watt, based on the industry rule-of-thumb. Typically this cost includes the materials, installation, basic rack support, but not building structural upgrades, if needed.*
12	**Solar Density**, *watt/sf* (Based on Sunpower X-Series, Derated for spacing, Actual Panel = 19 watt/sf)
3.94	**Average Daily Solar Radiation,** (kWh/m2-day)
1,052	**Estimated Production**, *kWh/yr per installed kW* (PVwatts, Portland, South-facing, flat)

Source: *PVwatts - http://mapserve3.nrel.gov/PVWatts_Viewer/index.html*

SOLAR SYSTEM SIZE & PRODUCTION

288	**Maximum System Size**, *kW*
302,976	**System Electricity Production**, *kWh*
108%	**Building Energy Served by Solar, % of Building Load (Net Zero EUI Target)**
49%	**Building Energy Served by Solar, % of Building Load (2030 Challenge EUI Target)**

COST ANALYSIS

$1,296,000	**Total System Cost**, Based on System Size and Installation Cost $/watt

Year 0

$233,800	**Energy Trust of Oregon, Solar Cash Incentives,** (0-35 KW: $1.20/watt, 36-200 KW: $1.20-$0.60/watt, 201-500 KW: $0.60/watt; maximum of $300,000)
$0.230	**Portland General Electric Solar Payment Option (Feed-in Tariff Rate),** Medium-Scale Systems 10-100 kW, $0.23kWh
$1,062,200	**Net Cost**, $

Years 1-15

$24,238	**Net Metering - Value of Electricity Produced**, $/yr
$69,684	**PGE Solar Payment Option - Value of Annual Payment**, $/yr

Results - Net Meter		Results - Net Meter	
43.8	**Simple Payback**, Years	-$698,629	**Net 15-yr Cash Flow**
OR		OR	

Results - Solar Payment Option		Results - Solar Payment Option	
15.2	**Simple Payback**, Years	-$16,933	**Net 15-yr Cash Flow**

Rainwater Capture and Reuse Calculator 10/14/2013
PSU School of Business

Executive Summary
The Portland State School of Business Administration is considering non-potable water usage. With aggressive water efficiency measures & rainwater capture/reuse, it does seem possible to accomplish this goal, whether only on the new building or including the renovation. Some notable high efficiency measures include: Niagara Conservation Stealth Toilet (0.8 gallons/flush), high efficiency dishwasher and washing machine, and other high efficiency fixtures. Paired with a 25,000-gallon cistern and potable treatment system, our analysis demonstrates that non-potable water usage is within reach.

Please note that further confirmation of assumptions and inputs below are needed. Analysis is completed using 3 years of daily precipitation data and tracking daily use and cistern levels to confirm water availability. Additionally, the fixture usage and flow rates were determined with the assumption that the current building has highly inefficient fixtures, therefore, the highly efficient fixtures assumed in our analysis could have potential to decrease the water usage by over 70%.

RAINWATER CAPTURE & REUSE CALCULATOR - PROJECT INFORMATION		
Project:		PSU SBA
Location:		Portland, Oregon
Cistern Size :	*gallons*	25,000
Roof Area: *(based on 147,200 gsf, 6-story building)*	*square feet*	25,000
Capture Efficiency:	*after first flush*	90%
Total Users:	*full-time equivalency*	495
Lavatory Usage:	*uses per person per day*	3
Faucet Flow Rate:	*gallons per minute*	0.35
Duration:	*seconds*	15
Lavatory Usage:	*gallons per use*	0.088
Total Daily Lavatory Usage:	*gallons*	130
Shower Duration:	*minutes*	5
Shower Frequency:	*per person per day*	0.04
Shower Fixture Flowrate:	*gallons per minute*	1.75
Total Daily Shower Usage:	***gallons***	173
Toilet Flush Volume:	*gallons per flush*	0.80
Toilet Flush Frequency:	*flushes per person per day*	2.75
Urinal Flush Volume:	*gallons per day per person*	0.125
Urinal Flush Frequency:	*flushes per person per day*	0.25
Total Daily Building Flush Volume:	***gallons***	1,104

RAINWATER HARVEST & REUSE ANALYSIS, MONTH BY MONTH

Month	Monthly Rainfall (inches)	Total Roof Rainfall (gallons)	Average Captured Rainwater (gallons)	Available Captured Rainwater (3-yr average) (gallons)	Total Usage (gallons)	Percent Reduction of Total Usage (%)
January	6.43	100,201	90,181	30,030	30,030	100%
February	4.97	77,449	69,704	28,622	28,622	100%
March	4.51	70,281	63,253	31,907	31,907	100%
April	2.91	45,348	40,813	30,030	30,030	100%
May	2.16	33,660	30,294	30,699	30,699	100%
June	1.56	24,310	21,879	13,674	14,077	97%
July	0.53	8,259	7,433	6,622	13,000	51%
August	0.75	11,688	10,519	6,698	14,408	46%
September	1.76	27,427	24,684	24,803	30,030	83%
October	3.33	51,893	46,703	30,499	30,499	100%
November	6.26	97,552	87,797	30,897	30,968	100%
December	6.94	108,148	97,334	30,968	30,968	100%
totals	42.11	656,214	590,593	295,450	315,239	**93.7%**

Results Summary
Utilizing three years of historic precipitation data and projections for water capture and re-use as detailed above, in 2 out of 3 years, the water demand was met 100% by the rainwater capture system for the months of September through May. The usage rates will need to be confirmed during the 'summer' months to gain further insight as to whether using no potable water usage in the new PSU SBA building for the entire year is feasible.