


CODE AND REGULATORY BARRIERS TO THE LIVING BUILDING CHALLENGE FOR SUSTAINABLE, AFFORDABLE, RESIDENTIAL DEVELOPMENT

REPORT #3: COST BENEFIT SUMMARY

PREPARED FOR:

CITY OF VANCOUVER, WA
CLARK COUNTY, WA

PREPARED BY:

CASCADIA REGION
GREEN BUILDING COUNCIL

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PROJECT TEAM & CONTRIBUTORS

This report is the third and final for the project: Code and Regulatory Barriers to the Living Building Challenge for Sustinable, Affordable, Residential Development (SARD). The SARD project is funded through the Washington State Department of Community, Trade and Economic Development and managed by the City of Vancouver, which contracted with the Cascadia Region Green Building Council to perform the study.

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Clark County: Community Development, Community Planning, Public Works, Transportation, Fire, and Public Health

Clark Regional Wastewater District Engineering

Clark Public Utilities District

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EXECUTIVE SUMMARY

This report quantifies the cost and benefits of removing barriers to sustainable, affordable, residential development (SARD) in Clark County and the City of Vancouver. Its purposes are:

- To provide an estimate of the benefits resulting from implementation of green building goals in the context of sustainable, affordable, residential development;
- To provide an estimate of the cost impacts of implementing the proposed code, standard, and policy recommendations delineated in *Report #2* to the City and County; and
- To provide an estimate of the cost impacts of sustainable development (as defined by the Living Building Challenge™) to developers and buyers of affordable, residential projects.

The Living Building Challenge, a rigorous performance-based standard developed by the Cascadia Region Green Building Council, was used as a metric to define sustainable development. The standard was selected because it is the most stringent standard established for green building projects available today, and thus represents the closest measure of true sustainability in the built environment.

Report #1: Findings highlighted the obstacles project teams may encounter when seeking approval for a Living Building project. Some of the barriers found were directly related to City and County regulations, while others extended beyond the authority of the local jurisdiction to the state level.

Report #2: Strategies and Recommendations provided a prioritized list of key barriers with short and long term recommendations for overcoming those barriers.

This report, *Report #3: Costs and Benefits,* provides some understanding of the costs of implementing each of the twenty-one recommendations identified in *Report #2* and provides a summary of the environmental, societal, and financial benefits of sustainable, affordable, residential development. The report also provides developers of single and multi-family residential projects with a range of additional first costs for developments which strive to achieve the Living Building Challenge. Finally, the payback period for investing in single and multi-family residential buildings, which strive to attain this high level of sustainability, was evaluated against water and energy costs in the City of Vancouver and Clark County.

The costs of implementing the twenty-one recommendations noted in *Report #2* were estimated in four general categories: additional staff needs, additional training needs, additional costs for a public outreach campaign, and infrastructure costs associated with implementing any of the other three. For the purposes of estimating the costs for each recommendation, it was assumed that all twenty-one measures were implemented in isolation. In reality, we recommend that the measures be combined, either with each other or with joint funding from the City and County to minimize duplication of effort and achieve economies of scale. The measures were prioritized in terms of long term and short term recommendations in the previous report. A next step for moving forward with the recommendations would be development of an implementation plan that thoroughly considers potential synergies between the various recommendations.

Quantifying the true costs of non-sustainable development is very difficult, as the larger societal costs of many current development practices are not often accounted for. For example, the global impacts of greenhouse gas emissions from the long distance transport of materials is not included in the current costs of materials, allowing materials from China to be cheaper than those manufactured in our own state. Similarly, the added health care costs that result from residents living or working around off-gassing materials is not included in the cost of the construction.

The cost of building a Living Building was estimated by comparing the cost estimates from two

real projects constructed locally to the same projects hypothetically redesigned to meet the Living Building Challenge. For the purposes of this cost estimating exercise, the societal costs of non-sustainable development were not accounted for. Only direct construction costs attributable to changes in the development's physical features and systems were considered for this analysis. Payback was calculated using only direct water and energy costs. The less tangible, but very real, benefits seen from improved quality of life are not included in the payback calculation.

In the City of Vancouver/Clark County, our analysis showed the payback period for projects striving to meet the Living Building Challenge were relatively high. This is due to the small scale of the residential projects and the comparatively low local utility rates charged in the area. The incentives available in a jurisdiction also have an effect on the first cost increase, which in turn affects payback. Projects in the City of Vancouver and Clark County can utilize federal and state incentives for many of the project's energy related features. Other jurisdictions offer additional incentives which lower first costs further.

TABLE 1: BENEFITS OF SUSTAINABLE, AFFORDABLE, RESIDENTIAL DEVELOPMENT

This table lists benefits of sustainable affordable, residential development in three benefit categories: environmental, societal, and financial.

Benefit Category	Benefits
I. ENVIRONMENTAL	• Reduced fossil fuel use and dependence • Reduced greenhouse gas emissions, which is linked to reduced risk of global climate change • Enhanced protection of ecosystems • Improved air and water quality • Reduced waste • Conservation of natural resources • Reduced pollutants • Clean, renewable energy
II. SOCIETAL	• Enhanced occupant comfort and health • Minimized strain on local infrastructure • Improved enjoyment and quality of life • Reduced pressure from sprawling development models on prime agricultural lands which helps maintain localized food production systems and reduce transportation costs
III. FINANCIAL	• Reduced home/building operating costs • Increased jobs and economic development resulting from exporting green building technology beyond our region • Improved occupant productivity and lower health care costs • Optimized life-cycle economic performance • Reduced costs to maintain and expand infrastructure

TABLE 2: SUMMARY OF COST BY RECOMMENDATION

This table reflects maximum aggregated costs. Costs could be minimized and economics of scale achieved by combining strategies and implementing them jointly amoung departments and jurisdictions.

Barriers	Maximum Estimated Costs				Potential Strategies to Control Cost
	Staff	Training	Outreach	Infrastructure	
INSTITUTIONAL/PROCESS BARRIER					
1. Expedited or priority permit processing program	City: $170,000 - $240,000 County: $115,000	$7,500 $7,500	$2,500 $22,000	NA NA	Assign innovative projects to most experienced reviewers rather than add staff.
2. In-House Mandatory Trainings	City: $60,000 County: $35,000	$20,000 $10,000	NA NA	NA NA	Incorporate into existing training procedures and cycles. Use local experts wherever possible.
3. Mandatory Green Pre-Application Meetings	City: basic cost included in present services; ombudsman, $100,000 - $120,000/year County: no additional cost if bundled with In house trainings	NA NA	$2,500 NA	NA NA	Combine position.
4. Green Building Technical Assistance Program	City: $75,000/ year County: $35,000	NA $350/person	NA $5,000	NA NA	Combine position. Collaborative public outreach campaign with other agencies.
ENERGY					
1. Develop Guidelines for Permitting Renewable Energy and Passive Heating/ Cooling Systems	City: $115,000 County: $50,000	NA NA	$5,000 NA	NA NA	Utilize MSRC research, others to reduce time devoted to original research. Bundle revisions with other code.
2. Consider Density Bonuses for Energy Efficiency Measures	City: $50,000 County: NA	NA NA	NA $1,000	NA NA	Revisions to minimize review time.
3. Amend SEPA to Include Evaluation and Mitigation of Greenhouse Gas Emissions from New Construction Projects Including Embodied Energy of Materials, Construction Activities, and Ongoing Operating Energy	City: $50,000 - $150,000 County: NA	NA NA	NA NA	NA NA	Utilize resources — calculators, background data, etc. — from State, King County.
4. Require and Enforce performance testing to demonstrate Residential Energy Code Compliance	City: NA County: $50,000	$5,000 NA	NA NA	NA NA	Partner with a community college or green building program to provide this service.
5. Develop a District Energy Demonstration Project Ordinance	City: $100,000 County: NA	NA NA	NA NA	NA NA	

Barriers	Maximum Estimated Costs				Potential Strategies to Control Cost
	Staff	Training	Outreach	Infrastructure	
NON-CONVENTIONAL GREEN BUILDING STRUCTURES					
1. Allow Flexibility within the Building Codes for "Incubator" Pilot Projects to Test Alternative Green Materials	City: minimal County: $50,000 +	NA NA	NA NA	NA NA	
2. Develop Code Guidance for Strawbale Structures	City: NA County: $20,000	NA NA	$250 NA	NA NA	Adapt from other jurisdictions.
3. Develop an Advisory Committee of Green Building Experts for Alternative Technologies	City: $60,000 County: $60,000	NA NA	NA NA	NA NA	Combine with other strategies, such as technical assistance.
DRIVEWAY & FIRE ACCESS ROAD WIDTHS					
1. Develop Code Guidance on Acceptable and Best Practices for Low Impact Development	City: $155,000 County: NA	NA NA	$9,000 NA	NA NA	Integrate with other code updates.
2. Update Standards for Streets, Fire Access Roads and Private Driveways	City: NA County: $25,000	NA NA	$5,000 - $10,000 NA	NA NA	Integrate with other code updates.
3. Consider Stormwater Management Utility or SDC Fee Reductions	CIty: Complete County: NA	NA NA	NA NA	NA NA	Raise fees on other projects to create a fund for fee waivers. Fees would be directly tied to impacts on public infrastructure.
PARKING					
1. Consider New Policies to Reduce Minimum Parking Requirements	City: $50,000 County: $34,000	NA NA	NA NA	NA NA	Integrate with full Transit Oriented Development (TOD) program.
CISTERNS					
1. Provide Guidance on Designing, Permitting, Installing, and Maintaining Rainwater Harvesting Cisterns into New Construction	City: $10,000 County: minimal	NA NA	NA NA	NA NA	Adapt from other jurisdictions.
2. Revise Code Requirements for Setbacks and Building Separation for Above-Ground Rainwater Cisterns	City: $30,000 County: NA	NA NA	NA NA	NA NA	Adapt from other jurisdictions.
CLUSTER DEVELOPMENT					
1. Develop New City and County Cottage Housing Codes	City: $30,000 County: NA	NA NA	NA NA	NA NA	Integrate with other code updates.
WATER					
2. Provide Guidance on Designing, Permitting, Installing, and Maintaining Rainwater Harvesting Cisterns	City : $0 - $20,000 County: NA	NA NA	NA NA	NA NA	Adapt from other jurisdictions.

TABLE 3: PRIVATE SECTOR COSTS / PAYBACK

This table summarizes the anticipated first cost increase and payback for the single family residence and multi-family residence when prerequisites of the Living Building Challenge are met.

Project Size	Anticipated First Cost Increase	Payback
SINGLE FAMILY RESIDENCE	27-32% increase	30 years
MULTI-FAMILY RESIDENCE	31-36% increase	22 years

INTRODUCTION

Climate change, loss of forested land, water contamination, air pollution and dependence on foreign oil are concerns associated with building construction and operation. In aggregate, buildings consume a large portion of the water, energy, materials, and other resources used in the United States. For example, US buildings are responsible for more CO_2 emissions than any other economic development sector, including industry and transportation.

In the United States, buildings consume 48% of the total energy and 76% of the nation's electricity. In addition, they consume a large portion of the materials and water used by our economy, as well as generating significant amounts of waste. For additional information on the impacts of green building, see www.usgbc.org.

FIGURE 1: CO_2 EMISSIONS 1

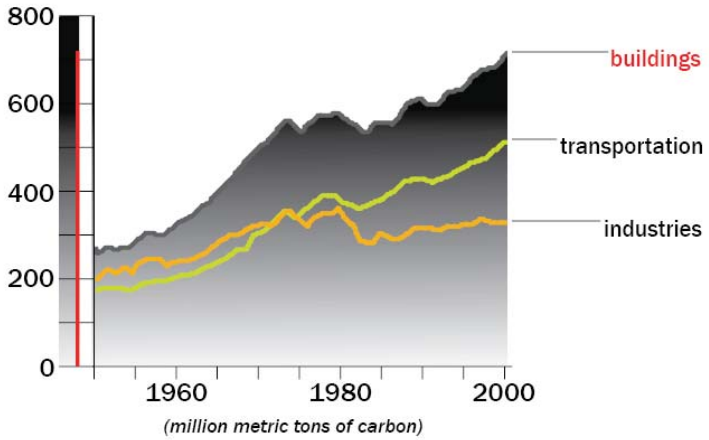


FIGURE 2: ENERGY USE

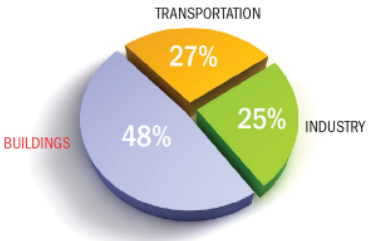
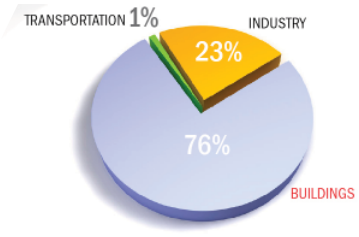


FIGURE 3: ELECTRICITY USE



The above graphics, prepared by SERA Architects, are based on information provided by Architecture 2030. See www.architecture2030.com.

Because humans spend the majority of our time indoors, buildings also significantly affect human health and productivity and can have a negative effect through poor indoor air quality and exposure to toxic materials. Due to growing health concerns and higher operational costs, questions have begun to emerge about whether we can produce, operate, and maintain buildings more sustainably to minimize adverse impacts on the environment and public heath, and whether this can be done economically.

This report examines the costs and benefits of incorporating progressive green building strategies into affordable residential developments utilizing the twenty-one strategies identified in *Report #2* as a means to encourage and provide support for public and private developers.

BACKGROUND

The City of Vancouver, Washington, in partnership with Clark County, has contracted with the Cascadia Region Green Building Council (Cascadia) to evaluate City and County codes and regulations that pose barriers to sustainable, affordable, residential development. Cascadia's Living Building Challenge™ was used as the benchmark performance standard for the code study, because it is the most stringent standard established for green building projects available today and, thus represents the closest measure of true sustainability in the built environment.

The following codes were analyzed as part of this project:

Code	
Zoning	VMC Title 20, CCC Title 40
Land Divisions	VMC 20.320, CCC 40.540
Planned Unit Development	VMC 20.260, CCC 40.520
Site Plan	VMC 20.270, CCC 40.520
Grading	VMC 17.12, CCC 14.07
Erosion Control	VMC 14.24, CCC 40.380
Stormwater Management	VMC 14.25, CCC 40.380
Parking Standards	VMC 20.945, CCC 40.340
Street Standards	VMC Title 11, CCC 40.350
International Building Code – 2006 Edition	Standards and Amendments WAC 51-50
International Mechanical Code – 2006 Edition	Standards and Amendments WAC 51-52
International Fire Code – 2006 Edition	Standards and Amendments WAC 51-54
Uniform Plumbing Code – 2006 Edition	Standards and Amendments WAC 51-56, 51-57
Washington State Energy Code – 2006 Edition	WAC 51-11
Washington State Ventilation and Indoor Air Quality Code – 2006 Edition	WAC 51-13
On-site Sewage Systems	CCC 24.17
Group A Public Drinking Water Systems	WAC 246-290
Group B Public Drinking Water Systems	WAC 246-291
Large On-Site Sewage Systems	WAC 246-272B
Wastewater Treatment Facilities	WAC 173-240
Evidence of Adequate Drinking Water Supply	RCW 19.27.097

In November 2008, Cascadia published *Report #1: Findings,* identifying more than 80 obstacles that currently exist within Vancouver and Clark County codes and regulations, which project teams may encounter when seeking approval for a Living Building project. Roughly 30 of these code barriers were found in the land use and development codes and another 50 were found within the building, mechanical, electrical, plumbing, fire, ventilation and indoor air, and energy codes. Some of the barriers were directly related to City and County regulations, while others extended beyond the authority of the local jurisdictions to the State level. A full list of building, development, and land use code barriers was identified in *Report #1: Findings,* which can be found online at: www.cityofvancouver.us/envplan.

Report #2: Strategies & Recommendations, published in April 2009, summarized a comprehensive list of strategies to address the barriers identified in *Report #1: Findings* and divided them into 21 short-term and long-term recommendations. This prioritized list of key barriers was developed in order to assist the City and County with addressing and removing barriers to sustainable, affordable, residential development.

GOALS

The purposes of *Report #3* are:

- To provide an estimate of the benefits resulting from implementation of green building goals in the context of sustainable, affordable, residential development;
- To provide an estimate of the cost impacts of implementing the proposed code, standard and policy recommendations delineated in *Report #2* to the City and County; and
- To provide an estimate of the cost impacts of sustainable development (as defined by the Living Building Challenge) to developers and buyers of affordable, residential projects.

BENEFITS

The benefits of sustainable development can be categorized in three primary areas: Environmental Benefits, Societal Benefits, and Financial Benefits.

The benefits listed below are intended to demonstrate the breadth and diversity of potential positive outcomes that can be realized through sustainable building practices. References to studies and research regarding green building benefits are cited for areas where the benefits are not widely known or understood. The US Green Building Council's website[1] provides an excellent overview of both the impacts buildings have on the environment and the benefits from green building practices.

ENVIRONMENTAL BENEFITS

Sustainable development reduces the substantial impact buildings have on the natural environment, while increasing quality of life. Sustainable development also reduces fossil fuel use through energy efficiency and on-site production of renewable energy, which in turn reduces climate change and air pollution. It also provides direct environmental benefits for local and global ecosystems through the use of environmentally-sustainable practices. Sustainable development reduces the amount of material added to the waste stream and helps to conserve natural resources. Finally, sustainable development reduces the pollutants off-gassing into our atmosphere, providing a benefit to both human and non-human species.

- **Reduced fossil fuel use and dependence**
  Green buildings help to reduce fossil fuel consumption through energy efficiency and the use of clean energy technologies. Fossil fuels – e.g. petroleum, coal, natural gas – are limited resources. As they become more scarce, they are likely to increase in cost and could contribute to growing global instability if they continue as the dominant energy source for global economies. Extraction and transport of petroleum and other fossil fuels are also linked to environmental degradation through air pollution at oil fields and refineries, and water pollution through oil spills and the refining process.

- **Reduced greenhouse gas emissions**
  In addition to impacts associated with their extraction and scarcity, consumption of fossil fuels is linked to global climate change. The Architecture 2030 website states, "credible scientists give us 10 years to be well on our way toward global greenhouse gas (GHG) emissions reductions, in order to avoid catastrophic climate change. Yet there are hundreds of coal-fired power plants currently on the drawing boards in the US. Seventy-six percent (76%) of the energy produced by these plants will go to operate buildings."[2] The phenomenon of climate change is projected to lead to more volatile weather patterns and higher sea levels. The University of Arizona's Department of Geosciences Environmental Studies Laboratory has mapped the increased sea levels estimated to result from increases in global temperature to demonstrate the catastrophic effects that could occur.[3]

- **Enhanced protection of ecosystems**
  Many green building strategies can help reduce impacts on ecosystems. Reducing the need for water reduces stress on local water infrastructure and allows more water from managed watersheds to be made available for aquatic ecosystems.

1 See www.usgbc.org/Display page.aspx?CMSPageID=1718.

2 See www.architecture2030.org.

3 See http://www.geo.arizona.edu/dges/research/other/climate_change_and_sea_level/sea_level_rise/florida/sir_usafl_i.htm.

Sustainably produced materials, such as forest products, can also significantly reduce building impacts on ecosystems. For a forest product to be certified as sustainable, the forest management unit must demonstrate responsible forestry practices, including forest ecosystem maintenance, long-term timber management plans, and wildlife surveys.

Green buildings also keep ecosystems intact through careful siting and correct sizing. Building on or near an ecosystem that is sensitive to human activity can easily harm wildlife by hampering breeding or destroying hunting grounds. Siting decisions that avoid the most sensitive lands, maintain appropriate buffers, and provide for habitat continuity can directly support healthy ecosystems.

- **Improved air quality**
  Currently, green building practices that improve air quality are mainly concentrated on reducing toxicity of the materials using strategies such as incorporating only low VOC (volatile organic compounds) materials and enhanced ventilation rates. When low toxicity materials are selected, the potential for industrial pollutants to be introduced into the air or water streams is reduced. Several strategies have indirect benefits on general outdoor air quality as well. For example, reducing energy use also reduces particulates and greenhouse gasses associated with conventional energy production. Recycling of demolition materials and use of materials with high recycled content can reduce pollutants related to waste incineration in areas where that is a common practice.

- **Improved water quality**
  Water quality is also improved through several green building strategies. On-site management of stormwater reduces the potential for pollution of waterways, especially where storm and sanitary sewers are combined. Treatment of stormwater with swales directly reduces phosphates and particulates in surface waters.

- **Reduced waste**
  Because green buildings incorporate recycled materials and reduce construction scrap materials, they prevent those materials from ending up in landfills. A green building can also be planned for deconstruction at the end of its lifetime, thus saving any reusable materials and preventing the release of toxins associated with building demolition.

- **Conservation of natural resources**
  One objective of green building seeks to reduce the consumption of material resources by mandating recycling and the wise use of resources during construction and by promoting the use of recycled building materials.

- **Reduced pollutants**
  Paint, adhesives, carpets, and wood contain a wide array of chemical pollutants. These toxic substances continue to be released into the indoor and outdoor atmosphere long after construction has been completed. They can contaminate the air and water, with some substances remaining in the environment for many years. Because green buildings contain low-emitting materials, they pose less of a risk to the building's occupants and to the natural environment.

- **Public Health Outcomes**
  How communities are built affects human behavior which, in turn, affects public health. In their report, *Understanding the Relationship between Public Health and the Built Environment*, the LEED-ND® core committee summarized the positive relationship between smaller, dense development and physical activity, which results in fewer traffic accidents, and improved respiratory health and mental health.[4]

4 Ewing, R. & Kreutzer, R., "Understanding the Relationship Between Public Health and the Built Environment: A Report Prepared for the LEED-ND Core Committee.

SOCIETAL BENEFITS

Several studies have been performed to better understand the less tangible, but real benefits sustainable developments provide to society as a whole. Because the benefits of improving visual, thermal, and acoustic environments are so difficult to measure, studies have instead assessed the increased productivity that results from living or working in these environments. Occupant comfort and health are enhanced by the introduction of daylighting. Potentially one of the most significant improvements that can be made to the environment is improved air quality through reduced exposure to VOCs emitted by materials used during and after the building process. In addition, the societal benefits from sustainable development include minimized need to expand the capacity of local roads and utilities and reduced pressure from sprawl on prime agriculture lands.

- **Enhanced occupant comfort and health/Improved quality of life**
  Numerous studies have found that good ventilation, access to views, and exposure to natural daylight result in less sick days among building users, and can indirectly improve the quality of life.[5] Two studies involving "more than 11,000 workers in 107 buildings in Europe also found increases in perceived productivity, fewer illness symptoms, and less absenteeism in buildings that provide workers with control over temperature and ventilation conditions compared to a control group."[6] A major link drawn includes increased productivity of users, which benefits society at large.

  These comfort and health benefits also have been studied to indirectly analyze quality of life. For example, in schools, access to daylight has been linked to better student performance,[7] while in retail settings, daylighting has been shown to improve sales.[8]

  There are also directly attributable factors that influence human health which result from green building practices. For example, the *Public Health and Economic Impact of Dampness and Mold* study, completed in 2007, found "that exposure to dampness and mold in buildings poses a significant public health risk, resulting in an economic impact of $3.5 billion each year."[9]

- **Minimize need to expand the capacity of local roads and utilities**
  When green building projects manage stormwater on site or reduce the wastewater flow to public sewers, they can reduce the pressure to expand utility infrastructure, a significant (and typically public) expense.

- **Reduced pressure from sprawling development models on prime agricultural lands**
  Green building strategies that favor clustered development and preservation of open space can help to preserve farmlands, as well as natural areas. Farmland close to a city is of especially high value because of its accessibility to consumers, which minimizes transit costs. This proximity also generally means the land nearest the city is under the most pressure to develop.

- **Expansion of green practices industry-wide**
  An indirect, but important benefit of sustainable development practices results from the experience and leadership of the businesses that adopt emerging practices. By adopting best practices, builders and others demonstrate their leadership, help improve the industry practices, and position themselves for future business development opportunities.

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5 Judith Heerwagen, "Sustainable Design Can Be an Asset to the Bottom Line - expanded internet edition," Environmental Design & Construction, Posted 07/15/02. Available at: http://www.edcmag.com/CDA/Article Information/features/BNP__Features__Item/0,4120,80724,00.html.

6 Ibid.

7 Lisa Heschong, "Daylighting In Schools: Reanalysis Report," California Energy Commission available at www.newbuildings.org/downloads/FinalAttachments/A-3_Dayltg_Schools_2.2.5.pdf.

8 Lisa Heschong, "Daylighting In Retail Sales," California Energy Commission available a www.newbuildings.org/downloads/Final Attachments/A-5_Daylgt_Retail_2.3.7.pdf.

9 Mudarri, D. & Fisk W., " Public Health and Economic Impact of Dampness and Mold," 2007.

FINANCIAL BENEFITS

The financial benefits of green buildings include lower costs for energy, waste disposal, and water, as well as lower environmental and emissions costs, and lower operations and maintenance costs. In addition to the direct tangible benefits of lower operating costs, which are primarily a result of a reduction in energy use, sustainable development provides indirect value to the development's inhabitants, through improved occupant health, happiness, and productivity, which in turn provides an economic benefit to employers working in green buildings. Financial benefits can also be realized at the local or regional scale through the potential for greatly expanding markets for green products and services, which creates jobs and exportable skills and products.

- **Reduced home / building operating costs**
  Perhaps the most compelling argument for green buildings is their proven ability to provide monetary savings over time. "By incorporating green-building practices, Washingtonians and Oregonians could save more than $90 million each year in energy, water, and construction-related costs."[10] These savings come from better energy performance resulting from better insulation, more efficient heating, cooling, and ventilation equipment, more effective and efficient lighting, and by harnessing waste energy within the building. On-site renewable energy sources like solar, wind, and biomass can add to overall reductions in utility expenses.

- **Expanded market for green product and services, resulting increased jobs**
  The market for green products and services continues to grow and expand at an exponential pace. Incorporating green building practices in local development further increases this emerging market, creates a demand for locally-made products, positions the region in a leadership role, and thereby can help strengthen our trade with out-of-region markets, as well. The Pacific Northwest is home to many green building experts and manufacturers of green products; thus increasing sustainable development also increases our regional brand.

- **Improved occupant productivity and lower health care costs**
  As noted above, sustainable developments will generally have happier, healthier and more productive occupants. "Recent studies reveal that buildings with good overall environmental quality can reduce the rate of respiratory disease, allergy, asthma, sick building symptoms, and enhance worker performance. The potential financial benefits of improving indoor environments exceed costs by a factor of 8 to 14."[11] If an 8-14% increase in overall productivity is multiplied by the payroll cost of a business, the savings attributed to green building can be very high indeed.

- **Optimized life-cycle economic performance**
  An important, but often overlooked, green building strategy is to build for durability. A building component or system that is designed to perform well for a long period of time and be easily cleaned and serviced is likely to save money over the lifetime of a building.

- **Reduced costs to maintain and expand infrastructure**
  By reducing the need for new or larger roads and utilities, we save resources as well as dollars.

The specific environmental, societal, and financial benefits for each of the twenty-one recommendations are summarized in Appendix A. The table is divided into three columns summarizing the public sector benefits, private sector benefits, and the benefits to the community at large. In addition, icons are assigned to flag when a benefit is financial, societal, or environmental. For many of the strategies, more than one category might apply.

10 ECONorthwest, "Green Building: Saving Salmon, the Environment, and Mondy on the Path to Sustainability Opportunities for the Pacific Northwest," Available at www.econw.com/reports/Green-Building-Salmon-Environment-Sustainability_ECONorthwest.pdf.

11 William Fisk and Arthur Rosenfeld, "Potential Nationwide Improvements in Productivity and Health From Better Indoor Environments," Lawrence Berkeley National Laboratory, May 1998TABLEi.

COSTS

The costs of implementing sustainable, affordable, residential development were broken into two main categories: Public Sector Costs, which include costs to the municipalities, and Private Sector Costs, which include costs to developers. Public sector costs need to be offset by fees or offset through increased funding from an already tight general fund, while private sector costs are usually transferred to buyers and renters.

PUBLIC SECTOR COSTS OF IMPLEMENTING THE 21 RECOMMENDATIONS

The costs for each of the 21 recommendations for implementation identified in *Report #2* are summarized in Table 2: Summary of Cost by Recommendation. They reflect aggregated survey responses from City, County, and local Utility District staff, as well as from contacts with staff at King County, the City of Portland and the City of Eugene. The survey asked for detailed information on the staffing needs, training needs, infrastructure needs, and public outreach costs. Actual survey questions and summarized responses are presented in Appendix B.

Table 2: Summary of Cost by Recommendation also identifies some key strategies for controlling implementation costs that were captured from survey responses. Several responses noted that one of the ways to reduce costs to the City and County would be through the joint implementation of some of the recommended programs. It should be emphasized that significant savings to the public sector can be achieved by "bundling" multiple initiatives into one review process. Since a significant part of the public sector's process for approving code changes is administrative, e.g. public outreach mailings, staff time for setting meetings and hearings, etc., there will be efficiencies in pursuing a comprehensive set of policy changes, rather than pursuing piecemeal changes.

PRIVATE SECTOR COSTS OF SUSTAINABLE, AFFORDABLE, RESIDENTIAL DEVELOPMENT

Background

Several studies have been done on the costs of adding sustainable design features to buildings. One study, *Green Building Costs and Financial Benefits*, states, "The average premium for these green buildings is slightly less than 2%, or $3-5/ft2, substantially lower than is commonly perceived."[12] Because of the prevalence of the LEED© rating system, most studies have compared conventional building projects to LEED projects. These studies have found results ranging from a very small cost premium (less than 1%) to a 6% cost premium for LEED Platinum projects. The Federal General Services Administration (GSA) study *LEED Cost Study*[13] found a range for GSA buildings of between a -.04% cost decrease to 8.1% cost increase. The Davis Langdon study entitled *The Cost of Green Revisited: Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption*[14] found that "there is no significant difference in average costs for green building as compared to non-green buildings." This study evaluated 221 buildings in total, 83 LEED buildings and 138 non-LEED buildings. The buildings were categorized by type to facilitate comparison.

Less information is available on the potential cost increase for buildings achieving the Living Building standard. Two studies provide information in this area: The David and Lucile Packard

12 Gregory E. Kats, Capitol E, "Green Building Costs and Financial Benefits," Massachusetts Technology Collaborative, available at www.cap-e.com/ewebeditpro/items/O59F3481.pdf

13 See www.wbdg.org/ccb/GSAMAN/gsaleed.pdf for the GSA Cost of LEED® Study.

14 See the Davis Langdon website http://www.davislangdon.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-Revisited for more information on the Cost of LEED® study.

Foundation's *Los Altos Project Sustainability Report*[15] and the *Living Building Financial Study*.[16] The Packard report, first completed in 2001 and updated in 2002, was the first comprehensive look at the costs of all levels of LEED construction from Certified through Platinum, including the Living Building. At that time, the Living Building was a conceptual framework and not a rating system, which meant many of the requirements of the Living Building project were not defined and thus could not be priced. Although the Packard matrix demonstrated that the level of Living Building was the best long term economic choice, the anticipated first cost premium was significant for the proposed project (a foundation headquarters located in California's Bay Area).

A second study on the cost of Living Buildings entitled *The Living Building Financial Study: The Effects of Climate, Building Type and Incentives on Creating the Buildings of Tomorrow*[17] was completed in April of 2009 by the team of SERA Architects, Skanska USA Building, Gerding /Edlen Development, New Buildings Institute, and Interface Engineering, along with Cascadia staff. This study evaluated nine different building types in four climate zones and found, "Living Buildings can be built cost effectively in today's market-driven economy given the rising costs of energy and water." The study went on to delineate the importance of building type, use, and scale, as well as the role of incentives on the affordability of this highest level of sustainability.

Understanding Costs to the City and County

In order to develop a scope for the cost to the City and County for implementing each of the 21 recommendations, a survey was sent to City, County, and local Utility District staff. The survey asked for detailed information on the staffing needs, training needs, infrastructure needs, and public outreach costs for each of the recommendations identified in *Report #2*. The survey question responses are summarized in Appendix B. It was noted in several responses that one of the ways to reduce costs to the City and County would be through the joint implementation of some of the recommended programs.

Methodology for Estimating Costs and Premiums

The costs and premiums for building a Living Building were estimated using the protocol developed in *The Living Building Financial Study*, published by Cascadia. Calculations determined the increase in first cost and the payback period for two projects: a multi-family and a single family residential project, which were considered representative of sustainable, affordable residential housing developments in the area.

Similar to the approach used to identify code barriers in *Report #1*, real projects were utilized both to simplify the methodology, as well as to provide a solid foundation for careful estimating. For the single-family residence, an 1,840 sf house, known as the Bacon Brenes House, was used as the cost model. For the multi-family residential project, the Tupelo Alley Development, a 140-unit mixed-use development was used. Each project's cost estimate was divided into two areas: construction costs and owner / design build costs. Construction costs include costs for materials or systems and fees for contractor or subcontractor services. Owner / Design Build costs refer to costs borne by the developer, such as design fees, permit fees, carbon or habitat offsets, and incentives. Together, these two cost categories represent the total project cost. No costs were excluded, except for the cost of land, which is location specific and can vary widely. Each of the strategies added to the project is priced separately. For each strategy, the estimate displays the premium for the item on that division of work (e.g. Plumbing, Electrical, Mechanical) and the premium on percentage basis compared to the total cost of construction.

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15 See http://www.bnim.com/fmi/xsl/research/packard/index.xsl for complete information of the Packard matrix and report. Visit the Packard Foundation website at http://www.packard.org/home.aspx for more information on the foundation.

16 See Cascadia's website http://www.ilbi.org/resources/research/financial-study for more information on the Living Building Financial Study.

17 Ibid.

Incentives available for sustainable development were subtracted from the total project cost. Specific incentives available for projects in the study area include: the Washington State Solar PV Incentive, the Washington State Solar Thermal Incentive (which is sales tax exempt), the Clark County Public Utilities Solar Thermal Rebate, and the Clark Public Utilities Residential Rebates. In addition, federal incentives for solar were also included. Finally, it was assumed that a Living Building, which has no public water or sewer usage, could receive a 50% reduction in the County and City's systems development charges (SDC's).

Cost premiums for Living Building strategies were priced assuming that the proposed modifications were a part of the original design, not incorporated late in the project design or construction. This is based on the reasonable assumption that a developer would decide at the outset of a project whether or not to pursue the Living Building Challenge, not when the project is nearing completion, which would cause substantial project cost increases. The strategies employed to achieve Living Building status were all based on current, readily available technologies, using products and techniques currently in use.

Similar to the value engineering process during design, where individual systems, products, or materials are analyzed for cost impacts and less expensive alternates, changes to meet the Living Building Challenge were analyzed on a net-impact basis across the various building trade disciplines (e.g. mechanical, electrical, plumbing, structural). Although the impacts of each measure on other systems were considered, detailed engineering was not completed. For example, in the multi-family residential project, the building was redesigned to have a different orientation, which resulted in a cost reduction due to reduced building envelope area. This modification also created an energy conservation benefit because of less heat loss, which was accounted for. However, a full energy model was not provided to verify if we could also reduce the size of the mechanical system beyond the reduction in efficiencies achieved from modifying the mechanical systems as a separate energy conservation measure (ECM). Potentially because of the reduced heat loss from the improved building envelope, we might also be able to downsize the mechanical system, as well.

Methodology for Estimating Payback Period

The methodology developed in *The Living Building Financial Study* was also utilized to arrive at an estimated payback for developing the project as a Living Building. First, the cost estimating team compared the building baseline costs (i.e. costs of a building built per current code standard construction practices) to the costs projected for the Living Building modification (adjusted to May 2009 dollars) to arrive at the present worth for each building. Energy and water usage for baseline buildings were calculated using an escalation rate of 3% for energy and water in accordance with Federal Energy Management Program (FEMP). Current energy and water rates were multiplied by the present worth factor of 24.165 (this factor reflects a 30-year life cycle, 4.5% discount rate and 3% differential escalation). The total life cycle cost looks at both the annual cost and the present worth of the building to arrive at a present worth for the baseline building. The Living Building does not have any operational costs added to it as it has net zero energy and net zero water usage.

A major unknown, and unknowable, in these calculations is inflation. It is also difficult to estimate how energy prices will change over time, especially considering that carbon emissions may become a nationally regulated or taxed commodity, which would establish a price for carbon and increase the price of carbon-fueled energy. The calculations used in the study follow the FEMP Modified Uniform Present Value methodology[18] for calculating the present value of energy costs or savings accruing over time. This is a relatively conservative approach because, while runaway inflation is possible, it is even more likely that energy costs will rise and that carbon will soon have a cost that will increase energy costs more.

18 See NISTIR 85-3273 Energy Price indices and Discount Factors for Life-Cycle Cost Analysis; http://www1.eere.energy.gov/femp/pdfs/ashb08.pdf- 1102.4KB-EREN.

Results

Because of their small scale, residential buildings have one of the highest first cost increases and a relatively long payback period (time needed to recapture the first cost premium). In the City of Vancouver and Clark County the added costs for a net zero energy, net zero water, toxic free residence are anticipated to be between 27 and 32% for a single family residence and between 31 and 36% for a multi-family residence. The payback period varied depending on the assumed location of the structure, as the water and sewer rates vary slightly between residences inside the City of Vancouver and those outside the city limits. The payback period for a single family residence was approximately 30 years; for multi-family residential project, the payback period was 22 years.

It is interesting to note that varying choices (like eliminating a garage, changing building materials, or reducing house size) which were outside the parameters of this study, could negate the first cost increases to achieving the Living Building Standard. Furthermore, the payback period is directly related to the cost of energy and water. If energy and water rates were higher, the calculated payback period would be reduced. Utility rates in Vancouver and Clark County are lower than other municipalities in the region where we have performed similar payback calculations. While lower rates may keep individual customer bills low, they also create a disincentive to building green in the local area.

Incentives also influence payback. Projects in the CIty of Vancouver and Clark County can utilize federal and state incentives for many of the project's energy related features. Other jurisdictions offer additional incentives which lower first costs further.

LEGEND
Societal
$ Financial
Environmental

Barriers	Benefits					
	Public		Private		Community	
INSTITUTIONAL/PROCESS BARRIERS						
Expedited or priority permit processing program Consider utilizing existing green building standards as a reference for achieving green building performance.	$ Societal	• Establishes a protocol for projects that allows them to be more easily categorized to avoid delays in permitting. • Provides a smoother process.	$ Societal	• Time saved in permitting will save developers money. • Provides a smoother process. • Builds industry recognition of established green building standards and practices.	Societal Environmental Societal Environmental $	• Encourages sustainable development and resource conservation. • Gets more sustainable development into the community more quickly. • Cost savings may be reflected in lower housing prices.
In-House Mandatory Trainings Combined trainings with monthly or quarterly meetings between building officials, plans examiners, and inspectors to learn about new technologies and coordinate communication on green building projects. Bring in experts from the private sector and utilize in-house experts to teach trainings, and include field trips to see sustainable development strategies in-place.	Societal Societal $	• Provides coordinated responses and consistency. • Utilizes expertise of local community. • Some industry experts may be willing to donate some services for training, allowing for staff to gain expanded knowledge of green building at low cost to the agency.	Societal Societal	• Coordinated responses and consistency. • In addition to primary benefit of educating public sector staff, there may be reciprocal sharing of information in both directions.	Societal Environmental	• Better training results in better products on the market.
Mandatory Green Pre-Application Meetings Early design meetings. Ombudsman or "green champion."	Societal Societal $	• Allows staff to better schedule reviews, and obtain additional information needed prior to review deadlines of a submitted project. • Communication with team earlier in the process can ultimately result in a quicker review process and less staff time spent overall.	Societal $ $ Societal Societal	• Champion provides a single point of contact throughout the process, streamlining the process. • Reduces time in permitting by eliminating the "turn in, get feedback, turn in again, get feedback" approach to project review. • Allows for dialogue between reviewer and application to facilitate decisions. • Allows decisions about new green building ideas to happen much earlier in the process while they can be more easily be modified.	$ Societal Environmental	• Cost savings from streamlined process may be reflected in lower housing prices. • Better communication results in better products on the market.
Green Building Technical Assistance Program Internal education and outreach. Technical assistance program. Technical coordination group. Leverage existing conservation programs.	Societal Societal Societal	• Allows agencies to track projects earlier, plan resources for review. • Agencies can help set priorities, bring resources to projects. • Can increase interaction between different agencies.	Societal Societal	• Makes educational resources available to development teams. • Provides a starting point to bring in new and innovative sustainable development design strategies.	Societal Environmental	• Improves products on the market.

Barriers	Benefits					
	Public		Private		Community	
BARRIERS TO ENERGY EFFICIENCY						
Develop Guidelines for Permitting Renewable Energy and Passive Heating/Cooling Systems Define standards for urban and rural small scale wind energy systems, photovoltaic and solar thermal installations, passive solar design, and natural ventilation.		• Creates a common baseline for emerging technologies.		• Provides predictability in the permitting process. • Reduced energy costs over the life of the building.		• Helps cut pollution from fossil fuels through a program that supports diversified, cleaner energy sources.
Consider Density Bonuses for Energy Efficiency Measures Increase density for cottage housing developments. Increase floor area ratios (FAR) for high performance projects.		• Cultivates innovation with minimal investment – i.e., no cash subsidies or staff time.		• Allows more development, potential income. • Reduced energy costs.		• Supports growth while preserving large tracts of undeveloped land which may serve as a collective resource for the larger community and other species. • Creates livable communities at densities that allow for services to develop near residential development. • Reduced pollution from fossil fuels through lower energy use.
Amend SEPA to Include Evaluation and Mitigation of Greenhouse Gas Emissions from New Construction Projects Including Embodied Energy of Materials, Construction Activities, and Ongoing Operating Energy Adapt programs and resources from other jurisdictions (King County, state).		• Generates data to evaluate progress toward GHG reduction. • Provides comparable metrics across state.		• Links all environmental assessment to a single program, across all state jurisdictions.		• Provides a metric to evaluate construction's impact on greenhouse gas emission. • Reduced pollution from fossil fuels.
Require and Enforce Performance Testing to demonstrate Residential Energy Code Compliance Require blower door testing on new residential. Develop a job training program around blower door testing.		• Ensures measurable benefit from energy policies, as opposed to design; i.e. tests installation, not just design intent.		• Provides assurance that projected energy savings will be achieved. • Reduced energy costs over life of the project.		• Potential green building job program. • Reduced pollution from fossil fuels. • Improve the energy efficiency of the building stock for the entire community.
Develop a District Energy Demonstration Project Ordinance Address land use planning issues associated with crossing property boundaries, utility connection requirements, and ongoing maintenance and management for district systems. Greater zoning flexibility for pilot projects with required reporting.		• Demonstration project allows all parties to better understand requirements, potential of district systems to facilitate wider adoption as appropriate.		• Simplifies approvals process associated with specific projects. • Allows multiple property owners to collaborate to achieve energy savings.		• Produces energy at local level, reducing dependence on conventional (and often polluting) sources. • Reduces demand for new energy infrastructure to be built.

Appendix A: Benefits

Barriers	Benefits					
	Public		Private		Community	
BARRIERS FOR NON-CONVENTIONAL GREEN BUILDING STRUCTURES						
Allow Flexibility within the Building Codes for "Incubator" Pilot Projects to Test Alternative Green Materials	👥 👥 $	• Reduces repetition for reviewers by providing guidelines for developers to follow. • Reduces research time needed to approve alternate technologies.	👥	• Allows emerging systems to enter the market ahead of changes in state and national codes.	👥	• If combined with monitoring requirements, provides real world data on material performance in local conditions.
Develop Code Guidance for Strawbale Structures Utilize code guidance language from other jurisdictions.	👥	• Provides consistency with other jurisdictions and benefits from lessons learned elsewhere.	👥	• Facilitates adoption of proven technology.	👥	• Provides information on a specific green building technique.
Develop an Advisory Committee of Green Building Experts for Alternative Technologies Assemble a group of third-party experts charged with reviewing data supplied by the applicant and making recommendations to building officials. Participate on the City of Portland's Alternative Technologies Committee, or develop a similar committee specific to City and County projects.	👥 $	• Information sharing improves knowledge base for all agencies. • Reduces research time needed to approve alternate technologies.	👥 $	• Provides technical resources for projects. • Facilities a faster turn-around time.	🌍	• Provides a forum for the dissemination of green building technologies
DRIVEWAY & FIRE ACCESS ROAD WIDTHS						
Develop Code Guidance on Acceptable and Best Practices for Low Impact Development Provide education and guidance to developers on code-acceptable LID practices.	$	• Code guidance will help ensure that appllications are complete, and address concerns identified by agencies.	$ 👥 $	• LID solutions are often more cost effective, reducing infrastructure costs for large pipes, detention / retention facilities and associated excavation for these facilities. • Pre-approved practices simplify design and permit review processes.	$	• Infrastructure costs for new facilities are reduced, thereby reducing costs for all.

Barriers	Benefits					
	Public		Private		Community	
Update Standards for Streets, Fire Access Roads and Private Driveways Require LID approaches that reduce impervious surfaces through the design of narrower roads and the use of pervious pavements.	$ people, globe	• Reduced maintenance for streets. • Provides an integrated and balanced approach to several sometimes opposing public safety factors: traffic calming, fire access and stormwater best management practices.	$ people people	• Reduced construction costs. • Enhanced developments. • Potentially safer streets due to slower speeds.	globe	• Reduced downstream impacts due to reduced impervious surfaces.
Consider Stormwater Management Utility or SDC Fee Reductions Offer fee reductions for LID approaches that manage stormwater on-site. Tier fee reductions to promote more aggressive LID approaches that include comprehensive natural drainage strategies.	$	• Over long term, fee reductions can be offset by reduced impacts on public infrastructure, reduced pressure for expansion, and reduced capital expenditures.	$	• Reduced fees to reward best practices.	globe globe $	• Reduced downstream impacts due to reduced impervious surfaces. • Reduced pollutants in our natural water systems. • Reduces burden on public infrastructure, leading to reduced pressure to expand facilities and associated capital costs.
MINIMUM PARKING REQUIREMENTS						
Consider New Policies to Reduce Minimum Parking Requirements as Part of an Overall Strategy to Increase Alternative Transportation in the Next City/ County Comprehensive Plan Update Allow for a reduction in required on-site parking in exchange for dedicated car-share vehicle spaces. Reduce or eliminate parking requirements for developments located in mixed-use districts. Require bicycle storage facilities. Develop pedestrian-oriented street standards. Require pedestrian connections between housing developments and nearby community services. Allowing greater flexibility for affordable housing projects to reduce on-site parking provided based on need.	people, globe, $ globe people	• Reduces traffic and parking by reducing incentives to drive alone. • Potential to reduce impervious surface impacts on stormwater system. • Reducing parking demand for housing - where services and transit support are in place - creates an incentive for affordable housing.	$ $ globe	• Reduced costs associated with providing parking that would only be needed at peak times. • Controls costs of projects, especially affordable housing. • Contributes to incentives for transit.	globe globe people people, globe	• Reduces sprawling effect of underdeveloped land in parking lots. • Supports alternative transportation by reducing heavy traffic. • Encouragement of mixed-use districts can contribute to livelier safer neighborhoods, which are occupied at more times. • Supports bicycle and pedestrian travel, to reduce driving and create safer streets.

Barriers	Benefits					
	Public		Private		Community	
SETBACKS & SEPARATION FOR RAINWATER HARVESTING CISTERNS						
Provide Guidance on Designing, Permitting, Installing, and Maintaining Rainwater Harvesting Cisterns into New Construction and Retrofit Applications	$ $	• Adoption of these systems reduces impacts on public conventional infrastructure. • Reduces staff review time by providing a standard that developers can follow.	$	• Improves process and cost predictability.		• Low-impact development can benefit surface streams by better mimicking natural surface water flows, reducing pooling and flooding. • Provides stormwater for non-potable applications, conserving resources.
Revise Code Requirements for Setbacks and Building Separation for Above-Ground Rainwater Cisterns Eliminate setback and separation requirements for above ground cisterns.		• Supports adoption of low impact systems to reduce infrastructure impacts. • Reduces staff review time by providing a standard that developers can follow.	$	• Wider adoption of simple systems can reduce cost of low impact technology.		• Low-impact development can benefit surface streams by better mimicking natural surface water flows, reducing pooling and flooding. • Provides stormwater for non-potable applications, conserving resources.
CLUSTER DEVELOPMENTS/COTTAGE HOUSING						
Develop New City and County Cottage Housing Codes		• Facilitates new models of development that support community building and affordable housing.		• Supports collaborative model for development, with potential to reduce site infrastructure through clustered systems.		• Clustered development models typically preserve land for habitat, green space, etc. • More area is available for natural infiltration.
WATER-RELATED BARRIERS						
Provide Guidance on Designing, Permitting, Installing, and Maintaining Rainwater Harvesting Cisterns	$	• Reduces impacts on public infrastructure.		• Facilitates adoption of low-impact systems.		• LID can benefit surface streams by better mimicking natural surface water flows, reducing pooling and flooding. • Provides stormwater for non-potable applications, conserving resources.
Collaborate in a Neighborhood-Scale Net Zero Water Pilot Project Develop a demonstration ordinance that allows for flexibility within the current codes for a neighborhood-scale development with net zero water goals. Require monitoring and reporting of water use and wastewater reduction, and utilize data to support future code updates.		• Pilot project with monitoring provides data for future projects and for improving draft regulations and standards. • Reduces impact on water supplies, stormwater and sewage collection systems.		• Facilitates adoption of emerging technologies and systems.		• Establishes precedents for collaborative neighborhood-scale projects.

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Institutional/Process Barriers		
Barrier 1: Establish an expedited or priority permit processing program for green building that achieves a high level of green performance (e.g. LEED® Gold certification) **Approach:** **1A.** Consider utilizing existing green building standards as a reference for achieving green building performance.	**Staffing Needs**	
	Estimated staff FTE: Estimated Cost: How many projects do you see that have committed to a green building standard? Is there a resource available on staff that could provide green building technical assistance during the review process? What extra time is involved with expedited/priority permitting? Do you have a permit facilitator that could also provide this service?	City DRS/Building: approx. 1 FTE @ $110,000 City Solid Waste: 1 - 2 FTE, $60,000 to $120,000 - potential to share with County City DRS/Building: staff resource not currently available City DRS: Less than 10% of projects currently are green; Time involved depends on the complexity of the project, usually none use a multi-disciplinary review team. No additional staffing; would assign to a seasoned review team County Building: $90,000; about 10% commit to green goals; staff is building knowledge base; expedited permitting is analogous to existing phased permitting, approx 10-20% premium per project. Lead examiner would perform priority reviews, with cost identified to free up time for this.
	Training Needs	
	Estimated Training Cost: Are there existing programs that could be utilized to provide additional training for staff?	City DRS/Building: approx. $7,500 County Building: $7,500 City DRS: $15,000 to $20,000 for 6 to 8 people General: explore LEED training for staff; trainings must be evaluated for relevance and substance
	Public Outreach	
	Estimated Public Outreach Costs: How do you market new programs to the public? Could an existing newsletter be used to market this potential new program?	City DRS/Building: approx. $2,500 County Building: $22,000 None to minimal costs - from the General Fund General: GovDelivery program, city flyer, presentations to interest groups; existing newsletter available
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Institutional/Process Barriers		
Barrier 2: Develop in-house mandatory trainings targeted to planners, plans examiners, building officials, and inspectors. **Approach:** **2A .**Combined trainings with monthly or quarterly meetings between building officials, plans examiners, and inspectors to learn about new technologies and coordinate communication on green building projects. **2B.** Bring in experts from the private sector and utilize in-house experts to teach trainings, and include field trips to see sustainable development strategies in-place.	**Staffing Needs**	
	Estimated staff FTE: Estimated Cost: How many staff people should attend the trainings? Are there grant opportunities to allow for staff allocation of billable time? Could a brown bag lunch forum be utilized to reduce cost?	City DRS/Building: 0.5 FTE, $55,000 County Building: 0.25 FTE, $25,000. 6-10 people to train City Community Planning: 0.2 FTE to 0.25 FTE City SW: $5,000 currently budgeted in 09-10 C.C. Solid Waste Budget for 10 staff City SW: 10 - 15 staff people should attend training No specific grant opportunities identified Brown bags useful for office staff, less so for field staff, and may be of limited use for short time frame training
	Training Needs	
	Estimated Training Cost: Are there known experts in the community that could be utilized to provide trainings? Are there existing training resources that could be used for green building trainings?	City DRS/Building: $20,000 County Building: $10,000 City Community Planning: $200 for materials City SW: $10,000 for outside trainers and 2 days staff time City HR: estimated staff time for each hour of training: 4 for design 9one-time occurrence), 1 for set-up etc. 1 for delivery (each presentation) County Sustainability: $500 in 09-10 budget for speakers County stormwater expertise available on staff General: community resources are available, would need review to ensure they meet specific training needs
	Public Outreach	
	N/A	City DRS/Building: N/A
	Infrastructure Needs	
	Estimated Infrastructure Cost: Do you have spaces available that could be used for trainings? Are there costs associated with use of existing spaces? Could other community resources be used?	City DRS/Building: $0 County Building: minimal No infrastructure costs anticipated, private sector trainers could host Use of City spaces may have costs; County not typically; private sector conference rooms could be used, when hosting

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Institutional/Process Barriers		
Barrier 3: Establish mandatory green "pre-application" meetings to involve building officials and reviewers early on in the design process. **Approach:** **3A**. Provide early design meetings with building officials and reviewers free-of-charge to applicants as an incentive to encourage more sustainable development projects. **3B**. Assign the green project an ombudsman or "green champion" within the department who is responsible for ensuring a facilitated review process, helping to address any code obstacles that do arise, and communicating with project teams on possible solutions.	**Staffing Needs**	
	Estimated Staff FTE? Estimated Cost? Do you require pre-apps as part of your process? How many projects do you see come in the door with sustainability goals? Should this be something that gets added to all projects, not just green ones? Is there a resource available on staff that could provide green building recommendations? Could any existing training dollars be relocated?	City DRS/Building: $0 County Building: bundled with costs of in-house trainings, above City Community Planning: $100,000 - $120,000 for full time ombudsman General: less than 10% of projects currently are green; might be premature to require "green pre-app" of all projects
	Training Needs	
	Estimated Training Cost: Is there a mechanism to provide staff access to trainings? [For example, brown bag lunches for staff with industry experts facilitating training?] Could you use existing training budgets and reallocate time to green building training? For example do a day long training session? Could a grant be utilized?	City DRS/Building: $0 County Building: bundled with costs of in-house trainings, above City Community Planning: Draw on Portland experts; use large session for topics of wide appeal, smaller sessions for specific topics; city training budgets are currently frozen
	Public Outreach	
	Estimated Public Outreach Costs: How do you market new programs to the public? Could an existing newsletter be used to market this potential new program?	City DRS/Building: $2,500 County Building: bundled with costs of in-house trainings, above Resources: government delivery, city flyer, presentations to interest groups
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Institutional/Process Barriers		
Barrier 4: Create a green building technical assistance program. **Approach:** **4A**. Provide education and outreach internally to City and County staff as well as to the private development community. **4B**. Develop a cross-jurisdictional technical assistance program between Vancouver and Clark County and possibly including other cities/ towns within the County to help improve consistency and stretch limited resources. **4C**. Leverage existing conservation programs funded through local utilities (such as solid waste, drinking water, stormwater, wastewater or energy)	**Staffing Needs**	
	Estimated staff FTE: Estimated Cost: What existing conservation programs exist that have funds allocated for green building projects? [i.e. solid waste reduction programs, utility Energy Conservation incentives] Is there precedence for the city /county partner with other public agencies? Can you leverage across jurisdictions for example would Vancouver affordable housing participate?	County Building: 0.75 FTE $75,000 beyond costs of in-house trainings, above County Solid Waste: 0.5 - FTE, $35,000 Need to revise rate structure City Water: model on or expand existing water conservation program Resources/partners: Chamber of Commerce, Builders' Assoc.
	Training Needs	
	Estimated Training Cost: Could local green building experts be utilized to minimize training costs?	County Building:local experts could be utilized, but only to augment in-house programmatic solution County Solid Waste: $350/person; Experts could be used, if integrated with County requirements, alternatively could partner with an industry association
	Public Outreach	
	Estimated Public Outreach Costs: How do you market new programs to the public? Could an existing newsletter be used to market this potential new program?	County Building: bundled with costs of in-house trainings, above County Solid Waste: $5,000 for materials; collaborate with solid waste and water program newsletters Resources: advertisements, web materials, targeted mailings, and public presentations
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Barriers to Energy Efficiency		
Barrier1: Define requirements and develop guidelines for permitting renewable energy and passive heating/cooling systems. **Approach:** **1A**. Define standards for urban and rural small scale wind energy systems, photovoltaic and solar thermal installations, passive solar design, and natural ventilation.	**Staffing Needs**	
	Estimated Staff FTE? Estimated Cost? What is the process to get a new code/standard adopted? How are that process funded? Would development of energy efficiency ordinances require any additional resources? If so, are there resources in the local community you can utilize? Is it possible to combine several (or all) of these processes together to minimize cost?	City Community Planning: 0.5 FTE, $50,000 County Building: 0.5 FTE, $50,000 City Solid Waste: 1 FTE, $65,000 City: process is funded by fees; proposal can come from the public or private sector; input from multiple agencies, stakeholders. if all changes are bundled, there would be a reduced cost, paid through General Fund County: funds would need to be provided by Board, or grant funding pursued; planning/zoning changes can be bundled for savings, probably not with Building Resources; Municipal Research and Services Center (MRSC), Bonneville Power Administration (BPA), City of Portland, some stakeholder organizations for specialized knowledge
	Training Needs	
	Estimated Training Cost: Who would need to get training about the new code guides? Inspectors/plans examiners/etc.	County: combine with other zoning changes, for savings in training
	Public Outreach	
	Estimated Public OutreachCosts: How do you market new code guides to the public? Could the code guides be available on line?	County Community Planning: $1,000 for public open house City Community Planning: $4,000 for stakeholder outreach Resources: public open houses, hearings, stakeholder outreach, web
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Barriers to Energy Efficiency		
Barrier 2: Consider density bonuses for energy efficiency measures. **Approach:** **2A.** Increase density for cottage housing developments. **2B.** Increase floor area ratios (FAR) for high performance projects.	**Staffing Needs**	
	Estimated Staff FTE? Estimated Cost? What is the process to get a new code/standard opted? How are they funded? Would development of energy efficiency ordinances require any additional resources? If so, are there resources in the local community you can utilize?	City Community Planning: 0.5 FTE, $50,000 plus research costs Changes in density may potentially accelerate the need for new sewers in some areas
	Training Needs	
	Estimated training cost? Who would need to get training about the new code guides? Inspectors/plans examiners/etc.	none identified
	Public Outreach	
	Estimated Public Outreach Costs: How do you market new code guides to the public? Could the code guides be available on line?	County Community Planning: $1,000 Resources: brochures, web information, direct outreach to building industry, web
	Infrastructure Needs	
	N/A	
Barrier 3: Amend SEPA to include evaluation and mitigation of greenhouse gas emissions from new construction projects including embodied energy of materials, construction activities, and ongoing operating energy. **Approach:** **3A**. Adapt programs and resources from other jurisdictions (King County, State).	**Staffing Needs**	
		King County: Effort required part of 2 staff for 1-2 year period. On-going operational cost has not been formally estimated; staff time will vary depending on depth of review of SEPA materials. Potentially $50-150,000/per year City Transportation: 0.25 FTE
	Training Needs	
		City Transportation: $10,000 cost per year; need for 2 weeks training, on-going staffing and software
	Public Outreach	
	Infrastructure Needs	

Barriers	Questions	Answers
Barriers to Energy Efficiency		
Barrier 4: Require and enforce performance testing to demonstrate Residential Energy Code compliance. **Approach:** **4A**. Develop a process for requiring blower door testing on new construction residential projects. **4B**. Develop a job training program around blower door testing to help support local economic development.	**Staffing Needs**	
	Estimated Staff FTE? Estimated Cost? Are your inspectors familiar with blower door type testing? What additional paper work would be involved if a third party certification is provided in lieu of city testing? Note: Cost of blower door in private sector is $200 to $300	City DRS/Building: to be done by (approved) 3rd party, at developer's direct cost County Building: 0.5 FTE, $50,000
	Training Needs	
	Estimated training cost? Could an existing community college program be utilized for training?	County Building: $5,000; potential to use consulting firm
	Public Outreach	
	Estimated Public Outreach Costs: How do you market new procedures to the market?	
	Infrastructure Needs	
	Estimated Infrastructure costs: _____ What equipment is available to do blower door testing?	County: $2,000 if program run in-house
Barrier 5: Develop a district energy demonstration project ordinance. **Approach:** **5A**. Address land use planning issues associated with crossing property boundaries, utility connection requirements, and ongoing maintenance and management for district systems. **5B**. Allow for greater flexibility within the current codes for pilot projects and require reporting to inform future code amendments.	**Staffing Needs**	
	Estimated Staff FTE? Estimated Cost? What is the process to get a new ordinance adopted? How are they funded? Would development of district energy ordinances require any additional resources? If so, are there resources in the local community you can utilize?	County Community Planning: 0.1 FTE; ordinance costs are secondary to costs of partnership, it is important to identify a strong project partner City Community Planning: 0.5 FTE planning, 0.5 FTE legal, $100,000, includes legal input to define district and shared responsibilities
	Training Needs	
	Estimated training cost? Who would need to get training about the new ordinance? Inspectors/ plans examiners/ etc.	
	Public Outreach	
	Estimated Public Outreach Costs: How do you market new code guides to the public? Could the code guides be available on line? What is involved in informing the public about a new pilot project?	City Community Planning: website, news releases, direct mailing, public forum
	Infrastructure Needs	
	N/A	

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Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Barriers for Non-Conventional Green Building Structures		
Barrier 1: Allow flexibility within the building codes for "Incubator" pilot projects to test alternative green materials. **Approach:** **1A** Adapt approach similar to other jurisdictions	**Staffing Needs**	
	Estimated staff FTE required to develop pilot project guideline: Estimated Cost: Is there staff available to review existing guides from other jurisdictions to use as tests?	City DRS/Building: $0; no additional costs for alternate materials, systems County Building: 0.5 FTE, $50,000
	Training Needs	
	Estimated Training time for Plans Examiners: Are existing plans examiners qualified to inspect alternate green materials or is additional training required?	County Building: 40-80 hours, depending on scope of training; generally high level of training and knowledge base, but some specialized training would be required.
	Public Outreach	
	Estimated Public Outreach Costs: What is involved in informing the public about a new pilot project? How do you get the word out regarding pilot projects? Could an agreement to participate in information sharing process be a part of the required documentation?	
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Barriers for Non-Conventional Green Building Structures		
Barrier 2: Develop code guidance for strawbale structures. **Approach:** **2A**. Utilize code guidance language from other jurisdictions.	**Staffing Needs**	
	Estimated Staff FTE? Estimated Cost? What is the process to get a new code /standard adopted? How are they funded? Would development of strawbale ordinances require any additional resources? If so, are there resources in the local community you can utilize? Is it possible to combine several (or all) of these processes together to minimize cost?	County Building: 0.2 FTE, $20,000; already approved through alternate means and methods; limiting technology to a few prescriptive approaches might not serve intent to encourage innovative solutions
	Training Needs	
	Estimated training cost? Who would need to get training about the new code guides? [Inspectors, plans examiners, etc.]	County Building: all building staff
	Public Outreach	
	Estimated Public Outreach Costs: How do you market new code guides to the public? Could the code guides be available on line?	City DRS/Building: $250
	Infrastructure Needs	
	N/A	
Barrier 3: Develop an Advisory Committee of green building experts for alternative technologies. **Approach:** **3A**. Assemble a group of third-party experts charged with reviewing data supplied by the applicant and making recommendations to building officials. **3B**. Participate on the City of Portland's Alternative Technologies Committee, or develop a similar committee specific to City and County projects.	**Staffing Needs**	
	Estimated Staff FTE?	City: $60,000
	Training Needs	
	NA	
	Public Outreach	
	Estimated Public Outreach Costs:	$10,000
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Driveway & Fire Access Road Widths		
Barrier 1: Develop code guidance on acceptable and best practices for low impact development. **Approach:** **1A**. Provide education and guidance to developers on code-acceptable LID practices.	**Staffing Needs**	
	Staff FTE required to develop LID ordinances: Estimated Cost: Who (what department) should be involved in creating a demonstration ordinance? How much time would the creation of a demonstration ordinance involve?	City Community Planning: 0.5 FTE planning, 0.5 FTE legal, 0.5 PW/stormwater Estimated $150,000/year City Transportation: 0.3 FTE planning, $5,000 County Transportation: 0.25 FTE for 1/2 year City Depts involved: Public Works, Planning, Development Review Services, Legal
	Training Needs	
	N/A	
	Public Outreach	
	Estimated Public Outreach Costs:	City Community Planning: $4,000 if it's a required program, stakeholder outreach City Transportation: $5,000 if bundled with other changes County Transportation: in excess of 0.25 for 1/2 year - wide range possible
	Infrastructure Needs	
	N/A	City Solid Waste: general concern for adequate access for haulers
Barrier 2: Update standards for streets, fire access roads, and private driveways. **Approach:** **2A**. Require LID approaches that reduce impervious surfaces through the design of narrower roads and the use of pervious pavements.	**Staffing Needs**	
	Staff FTE required to develop LID ordinances: Estimated Cost: Who (what department) should be involved in creating a demonstration ordinance? How much time would the creation of a demonstration ordinance involve?	County Planning: $25,000 County Transportation: 0.5 FTE for 1 year Involve: Public Works, Community Planning, Community Development, Transportation, Fire
	Training Needs	
	N/A	
	Public Outreach	
	Estimated Public Outreach Costs:	City Transportation: $5,000 - $10,000, more if private sector seeks studies to support proposed programs
	Infrastructure Needs	
	N/A	City Solid Waste: general concern for adequate access for haulers

Barriers	Questions	Answers
Driveway & Fire Access Road Widths		
Barrier 3: Consider stormwater management utility or SDC fee reductions. **Approach:** **3A**. Offer fee reductions for LID approaches that manage stormwater on-site. **3B**. Tier fee reductions to promote more aggressive LID approaches that include comprehensive natural drainage strategies.	**Staffing Needs**	
	Staff FTE required to develop ordinance: Estimated Costs: Do you have staff available with expertise in Stormwater that could be utilized as a resource?	City Community Planning: 0 - already completed
	Training Needs	
	N/A	
	Public Outreach	
	Estimated Public Outreach Costs: Are public hearings required to modify SDC rates?	
	Infrastructure Needs	
Minimum Parking Requirements		
Barrier 1: Consider new policies to reduce minimum parking requirements as part of an overall strategy to increase alternative transportation in the next City/County Comprehensive Plan Update. **Approach:** **1A**. Allow for a reduction in required on-site parking in exchange for dedicated car-share vehicle spaces. **1B**. Reduced or eliminated parking requirements for developments located in mixed-use districts. **1C**. Define requirements for bicycle storage facilities. **1D**. Develop pedestrian-oriented street standards. **1E**. Require pedestrian connections between housing developments and nearby community services. **1F**. Allowing greater flexibility for affordable housing projects to reduce on-site parking provided based on need.	**Staffing Needs**	
	Staff FTE required to develop ordinance: Estimated staff time to review pilot projects water use: Estimated Cost: Who (what department) should be involved in creating comp plan update? How much time would a comp plan update take? What are the opportunities to partner with other agencies?	City Community Planning: 0.33 FTE City Transportation: 0.2 FTE County Community Planning: 0.3 FTE to develop ordinance, 0.1 FTE to review pilot project; $34,000 Should combine with a full transit-oriented development (TOD) policy rather than treating parking as piecemeal Involve Public Works, Planning, and Community Development, Public Health C-Tran Timing: 10 months - 1 year
	Training Needs	
	N/A	
	Public Outreach	
	Estimated Public Outreach Costs: Are public hearings required as part of the comp plan amendment process? What means is currently utilized to inform the public of comp plan amendments?	City Transportation: 0.1 FTE, consultants to guide approvals process County Community Planning: the policy exists; further changes should be combined with Clark County Development Code Title 40 upgrade that is just starting
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Setbacks & Separation for Rain water Harvesting Cisterns		
Barrier 1: Provide guidance on designing, permitting, installing, and maintaining rainwater harvesting cisterns. **Approach:** **1A** Review guidelines created by other jurisdictions.	**Staffing Needs**	
	Staff FTE required to develop rain water harvesting guideline: Estimated Cost: Is there staff available to review existing guides from other jurisdictions? What is the process to adopt a code guide?	City Community Planning: 0.2 FTE County Community Planning: coordination with the Fire Department is critical, minimal time expected
	Training Needs	
	Estimated Training time for Inspectors: Are existing inspectors qualified to inspect rainwater collection systems or is additional training required? Could a different entity inspect the rainwater harvesting system?	City Community Planning: 2 hours training required
	Public Outreach	
	Estimated Public Outreach Costs: What is involved in informing the public about a new code guide?	City Community Planning: none expected
	Infrastructure Needs	
	N/A	
Barrier 2: Revise Code Requirements for Setbacks and Building Separation for Above-Ground Rainwater Cisterns. **Approach:** **2A**. Eliminate setback and separation requirements for above ground cisterns.	**Staffing Needs**	
	Staff FTE required to develop separation guideline: Estimated Cost: Is there staff available to review the existing guides in other jurisdictions? What is the process to revise a code requirement?	City DRS/Building: continue to address on a case-by-case basis City Community Planning:0- 0.2 FTE for 6 months, $30,000 - might be able to accomplish with existing staffing. Resources: use Municipal Research & Services Center of Washington
	Training Needs	
	Estimated Training time for Inspectors: Are existing inspectors qualified to inspect rainwater collection systems or is additional training required?	none identified
	Public Outreach	
	Estimated Public Outreach Costs: What is involved in informing the public about a code requirement?	City Community Planning: web update and bulletin
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Cluster Developments/Cottage Housing		
Barrier 1: Clustered housing is discouraged by structure of codes. **Approach:** **1A.** Develop new City and County cottage housing codes.	**Staffing Needs**	
	Staff FTE required to develop cottage housing codes Estimated Cost: Is there staff available to review similar ordinances from other jurisdictions? What is the process to develop a new code guide?	City Community Planning: 0.5 FTE, $30,000 County Community Planning: 0.05 FTE
	Training Needs	
	Estimated training time for ordinance developments:	County Community Planning: minimal
	Public Outreach	
	Estimated Public Outreach Costs: What is involved in informing the public about a new code? Could existing forums (newsletters, meetings etc) be utilized to inform the public?	City Community Planning: Stakeholder meetings County Community Planning: Existing newsletters and other media
	Infrastructure Needs	
	N/A	
Water Related Barriers		
Barrier 1: Provide guidance on designing, permitting, installing, and maintaining rainwater harvesting cisterns. **Approach:** **1A**. Eliminate setback and separation requirements for above-ground cisterns.	**Staffing Needs**	
	Staff FTE required to develop rain water harvesting guideline: Estimated Cost: Is there staff available to review existing guides from other jurisdictions? What is the process to adopt a code guide?	City DRS/Building: recommends use of existing alternate methods and materials process until statewide code is adopted. City Community Planning:0- 0.2 FTE - probably could rely on existing staffing
	Training Needs	
	Estimated Training time for Inspectors: Are existing inspectors qualified to inspect rainwater collection systems or is additional training required? Could a different entity inspect the rainwater harvesting system?	none identified
	Public Outreach	
	Estimated Public Outreach Costs: What is involved in informing the public about a new code guide?	none identified
	Infrastructure Needs	
	N/A	

Appendix B: Summary of Responses to Survey on Public Sector Cost and Implementation Issues

Barriers	Questions	Answers
Water Related Barriers		
Barrier 2: Collaborate in a neighborhood-scale net zero water pilot project. **Approach:** **2A**. Develop a demonstration ordinance that allows for flexibility within the current codes for a neighborhood-scale development with net zero water goals. **2B**. Require monitoring and reporting of water use and wastewater reduction, and utilize data to support future code updates.	**Staffing Needs**	
	Estimated staff FTE required to develop ordinance: Estimated staff time to review pilot projects water use: Estimated Cost: Who (what department) should be involved in creating a demonstration ordinance? How much time would the creation of a demonstration ordinance involve? What are the opportunities to partner with utilities to minimize reporting? How many projects should be involved in a pilot program (1-2, 3-5, 6+)? Are there existing pilot programs that can be reviewed as a guide?	City Community Planning: 1.0 FTE, $125,000 City: Water Engineers, Sewer/Public Works, Health, Building, Planning, Fire Timing and size: 4 - 6 months, 3 projects max 1 hour bimonthly per home City Water: State Health will need to approve water from non-City sources. Fireflow not feasible to be "off grid" due to volumes/flow rates required. City Transportation: 0.1 FTE for ordinance, and 0.1 to review pilot project
	Training Needs	
	N/A	
	Public Outreach	
	Estimated Public Outreach Costs: How would you advertise the pilot program to encourage a good mix of projects?	City: website, articles, meetings with building industry, stakeholders, targeted mailings
	Infrastructure Needs	
	Estimated Infrastructure Costs: What equipment would be needed to verify water use and waste water reduction? Could the utilities report this information without violating privacy laws? to reduce metering costs? Is there precedence for self reporting of pilot projects?	Individual meters and connection to SCADA system Create a release form City Water: winter flow will give reliable baseline estimate for non-irrigation uses.

Appendix C: Private Sector Costs/Payback Calculations

BUILDING TYPE: **SINGLE FAMILY RESIDENTIAL**
BUILDING LOCATION: **VANCOUVER, WA**

SKANSKA

Base Building Gross SF = **1,840**
Living Building Gross SF = **1,840**
Site Gross Acreage = **0.11**

	Division Premium (%)	Building Premium (%)	LEED™ Gold Baseline		Living Building	
			Total	Cost/SF	Total	Cost/SF
CONSTRUCTION COST						
A Substructure	**0.0%**	**0.0%**	**$63,527**	**$34.53**	**$63,527**	**$34.53**
Baseline Building			$63,527	$34.53	$63,527	$34.53
W2 Rainwater Containment - 10,000 gal Rainwater Tank (included in base building)					$0	
B Shell	**8.3%**	**3.8%**	**$131,226**	**$71.32**	**$142,129**	**$77.24**
Baseline Building			$131,226	$71.32	$131,226	$71.32
E1A Improved Glazing (reduce solar heat gain)					$4,303	$2.34
E1B Exterior Shading Devices					$6,600	$3.59
M2H "High Mass" Concrete (existing exterior walls are ICF)					$0	
C Interiors	**11.6%**	**1.5%**	**$37,430**	**$20.34**	**$41,780**	**$22.71**
Baseline Building			$37,430	$20.34	$37,430	$20.34
M2A Thicken Lower Level Slab (2") and Gypcrete on Upper Level					$4,350	$2.36
L1A Exposed Ceilings (white matte surfaces)					$0	
D.1 Services - Conveying Systems	**0.0%**	**0.0%**	**$0**	**$0.00**	**$0**	**$0.00**
Baseline Building			$0		$0	
D.2 Services - Plumbing Systems	**57.3%**	**2.1%**	**$10,654**	**$5.79**	**$16,754**	**$9.11**
Baseline Building			$10,654	$5.79	$10,654	$5.79
W6 Low-Flow Fixtures / Optical Sensors					$0	
W2 Rain Harvesting (piping & pumps and filtration)					$0	
W7 Composting Toilets					$6,100	$3.32
D.3 Services - HVAC Systems	**98.4%**	**4.1%**	**$12,008**	**$6.53**	**$23,827**	**$12.95**
Baseline Building			$12,008	$6.53	$12,008	$6.53
Baseline HVAC System Reduction (2/3 reduction in Air Handler and Ducting)					($7,381)	($4.01)
M2A In-Slab Radiant Heating and Cooling					$9,200	$5.00
M2B Energy Recovery Wheel / Plate & Frame/Dedicated Outside Air System(DOAS)					$0	
M3C Solar Thermal System					$10,000	$5.43
D.4 Services - Fire Protection Systems	**0.0%**	**0.0%**	**$0**	**$0.00**	**$0**	**$0.00**
Baseline Building			$0		$0	
D.5 Services - Electrical Systems	**68.1%**	**2.4%**	**$10,136**	**$5.51**	**$17,036**	**$9.26**
Baseline Building			$10,136	$5.51	$10,136	$5.51
L2K Provide hardwired compact fluorescent fixtures in all spaces					$2,200	$1.20
L2L Motion sensors for exterior lighting					$300	$0.16
M2Z Ceiling Fans and window box fans (five of each)					$4,400	$2.39

Appendix C: Private Sector Costs/Payback Calculations

BUILDING TYPE: **SINGLE FAMILY RESIDENTIAL**
BUILDING LOCATION: **VANCOUVER, WA**

SKANSKA

Base Building Gross SF = 1,840
Living Building Gross SF = 1,840
Site Gross Acreage = 0.11

		Division Premium (%)	Building Premium (%)	LEED™ Gold Baseline		Living Building	
				Total	Cost/SF	Total	Cost/SF
E Equipment and Furnishings		**0.0%**	**0.0%**	**$1,011**	**$0.55**	**$1,011**	**$0.55**
Baseline Building				$1,011	$0.55	$1,011	$0.55
F Special Construction		**0.0%**	**0.0%**	**$0**	**$0.00**	**$0**	**$0.00**
Baseline Building				$0		$0	
G Sitework		**60.9%**	**4.2%**	**$20,208**	**$10.98**	**$32,508**	**$17.67**
Baseline Building				$20,208	$10.98	$20,208	$10.98
W4 Stormwater Retention / Building Water Discharge						$12,300	$6.68
H Logistics		**0.0%**	**0.0%**	**$3,280**	**$1.78**	**$3,280**	**$1.78**
Baseline Building				$3,280	$1.78	$3,280	$1.78
Living Building Prerequisites				**$0**	**$0.00**	**$13,603**	**$7.39**
PR5 - Materials Red List		**100.0%**	**1.0%**			$2,907	$1.58
PR7 - Responsible Industry		**100.0%**	**2.6%**			$7,488	$4.07
PR8 - Appropriate Materials / Services Radius		**100.0%**	**1.1%**			$3,208	$1.74
PR9 - Leadership in Construction Waste		**0.0%**	**0.0%**			$0	
Subtotal Direct Costs			22.8%	$289,480	$157.33	$355,456	$193.18
General Conditions	9.5%	**22.8%**	**2.2%**	$27,383	$14.88	$33,624	$18.27
Fee, Construction Contingency, Insurance	10.5%	**22.8%**	**2.6%**	$33,399	$18.15	$41,011	$22.29
Sales Tax on Permanent Materials	8.1%	**22.8%**	**1.0%**	$12,767	$6.94	$15,677	$8.52
Location Modifier for VANCOUVER, WA	1.00	**0.0%**	**0.0%**	$0		$0	
TOTAL MODIFIED CONSTRUCTION COST			**22.8%**	**$363,030**	**$197.30**	**$445,768**	**$242.27**

Appendix C: Private Sector Costs/Payback Calculations

BUILDING TYPE: **SINGLE FAMILY RESIDENTIAL**
BUILDING LOCATION: **VANCOUVER, WA**

SKANSKA

Base Building Gross SF = **1,840**
Living Building Gross SF = **1,840**
Site Gross Acreage = **0.11**

					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				0.0%	0.0%			$0	
PV1	Photovoltaic Panels and Infrastructure	5,900	Watts		100.0%	18.3%			$53,100	$28.86
LB Prerequisite Items										
	PR3 - Habitat Exchange	0.114784	acres		100.0%	0.2%			$574	$0.31
	PR6 - Construction Carbon Footprint	50	tons		100.0%	0.2%			$550	$0.30
	PR15 - Beauty and Spirit (included in A/E fees below)				0.0%	0.0%			$0	
	PR16 - Inspiration and Education				100.0%	0.5%			$1,500	$0.82
Development Costs			LEED	LBC						
	Develoment Costs		3.31%	2.69%	0.0%	0.0%	$12,000	$6.52	$12,000	$6.52
	Architecture & Engineering		12.00%	15.00%	53.5%	8.0%	$43,564	$23.68	$66,865	$36.34
Credits / Rebates / Incentives										
	PV Credits-(state, city, utility)	50%			-100.0%	-9.2%	$0		($26,550)	($14.43)
	SDC Credits	50%			-100.0%	-1.0%	$0		($2,966)	($1.61)
	WA State Solar PV Incentive	8,738	kWh		-100.0%	-0.7%	$0		($2,000)	($1.09)
	WA State Solar Thermal (sales tax exempt)				-100.0%	-0.1%	$0		($365)	($0.20)
	Clark Public Utilities Solar Thermal Rebate				-100.0%	-0.3%	$0		($1,000)	($0.54)
	Clark Public Utilities Residential Rebates				-100.0%	-1.5%	$0		($4,225)	($2.30)
TOTAL OWNER & DESIGN-BUILD COSTS						**75.4%**	**$55,564**	**$30.20**	**$97,484**	**$52.98**
				TOTAL CONCEPTUAL COST:			**$418,593**	**$227.50**	**$543,252**	**$295.25**

LIVING BUILDING CONCEPTUAL PREMIUM RANGE: **27%** **TO** **32%**
SINGLE FAMILY RESIDENTIAL IN VANCOUVER, WA

Appendix C: Private Sector Costs/Payback Calculations

BUILDING TYPE: **MULTI-FAMILY HOUSING**
BUILDING LOCATION: **VANCOUVER, WA**

SKANSKA

Base Building Gross SF = 209,678
Living Building Gross SF = 209,678
Site Gross Acreage = 2.87

	Division Premium (%)	Building Premium (%)	LEED™ Gold Baseline		Living Building	
			Total	Cost/SF	Total	Cost/SF
CONSTRUCTION COST						
A Substructure	**10.3%**	**0.3%**	**$622,710**	**$2.97**	**$686,735**	**$3.28**
Baseline Building			$622,710	$2.97	$622,710	$2.97
W2 Rainwater Containment - 30,000 gal Rainwater Tank					$64,025	$0.31
B Shell	**5.0%**	**1.6%**	**$7,656,970**	**$36.52**	**$8,040,942**	**$38.35**
Baseline Building			$7,656,970	$36.52	$7,656,970	$36.52
E1D Reduce Glazing (30% of original window glazing)					$165,200	$0.79
E1A Improved Glazing (reduce solar heat gain)					$12,972	$0.06
E1B Exterior Shading Devices					$468,000	$2.23
D2A Reduce Wall / Skin for Modified Design (not in base building design)					($405,600)	($1.93)
D3 Relocate Elevator					$45,000	$0.21
D3 Covered Walkway					$98,400	$0.47
C Interiors	**5.3%**	**1.3%**	**$5,891,333**	**$28.10**	**$6,205,850**	**$29.60**
Baseline Building			$5,891,333	$28.10	$5,891,333	$28.10
M2A Topping Slab / Stair Premium for Underfloor Radiant System (3" concrete)					$314,517	$1.50
D.1 Services - Conveying Systems	**0.0%**	**0.0%**	**$244,158**	**$1.16**	**$244,158**	**$1.16**
Baseline Building			$244,158	$1.16	$244,158	$1.16
D.2 Services - Plumbing Systems	**8.0%**	**0.6%**	**$1,900,476**	**$9.06**	**$2,052,276**	**$9.79**
Baseline Building			$1,900,476	$9.06	$1,900,476	$9.06
W6 Low-Flow Fixtures / Optical Sensors					$1,800	$0.01
W2 Rain Harvesting (piping & pumps and filtration)					$150,000	$0.72
D.3 Services - HVAC Systems	**387.3%**	**11.5%**	**$717,870**	**$3.42**	**$3,498,260**	**$16.68**
Baseline Building			$717,870	$3.42	$717,870	$3.42
Baseline HVAC System Reduction (2/3 reduction in Air Handler and Ducting)					($535,000)	($2.55)
M2A In-Slab Radiant Heating and Cooling					$1,048,390	$5.00
M3A Ground Source Heat Pump					$1,959,000	$9.34
M2B Energy Recovery Wheel / Plate & Frame/Dedicated Outside Air System(DOAS)					$308,000	$1.47
M2C Carbon Dioxide Sensors					$0	
D.4 Services - Fire Protection Systems	**0.0%**	**0.0%**	**$462,507**	**$2.21**	**$462,507**	**$2.21**
Baseline Building			$462,507	$2.21	$462,507	$2.21
D.5 Services - Electrical Systems	**0.6%**	**0.1%**	**$3,452,618**	**$16.47**	**$3,471,778**	**$16.56**
Baseline Building			$3,416,018	$16.29	$3,416,018	$16.29
L2E Occupancy Sensor for Transient Lighting (corridors/stairs)			$28,000	$0.13		
L2I Dual day/night light levels in corridors; occupancy sensors			$8,600	$0.04		
L2K Provide hardwired compact fluorescent fixtures in all spaces					$55,760	$0.27

Appendix C: Private Sector Costs/Payback Calculations

BUILDING TYPE: **MULTI-FAMILY HOUSING**
BUILDING LOCATION: **VANCOUVER, WA**

SKANSKA

Base Building Gross SF = 209,678
Living Building Gross SF = 209,678
Site Gross Acreage = 2.87

		Division Premium (%)	Building Premium (%)	LEED™ Gold Baseline		Living Building	
				Total	Cost/SF	Total	Cost/SF
E Equipment and Furnishings		**0.0%**	**0.0%**	**$948,170**	**$4.52**	**$948,170**	**$4.52**
Baseline Building				$948,170	$4.52	$948,170	$4.52
F Special Construction		**0.0%**	**0.0%**	**$0**	**$0.00**	**$0**	**$0.00**
Baseline Building				$0		$0	
G Sitework		**6.2%**	**0.6%**	**$2,221,462**	**$10.59**	**$2,358,962**	**$11.25**
Baseline Building				$2,221,462	$10.59	$2,221,462	$10.59
W2 Stormwater Retention / Building Water Discharge						$50,000	$0.24
D3 Added Courtyard						$87,500	$0.42
H Logistics		**0.0%**	**0.0%**	**$0**	**$0.00**	**$0**	**$0.00**
Baseline Building				$0		$0	
Living Building Prerequisites				**$0**	**$0.00**	**$657,243**	**$3.13**
PR5 - Materials Red List		**100.0%**	**0.8%**			$194,424	$0.93
PR7 - Responsible Industry		**100.0%**	**0.8%**			$202,298	$0.96
PR8 - Appropriate Materials / Services Radius		**100.0%**	**1.1%**			$260,521	$1.24
PR9 - Leadership in Construction Waste		**0.0%**	**0.0%**				
Subtotal Direct Costs			18.7%	$24,118,274	$115.03	$28,626,881	$136.53
General Conditions	4.0%	**18.7%**	**0.7%**	$964,731	$4.60	$1,145,075	$5.46
Fee, Construction Contingency, Insurance	4.0%	**18.7%**	**0.8%**	$1,003,320	$4.79	$1,190,878	$5.68
Sales Tax on Permanent Materials	8.1%	**18.7%**	**0.7%**	$950,847	$4.53	$1,128,595	$5.38
Location Modifier for VANCOUVER, WA	1.00	**0.0%**	**0.0%**	$0		$0	
TOTAL MODIFIED CONSTRUCTION COST			**18.7%**	**$27,037,172**	**$128.95**	**$32,091,430**	**$153.05**

Appendix C: Private Sector Costs/Payback Calculations

BUILDING TYPE: **MULTI-FAMILY HOUSING**
BUILDING LOCATION: **VANCOUVER, WA**

SKANSKA

Base Building Gross SF = 209,678
Living Building Gross SF = 209,678
Site Gross Acreage = 2.87

				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%	4.1%			$1,000,000	$4.77
PV1	Photovoltaic Panels and Infrastructure	825,000	Watts	100.0%	25.7%			$6,187,500	$29.51
LB Prerequisite Items									
	PR3 - Habitat Exchange	2.86961	acres	100.0%	0.1%			$14,348	$0.07
	PR6 - Construction Carbon Footprint	6,400	tons	100.0%	0.3%			$70,400	$0.34
	PR15 - Beauty and Spirit (included in A/E fees below)			0.0%	0.0%			$0	
	PR16 - Inspiration and Education			100.0%	0.2%			$43,500	$0.21
Development Costs		LEED	LBC						
	Develoment Costs	28.00%	31.00%	31.4%	9.9%	$7,570,408	$36.10	$9,948,343	$47.45
	Architecture & Engineering	7.00%	9.00%	52.6%	4.1%	$1,892,602	$9.03	$2,888,229	$13.77
Credits / Rebates / Incentives									
	PV Credits-(state, city, utility)	50%		-100.0%	-12.8%	$0		($3,093,750)	($14.75)
	SDC Credits	50%		-100.0%	-1.4%	$0		($343,583)	($1.64)
	WA State Solar PV Incentive	913,844	kWh	-100.0%	0.0%	$0		($2,000)	($0.01)
	WA State Solar Thermal (sales tax exempt)			0.0%	0.0%	$0		$0	
	Clark Public Utilities Solar Thermal Rebate			0.0%	0.0%	$0		$0	
	Clark Public Utilities Residential Rebates			-100.0%	-0.1%	$0		($14,075)	($0.07)
TOTAL OWNER & DESIGN-BUILD COSTS					**76.5%**	**$9,463,010**	**$45.13**	**$16,698,912**	**$79.64**
TOTAL CONCEPTUAL COST:						**$36,500,182**	**$174.08**	**$48,790,342**	**$232.69**

LIVING BUILDING CONCEPTUAL PREMIUM RANGE: **31%** **TO** **36%**
MULTI-FAMILY HOUSING IN VANCOUVER, WA

Appendix C: Private Sector Costs/Payback Calculations

Life Cycle Cost Analysis Worksheet **Project: Single Family Residential** **Location: Vancouver, WA**				***Baseline***		***Living Building***	
Project: **Living Building Challenge Financial Study**				**Estimated Costs**	**Present Worth**	**Estimated Costs**	**Present Worth**
Discount Rate : **4.5%** Date: **5/20/2009**							
Life Cycle (Yrs.) **30**							
INITIAL / COLLATERAL COSTS	Initial/Collateral Costs						
	A. Initial Costs			$ 363,030	363,030	$ 445,768	445,768
	B.						
	C.						
	D.						
	E.						
	F.						
	G.						
	Total Initial/Collateral Costs			$363,030	$363,030	$445,768	$445,768
	Difference						($82,738)
REPLACEMENT / SALVAGE COSTS	Replacement/Salvage (Single Expenditures)	Year	PW Factor				
	A.						
	B.						
	C.						
	D.						
	E.						
	F.						
	G.						
	Total Replacement/Salvage Costs						
ANNUAL COSTS	Annual Costs	Differential Escal. Rate	PW Factor				
	A. Energy Costs	3.0%	24.165	1,609	38,882		
	B. Water Costs	3.0%	24.165	216	5,220		
	C. Carbon Offset						
	D.						
	E.						
	F.						
	G.						
	Total Annual Costs			$1,825	$44,102		
LIFE CYCLE COSTS	Total Life Cycle Costs (Present Worth)				$407,132		$445,768
	Life Cycle Cost PW Difference						($38,636)
	Discounted Payback (Living Building vs. Baseline)						**30.6**
	Total Life Cycle Costs - Annualized			Per Year:	$24,994	Per Year:	$27,366

Appendix C: Private Sector Costs/Payback Calculations

Life Cycle Cost Analysis Worksheet
Project: Multi Family Residential
Location: Vancouver, WA

					Baseline		***Living Building***	
Project:	**Living Building Challenge Financial Study**				**Estimated Costs**	**Present Worth**	**Estimated Costs**	**Present Worth**
Discount Rate :	**4.5%**	Date:	**5/20/2009**					
Life Cycle (Yrs.)	**30**							
INITIAL / COLLATERAL COSTS	Initial/Collateral Costs							
	A. Initial Costs				$ 27,037,172	27,037,172	$ 32,091,430	32,091,430
	B.							
	C.							
	D.							
	E.							
	F.							
	G.							
	Total Initial/Collateral Costs				$27,037,172	$27,037,172	$32,091,430	$32,091,430
	Difference							($5,054,258)
REPLACEMENT / SALVAGE COSTS	Replacement/Salvage (Single Expenditures)		Year	PW Factor				
	A.							
	B.							
	C.							
	D.							
	E.							
	F.							
	G.							
	Total Replacement/Salvage Costs							
ANNUAL COSTS	Annual Costs		Differential Escal. Rate	PW Factor				
	A. Energy Costs		3.0%	24.165	143,888	3,477,087		
	B. Water Costs		3.0%	24.165	10,443	252,358		
	C. Carbon Offset							
	D.							
	E.							
	F.							
	G.							
	Total Annual Costs				$154,331	$3,729,445		
LIFE CYCLE COSTS	Total Life Cycle Costs (Present Worth)					$30,766,617		$32,091,430
	Life Cycle Cost PW Difference							($1,324,813)
	Discounted Payback (Living Building vs. Baseline)							**22.1**
	Total Life Cycle Costs - Annualized				Per Year:	$1,888,810	Per Year:	$1,970,142