The Application of Information and Incentives as Tools to Promote Green Affordable Housing Development

by

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Bachelor of Architecture
Tsinghua University, 1999

Submitted to the Department of Urban Studies and Planning and the Department of Architecture in partial fulfillment of the requirements for the degrees of

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and
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Abstract

This thesis examines development barriers to green buildings, particularly to green affordable housing. Green buildings offer intangible benefits in the form of improved environment and health through better air quality. Certain green features also offer significant life-cycle operating savings. These advantages are particularly valuable for affordable housing projects, where low operating costs are critical to affordability and higher indoor air quality is beneficial to modest-income residents that can rarely affect the quality of their living environment. Furthermore, there are many monetary, regulatory, and technical regulations and incentives in the U.S. to promote green building development. Notwithstanding the above advantages and supports, green affordable housing is not yet standard practice.

Information and incentives are identified as two of the most important and easy-to-implement tools to promote green affordable housing development. Examples of available information and incentive mechanisms in the U.S. are briefly presented for the green affordable housing industry. Meanwhile, gaps and dysfunctions in the application of these tools are identified as development barriers. The Upham's Corner Marketplace Redevelopment in Massachusetts is presented as an example of a green affordable housing project.

Finally, recommendations are made to better utilize information and incentives as tools to promote and sustain green affordable housing development. A green guarantee program, with more efficient information collection and incentive application, is proposed as a means to simplify and standardize certain aspects of the development process for green affordable housing to lower project risks, and to encourage investors and developers to produce more green affordable housing.

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I. INTRODUCTION

With more awareness of environmental issues and advanced technologies, sustainable development is becoming the main trend in the building industry. However, with low profit margins and regulatory burdens, green affordable housing development appears to be particularly constrained by perceived high initial costs to implement green features. This thesis addresses the fundamental barriers to green affordable housing development and demonstrates green benefits as well as available information and incentive tools for green affordable housing development. Finally, a green guarantee program is proposed as a means to utilize the existing tools more collaboratively to facilitate public education, best practices, and access to conventional financing, in order to expedite the process of green revolution in the affordable housing industry.

A. Sustainable Development and Green Building

1. Energy consumption

- "Energy use of the human economy grew sixty-fold between 1860 and 1985, and is projected to grow by another 75% by 2020."[1]
- "U.S. is 4.5% of world's population and consumes 25% of the world's energy."[2]

With the growth in population and the warming climate, energy consumption is increasing. For example, when temperatures in urban centers increase, more energy is needed because of the greater demand for air conditioning. Both energy consumption and pollution increase as power plants burn more fossil fuels. The following diagram (see Figure 1) from the Heat Island Group shows the correlation between temperature and power consumption.

[1] Donella Meadows, Dennis Meadows, Jorgen Randers, *Beyond the Limits, An Executive Summary*, 1992.
[2] Lester Brown, Michael Renner, Brian Halweil, Worldwatch Institute, *Vital Signs* 1999.

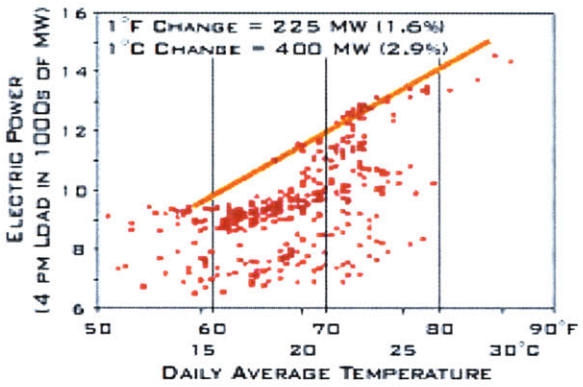

Figure 1: The increased summertime temperatures increased cooling requirements. The data is the peak load for Southern California Edison in 1988.

In the developing world, more dramatic increase of energy consumption is predicted. For example, a report[3] from the Development Research Centre of the State Council (DRCSC) says that demands on energy will surge dramatically in China over the next two decades, a critical period in which China must realize its goal of industrialization. According to the report, China has become the second largest energy-consuming country in the world, with 1.48 billion tons of standard mine coal used in 2002, while the energy reserves per capita in China are far less than the world average. Experts suggest improving the efficiency of energy use, developing other types of energy resources, and using energy other than petroleum, such as natural gas, hydropower, solar energy, and wind power.

2. Sustainable development

With soaring energy consumption, sustainable development has gained increasing attention. It is defined differently in different contexts, but the objective is consistent. Sustainable development promotes *"development or practices that accommodate social, environmental, and economic needs using a balanced approach that strives to achieve vitality in all three."*[4] The following are practices often adopted for sustainable development.

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[3] *China Daily*, Dec. 15th, 2003

[4] Glen T. Daigger, Dave Burack, and Vincent Rubino, "Sustainable development of wastewater infrastructure", 2001

- "Increased energy conservation and efficiency
- Increased use of renewable energy resources
- Reduction or elimination of toxic and harmful substances in facilities and their surrounding environments
- Improvements to interior and exterior environments leading to increased productivity and better health
- Efficiency in resource and materials utilization
- Selection of materials and products based on their life-cycle environmental effects
- Increased use of materials and products with recycled content
- Recycling of construction waste and building materials after demolition
- Reduction in harmful waste products produced during construction
- Facility maintenance and operational practices that reduce or eliminate harmful effects on people and the natural environment. "[5]

The U.S. government is trying to have manufacturers and developers develop greener projects through renewable energy technologies, such as photovoltaic (PV) and wind power. But studies show that the current cost of PV is too high to justify its use through energy savings, especially in the U.S. where electricity prices are comparatively low. Fortunately, because of better technology, more experience with installation, and economies of scale, the costs for implementing new green technologies are decreasing. For example, PV cost decreased 50% from 2002 to 2004, and is predicted to decrease another 50% from 2004 to 2009. In the future, PV will become economically feasible, as PV prices decrease, energy prices soar, and more advanced Building Integrated PV (BIPV) technologies are developed. Other advanced features, such as the utilization of digital technology in homes, could also make economic sense as the prices of sensors and other digital components decrease due to improved technologies and economies of scale.

3. Green building, green design, and green features

- "54% of U.S. energy consumption is directly or indirectly related to buildings and their construction"[6]
- "Over 30% of the total energy and 60% of the electricity use in the United States is in buildings"[7]

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[5] "Navy at the Leading Edge of Green Design", Story in EBN Vol. 7, No. 10, November 1998

[6] *Sustainable Construction in the United States of America*, a report from the Georgia Institute of Technology, 1998.

- In some regions of the U.S., 40% of landfill space is taken up by construction and demolition debris, at least half of which could have been recycled[8].

Resource savings in buildings can have huge effects on sustainable development. Green building, as defined by the Office of the Federal Environmental Executive, is "the practice of 1) increasing the efficiency with which buildings and their sites use energy, water, and materials, and 2) reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal – the complete building life cycle." [9]

According to the United States Green Building Council (USGBC), green design is defined as design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas[10]: sustainable site planning, water and water efficiency, energy efficiency and renewable energy, conservation of materials and resources, and indoor environmental quality.

With advanced technologies, more green features have been developed to achieve the goals of green design. More environment-friendly materials have been invented, and materials can be recycled and used more efficiently through modular manufacturing. For instance, plastic lumber, engineered wood, fiber cement siding, etc., help to conserve natural resources. Natural fiber carpets, low-VOC and low-toxic interior finishes and appropriately designed ventilation systems can improve indoor air quality. Furthermore, the environment and natural resources will also benefit from more advanced technologies such as food recycling chutes, porous paving schemes, and rainwater collection. New technologies available to conserve material and energy usage also include advanced framing, high efficiency water heaters, efficient household appliances, and air sealing.

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[7] Ibid.
[8] The SPUR Sustainable Development Committee, *Green Buildings: Bringing Environmentally Sensitive Design to San Francisco.*
[9] Office of the Federal Environmental Executive, "The Federal Commitment to Green Building: Experiences and Expectations," 2003.
[10] Vanderveil Engineers, http://www.imakenews.com/vanderweil/e_article000062353.cfm

Among the available green features, energy efficiency is particularly popular because of the early regulations for energy efficiency and the fact that energy efficiency features have economic benefits that are more tangible than many other green features. In a previous MIT thesis study[11], a survey of developers and tenants was conducted, asking what green building technologies are most promising. It showed that both developers and tenants rated energy efficiency as the most promising green feature. Approximately 88% of the developers and 78% of the tenants also agreed that the use of daylight instead of electric lighting is a good green feature.

Owners can have fast payback for their green investment through greatly reduced operating costs. Surveys[12] of housing consumers show that consumers are well aware of the environmental benefits and energy savings of green homes. Their willingness to pay more for these features should encourage the development of green technologies from the demand side.

Many other surveys also show people's growing interests in green housing as well as lack of knowledge in practice. Research in green building has been done through organizations, consultants, and academic papers.

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[11] Richard J. Donovan, "Green Building Technologies: Should a Developer Implement Photovoltaics, Underfloor Air Distribution, and Natural Ventilation?", 1996

[12]

- In 1998 and 1999, surveys of consumers in Kitsap and Clark counties showed that 69% of buyers in both counties were willing to pay more for a house that generated lower utility bills. Of those surveyed, nearly 88% wanted more energy efficient homes built and equipped with energy saving appliances.
- In 1998, Pulte Tucson Division Survey found that 69.9% of buyers would spend an additional $1200 to $1500 for upgraded energy efficiency if it would result in annual utility savings of $300.
- In a 1997 Homebuyers Survey nearly half (47%) reported environmental features were as important as location and price in the decision to purchase homes built by McStain Enterprises of Denver, Colorado, a green builder enrolled in the Metro Denver HBA's Built Green™ Program. McStain's homes, priced near $150,000, were slightly more expensive than others in the development, but were the fastest selling.
- A 1996 Survey of home shoppers conducted by the NAHB and Fulton Research Inc. lists energy efficiency as one of the ten top items buyers want. In a 1999 NAHB Survey on Growth Issues, 88% of consumers surveyed indicate that builders/developers should build more energy efficient homes and equip them with energy-saving appliances.
- In a 1995 survey of 1350 real estate agents by Bank America Mortgage, 84% reported home sites with trees to be 20% more salable, and other studies reveal trees add 30% to the selling price of lots.
- A 1993 Professional Builders "Consumer Survey on Housing" reported 53% of consumers are willing to pay $1000 to $5000 more for healthy house features.

Preceding quoted from: http://www.builtgreen.net/certification.html

4. Previous green development research

a. MIT thesis research in green development

William Dee Browning (1991)[13] offered a chronology of environmental issues related to real estate development. He proposed that integrating environmentally responsive features into a project does not significantly raise the cost of the development. Through three community development case studies, it was proven that both the choice of measures and the timing of application affect the costs. The earlier the measures were chosen, the lower the costs were. Meanwhile, the value of the property increased as green features were integrated.

Patrick Field (1994)[14] used a coalition of New England environmental groups to explore negotiations among environmental advocacy groups. He concluded that these groups represent a broad spectrum of interests and values. Negotiations among them are complex with tensions and competition for money, publicity, leadership, etc., as well as shared interests in joint funding, joint public images, joint expertise, and a common vision of the future.

Christopher Trevisani (1998)[15] tried to translate environmental technologies into added value to a real estate development. He argued that energy and water efficiency increased Net Operating Income (NOI) of the asset, based on 100 case studies in different real estate development sectors.

Maia A. Hansen (1998)[16] examined the increasing demand for environmental and health improvements in construction, identified investment opportunities that satisfy the market changes, and developed a framework to analyze major green issues across top market segments. He addressed four major concerns in green building: energy efficiency, water conservation, indoor air quality, and material conservation and reuse.

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[13] William Dee Browning, *Green development: Determine the cost of environmentally responsive development*, 1991

[14] Patrick Field, *How green is green? Conflict and collaboration among environmental advocacy groups*, 1994

[15] Christopher Trevisani, *The effects of environmental technology on real estate development : how to increase asset value through the implementation of innovative environmental technology*, 1998

[16] Maia A. Hansen, *Building green: investment opportunities in sustainable construction materials,* 1998

Michael Eugene Finch (1999)[17] focused on the intangible benefits of green features, including productivity and health improvements. His qualitative analysis is more development-related than building-related.

Rocelyn Dee (2002)[18] had a more technical approach to the green building issue. She conducted two case studies, one with energy-efficient façade systems and the other as a comparative case. Through comparison of their economic performances, the proposed systems, which are widely used in Japan and Europe, are found to be not cost effective in the U.S. because of low energy prices.

Marc A. Harik (2002)[19] examined policies and incentive programs for developers to promote green development. It was concluded that tangible benefits of green features can only bring the green investment to the break-even point, and intangible benefits including better productivity and health need to be evaluated to initiate a green revolution in the building industry. The thesis proposed an Indoor Environment Quality (IEQ) certification system that was further tested on a figurative case study and found that productivity and health benefits from green improvements can successfully promote green development.

Meredith Sue Elbaum (2003) [20] bridged the disconnect between design professionals and resources available for green design by disseminating resources to the appropriate professionals to assist them in green design decision making during the design process.

b. Research and resources by organizations and consultants

Many studies were conducted through organizations focused on "greening" the industry including the United States Green Building Council (USGBC), the Coalition for Environmentally Responsible Economics (CERES), the Smart Growth Network, the Urban Land Institute (ULI), the Natural Step, and the Green Building Council (GBC). There are

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[17] Michael Eugene Finch, *Green realities: the financial opportunities of environmental sensitive development in the commercial real estate development industry*, 1999

[18] Rocelyn Dee, *Financial analysis of energy-efficient façade systems for application in commercial office developments*, 2002

[19] Marc A. Harik, *Green development: creating incentives for developers,* 2002

[20] Meredith Sue Elbaum, *Bridge green: bridging the disconnect between design professionals and resources fro environmentally, socially, and economically responsive architecture*, 2003

also green building consultants including Rocky Mountain Institute (RMI), Center for Maximum Potential Building Systems (CMPBS), Green Roundtable (GRT), etc. Numerous tools are available for green building design in product comparison, building design or decision support, and whole building assessment frameworks.

Some research has been conducted on green development including:

- Lists of the sources of green development information, including green initiatives, materials, governmental programs, etc.
- Manuals showing the procedures to implement the green features. Some are for industry professionals and some for homeowners to improve their homes.
- Cost-benefit of green building (mostly commercial and institutional buildings) with case studies.

Gregory Kats, a founding principal of Capital E, Washington, D.C., conducted the most recent and definitive cost-benefit analysis of green building, *The Cost and Financial Benefits of Green Building*, October 2003. It sought to define, document, and analyze the costs and financial benefits of green buildings, and demonstrates that sustainable building is a cost-effective investment: "The average premium for these green buildings is slightly less than 2% (or$3-5/sf), substantially lower than is commonly perceived. The majority of this cost is due to the increased architectural and engineering design time necessary to integrate sustainable building practices into projects." It is safe to say that as more experiences accumulate through practices, this architectural and engineering design time will decrease and the green premium will be lowered gradually.

However, there seems to be little, if any, information about Life Cycle Cost analysis for green affordable housing projects. Tellus Institute and Green CDCs Initiative collected data on four green affordable housing projects and conducted cost-benefit analyses in May 2003, finding that green homes provide residents with utility savings, and improved comfort and health, and do not have to cost more than comparable homes built in the traditional way.

More case studies for green affordable housing need to be conducted to have statistically significant results. Showing the feasibility of affordable housing implementing green building components will have a huge effect on not only affordable housing

development but also the overall building industry, proving that the modern building industry could and should be able to achieve significant energy efficiency through green development at all levels.

B. Introduction to Green Affordable Housing

1. Green affordable housing

Housing is one of the most powerful forces in the economy, especially during economic recoveries, when housing's impact on the economy accounts for up to 30% of the change in the Gross Domestic Product (GDP). Among the total household wealth in the United States, housing accounts for the largest portion, 31%. Savings on housing will have a huge effect on the economy and people's living standards. Moreover, compared to commercial real estate development, housing projects are more clustered, and thus have potentially greater impact on the environment. Since housing accounts for the highest proportion of the total floor area among all property types, basic green features implemented in housing will cultivate appreciation of green development concepts among the largest number of people.

Affordability is one of America's biggest housing challenges. According to the 2001 American Housing Survey, 14.3 million households, or one in seven, spend more than half their incomes on housing, and households with one full-time minimum wage earner cannot afford to rent a modest one-bedroom apartment anywhere in the country[21]. The affordability problem has worsened over the past 25 years. Rising energy costs, diminishing available land, and increasing housing prices are causing more and more concern in the housing market. For example, Low Income Housing Tax Credit projects in New York are facing the problem of increasing utility bills and controlled rent. When the deals are to be reconstructed after 15 years, and non-profit organizations are to take over the projects, many projects will not be able to maintain positive cash flow for another 15 years because of increasing operating costs and limited rental income.

[21] Joint Center for Housing Studies of Harvard University, 2003

Meanwhile, green features are particularly valuable for affordable housing projects, where low operating costs are critical to affordability: homes need to be affordable not only when they are built but also throughout their lives. There is a range of green features, some of which do not cost much more and can have positive effects on future cash flows through operating savings. Other green features can provide intangible benefits such as higher indoor air quality to residents that have modest-income and can rarely affect the quality of their living environment. Furthermore, many grants, subsidies, and technical assistance are offered to lower green premiums for affordable housing development.

However, affordability is still often perceived to conflict with green development, which is conventionally thought to be expensive and high tech with a hefty price premium. It has been traditionally perceived that *green* sounds and looks unusual, needs additional and special maintenance, and does not necessarily fit into our normal lives. Therefore, people often do not bother looking at available green techniques when developing affordable housing – the two are not thought to be compatible.

Fortunately, some green affordable housing projects have recently been developed around the country. According to Tellus Institute / Green CDCs Initiative's case study, "...green affordable housing can be constructed and operated at costs comparable to conventional affordable housing. While initial costs of green projects may be slightly higher than for conventional projects, savings in operating cost over the life of the buildings generally offset any incremental initial costs."[22] It also pointed out that since green affordable housing practice is relatively new, project teams need to make extra efforts in design, specifications, supervision, monitoring, budgeting, coordination, and commitments.

2. Case background – The Upham's Corner Market project [23]

Upham's Corner is a village in Dorchester, Boston, with 7,200 racially and ethnically diversified residents. The median family income and the home ownership rate (28.6%) are lower than that of the larger Dorchester neighborhood (35.8%) and the City of Boston (30.7%).

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[22] Tellus Institute / Green CDCs Initiative, "The Costs and Benefits of Green Affordable Housing: Opportunities for Action", May 2003.

[23] Kimberly Vermeer, *Upham's Corner Markeplace Redevelopment: Toward High-Performance Affordable Multifamily Housing*, November 2003

Once the largest grocery market in the U.S., the former Upham's Corner Market is a National Historic Register property. It is a classic mixed-used redevelopment project, developed by New Atlantic Development Corporation, and designed by Icon Architects, Inc. With input from local neighborhood groups, the community-identified needs included affordable housing and high-quality retail space along Columbia Road, as well as elderly housing. The program includes 30 units of affordable rental housing with tax-credit, 14 units of elderly housing, one staff apartment, 9,000 sf of rental/commercial space along Columbia Road and Ramsey Street, and 21 unenclosed parking spaces. With technical and financial support from KeySpan Energy Delivery, the EnergyStar Homes program and NStar, the Upham's Corner Market project meets many of the goals of green housing, especially energy efficiency. It provides an excellent case to identify the issues encountered when implementing green features into the design of affordable housing. As the primary high-performance focus in the project, energy efficiency was achieved through three areas:

- "Upgrading the building envelope
- Upgrading the HVAC and Domestic Hot Water systems
- Reducing "plug load" – lighting and appliances"[24]

Details of the upgrade elements are listed in the appendix and the cost-benefit data will be discussed in the following chapters.

[24] Ibid

Figure 2: The Upham's Corner Market project, photograph by Kimberly Vermeer

II. GREEN AFFORDABLE HOUSING DEVELOPMENT BARRIERS

A. Barriers to Green Building Development

People often ask the question: "If green housing is cost effective and beneficial to our environment, why it is not yet being widely developed as standard practice?" The answer is that things take time. Buildings are fixed assets that require a large amount of investment, and involve many industry professions and governmental agencies. Therefore, even if people are aware of the benefits of green housing, the utilization of green features lags their availability, partly due to the many barriers in green building development process. The barriers can be generally divided into four categories: general building industry issues, lack of information, design / development, and financing issues.

1. General building industry issues
    a. Conservative building professionals

The building industry is sluggish, both in the economic world and in the technological world. Buildings, as fixed assets, take a long time and a large amount of money to build. To control the risks, developers are cautious and prefer to replicate models that have been proved to be successful over time; design and building professionals tend to do things as they learned to do them. There are small changes, but big experiments are often not preferred.

    b. Code barriers

Building codes are always revised over a long period of time and do not necessarily match the current technologies in the building industry. Most housing projects simply built to code are not energy efficient. For instance, published and maintained by the International Code Council (ICC) as the "International Energy Conservation Code" (IECC) as of 1998, the Model Energy Code (MEC) contains energy efficiency criteria for new residential and commercial buildings and additions to existing buildings. However, a home built to the 1993 MEC consumes 40% more energy in its heating, cooling, and

water heating than a comparable Energy Star[25] labeled home[26]. Moreover, sometimes certain building codes even make green features difficult to apply in practice.

2. Lack of information

    a. Limited information

There is no national consensus on a definition and guide for green residences[27]. There is a lack of well-documented case studies of green housing projects and a lack of life-cycle cost-benefit analysis of the available green features. Even some of the energy saving programs like Energy Star that provide technical assistance, grants, and rebates, do not provide enough cost-benefit data on green savings. The model that Energy Star Program uses, REMRate, produces a composite score that does not translate directly back in a dollar, KW, or therm savings level[28] that could help developers, investors, and underwriters to understand and take into account the savings from green practices.

    b. Performance uncertainties

Some of the green features have not been in the industry long enough to prove the longevity of their benefits, and there is no reliable, and unbiased source of information available to market actors concerning the performance of energy-efficient designs or technologies[29].

    c. Perceived higher initial costs

The additional costs of green features vary extensively. Some green features are basically good design methods and do not result in any extra cost. For example, orienting a building to take advantage of (or to avoid) sunshine and local prevailing wind is the first and easiest configuration to begin with. Some green features, like renewable energy technologies, are very expensive and cannot, in many cases, be applied without

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[25] As a joint effort of the Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE), Energy Star is a nationally recognized, voluntary labeling program to identify and promote energy efficient products to consumers and business owners across the United States.

[26] Energy Star Labeled Manufactured Homes: Design, Manufacturing, Installation and Certification Procedures, 2003.

[27] Greg Kats, The Costs and Financial Benefits of Green Buildings, October, 2003.

[28] Kimberly Vermeer, *Upham's Corner Markeplace Redevelopment: Toward High-Performance Affordable Multifamily Housing*, November 2003

[29] National Resource Defense Council, Commentary and Q&A on Tax Incentives for Energy Efficient Buildings Legislation S. / H.R. 778

substantial financial support. In addition, some green techniques provide mainly intangible benefits, like improved health through better indoor air quality, and these social and environmental values are sometimes not in the financial interests of decision makers.

However, many green technologies, including better insulation and high efficiency equipment, can pay for themselves over a short period of time through operating savings. But the life-cycle benefits need to be well recognized to outweigh the perceived high initial cost.

3. Design / Development
    a. Lack of incentives for design professionals

Design professionals are often paid based on a percentage of the project cost (i.e., architects are paid a percentage of the hard cost, while mechanical engineers are paid a fee based on the mechanical equipment cost), instead of being based on savings. Essentially rewarded for inefficiency and penalized for efficiency[30], even designers that advocate for green buildings may not make the *right* decision.

    b. Difficulties sourcing green features

According to a survey[31] of architects, contractors, engineers, and owners, when asked "Do you have trouble sourcing green products", 55% of the people surveyed said yes, 29% said NA / Do not know, and only 16% said no. Among the people who have trouble sourcing green products, 81% think "green" is not always clearly defined, 47% do not know what is really green, and 39% do not know where to look.

There are often no consensus green guidelines for designers and specifiers to pick the right green strategies for their jobs. Many claims from manufactures are not validated, while existing rating and certification programs have different definitions and preferences of green features. Among the designers that advocate for green buildings, some use design software to initiate a list of possible green strategies applicable, but the software may not be designed to match the project's location and building type; some compose the list of green features through accumulated experience, but the application of new features may lag their availabilities.

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[30] Diane Wintroub Calmenson, Green Design Makes Dollars and Sense.
[31] Building Design & Construction White Paper Survey, source: Reed Research Group, September 2003.

c. Lack of collaborative efforts and commitment at the early stages

Green features need to be considered at the earliest stage of the project, with design input from not only the architects but also other professionals such as mechanical, electrical, and civil engineers, and landscape architects. The earlier the green features are considered and developed by all professionals collaboratively, the lower their costs. However, owners and developers often do not see the value of engaging a large team to focus on green issues at the beginning of the design process. According to an architect interviewed, "green design is the easiest part, while many green design features can be taken out and credits can be lost along the way of design and development". Without everyone on board and committed to green design at the early stage of the development, design development can be very frustrating, and projects aimed at LEED gold rating can end up with silver rating or lower.

4. Financing

a. Long-term operating savings not reflected in the market

It is commonly perceived that green housing costs more and the "green savings" have not been solidly established. Some existing programs that provide home energy performance ratings do not want to guarantee and take responsibility for the future savings. Although there are some guarantees of energy savings for two years (e.g. SystemVision™ Home Program Comfort and Energy Use Guarantee) and some product warranties for 2-5 years, these short periods of time do not match the investment horizon of permanent lenders. Therefore, without experience of, or a guarantee for, the savings from green practices, lenders and underwriters often consider the monthly savings as an additional cushion to the project cash flow, and are not willing to convert them into higher loan amount to help pay for the green features.

In the Upham's Corner Market project, the operating costs are as follows:

Exhibit 1: The Upham's Corner Market project Operating Expenses

	Estimation*	2002 actual	2002 savings	2003 actual	2003 savings
Electricity	$ 10,800	$ 30,300	$ (19,500)	$ 26,161	$ (15,361)
Gas	$ 32,400	$ 18,000	$ 14,400	$ 29,166	$ 3,234
Water	$ 27,000	$ 12,000	$ 15,000	$ 15,427	$ 11,573
Total	$ 70,200	$ 60,300	$ 9,900	$ 70,754	$ (554)
* The pro forma estimation at closing based on the developer's previous experience					

The actual electricity cost is higher than the developer's original estimate, possibly due to the central AC chiller. Based on the MassHousing loan term of 40 years @ interest rate of 7.4%, the savings on gas and water costs, can support an additional loan amount of $312,037 (based on 2002 savings) or $157,154 (based on 2003 savings), both of which are higher than the upgrade cost of $122,189!

b. Interests not well-aligned

Many developers, particularly fee-based developers, have short interests horizons. If future additional cash flows from green savings are not counted into the current value of a project, it does not make economic sense to developers to implement green features into the projects. With a higher initial cost, but the same property value, profits are lower, while over the long run, the renters who pay utility bills get all the benefits of the green savings. If a building owner passes energy costs to tenants on a pro-rata basis, neither the owner nor the tenants are motivated to invest in energy efficiency because the savings will be shared among all the (other) tenants. In the cases when owners pay utility bills, they have the incentives to implement green features to save energy, but tenants are still not motivated to use energy prudently.

c. Lack of marketing for financing tools

"The major energy efficient mortgage programs are run by national government departments or government-regulated organizations including Fannie Mae, Freddie Mac, HUD, Veterans Association, and EPA. These programs can, in theory, be accessed through any of the banks affiliated with these programs. However, marketing for the programs is virtually nonexistent – none of the corporate banks listed as program affiliates have descriptions of this mortgage option on their own websites, though several smaller and internet-based mortgage lenders do. This lack of marketing is noted in many analyses of the energy efficiency mortgage structure." [32] The financing tools are well constructed and carefully put in place, but the lack of marketing poses a serious barrier to the financing accessibility.

[32] Massachusetts Technology Collaborative, *Energy Efficient Mortgages*

d. Subsidy/rebate programs as double-edged swords

Subsidies for green development and related rebate programs are double-edged swords; although they promote green development, they also promote the perception of higher cost of the green features, and may handicap green development in the long run. Therefore, green features need to be measured independently from the subsidy programs to prove their economic feasibility. For example, in the Upham's Corner Market project, the operating savings from the green practice could have supported a potential higher loan value to cover the upgrade cost, had the green features been evaluated appropriately. If there were no subsidies or rebates, the green features would still have made economic sense.

These barriers need to be examined and addressed systematically through creative and collaborative programs to promote the overall green upgrade of the building industry.

B. Barriers to Green Affordable Housing Development

Besides the barriers to green building development cited above, there are additional barriers to the implementation of green features in affordable housing, mainly because of developers' and investors' higher sensitivity to initial costs, complicated financing structures, strict project budgets, organization capacity, and misaligned interests among developers, owners, and residents.

a. Perceived higher initial costs and lack of awareness

For affordable housing, perceived higher initial costs are particularly a barrier to implementing green features. Affordable housing projects have very low profit margins and have to meet numerous regulatory requirements with tight budgets. With the traditional perception of high price tags and the lack of the potentially positive awareness of cost-benefit characteristics of green features, *green* and *affordability* are often not perceived to be achievable at the same time. In other words, green affordable housing is often not perceived as economically feasible. Hence stakeholders in the affordable

housing industry, especially conventional lenders, are not keen to research on available green features.

b. Regulatory burdens and complexity of affordable housing finance

For affordable housing development, regulatory burdens and contracting constraints increase with the utilization of government funding. Funders often place a ceiling on development cost due to limited funding sources for affordable housing projects and require a minimum level of operating expense projected conservatively to reduce loan risk. Therefore, the higher initial costs and lower operating costs of green features often do not match the lending requirements. In addition, multiple funding sources have to be coordinated for affordable housing projects, which makes it hard to get all the lenders to buy into the special cost-benefit features of green technologies to facilitate new underwriting guidelines.

c. Limited development/maintenance capacity and resources

With comparatively fewer green projects in their portfolios, many Community Development Corporations (CDCs) and others that develop and maintain affordable housing have limited organizational capacity and specialized experience with green features. Therefore, initial costs may be higher because of a steep learning curve, and replacement cost and project risk may be higher due to the lack of maintenance expertise. For example, in the Upham's Corner Market project, a heat recovery ventilator (HRV) was incorporated into the fresh air ventilation system to save energy by extracting heat from the incoming air in the cooling season and capturing heat from the exhaust in the heating season, before fresh air is conditioned and distributed. Unfortunately, this ventilation system failed several times. Since the building envelope is also very tight with a high insulation level to save energy and the development budget only allowed one ventilation system, when this HRV system failed, the tenants suffered from the poor indoor air quality until it could be repaired. Although HRVs are used in other types of buildings, especially those that require consistent air quality like hospitals and other institutional buildings, there are fewer operating problems because there are back-up systems in place and more sophisticated maintenance personnel and service regimes that affordable housing managers often do not have.

d. Misaligned interests

Furthermore, there are often misaligned interests between the stakeholders. Some stakeholders pay for high performance features, while other stakeholders benefit. For example, the upgrade cost at the Upham's Corner Market project was $122,189, covered by grants and rebates from KeySpan, Energy Star, and NStar (Exhibit 2). Were there not these programs, the green features would not have been put in place, because interests were not well aligned.

Without taking into account the future operating savings, traditional underwriting criteria did not allow a higher property value. Therefore, other than the developer's profit, there was no other funding source for this $122,189 additional cost. Although the upgrade cost was modest at 1.4% of the Total Development Cost ($8,717,766) or 2.1% of the total hard costs ($5,931,129), it could have been 26% of the developer's profit ($468,746) or 64% of the developer's net payable profit ($189,883). Developers do not have incentives to lose this much profit and leave the benefits to the tenants and owners.

Exhibit 2: The Upham's Corner Market project Upgrades Costs[33]

KEYSPAN ENERGY DELIVERY	
Boiler, DHW upgrades, controls	$ 8,730
Heat Recovery Ventilator	$ 44,296
Roof Insulation Upgrade	No added cost
EnergyStar® Homes	
Wall insulation	$ 14,608
Add argon gas to windows	$ 7,781
Added design cost	$ 4,166
NSTAR	
Lighting upgrade to compact fluorescents	$ 35,328
EnergyStar® Appliance rebates	$ 7,280
TOTAL	**$ 122,189**

The upgrade cost **$ 122,189** = **1.4%** of the TDC ($8,717,766)

= **2.1%** of the total hard costs ($5,931,129)

= **26%** of the developer's profit ($468,746)

= **64%** of the developer's net payable profit ($189,883)

[33] Kimberly Vermeer

In addition to these misaligned interests between short-term and long-term stakeholders, there may be objections from lenders and investors. Since developer's profit is often deferred to fill funding gaps and sometimes serves as an extra cushion against project risk, lenders and investors do not want developers to spend their profit to implement green features without increasing the property value, even if developers are willing to do so. In the Upham's Corner Market project, the green features were implemented into design *after* all the financing sources were confirmed. The lenders were happy with the green features as long as others, the rebate and subsidy programs, covered all the incremental upgrade costs.

C. Tools for Government Actions

Sustainable development needs to be promoted by strong leadership. Government, with the ultimate power of regulation and tax policies, financial strength, political connections, and responsibilities for a country's economic and environment, should play an important role in promoting green development. It is argued that there are five distinct tools that government can use to implement their urban design and development policies[34]:

1)	Ownership and Operation	"The state will do X."
2)	Regulation	"You must (or must not) do X."
3)	Property rights	"You have a right to do X, and the state will enforce that right."
4)	Incentives (and disincentives)	"If you do X, the state will do Y."
5)	Information	"You should do X," or "You need to know Y in order to do X." [35]

Each tool will entail a different relationship between government and decision makers in these disciplines. Government can realize its goals by direct *ownership and operation*, but its often bureaucratic system may be inertia and lack the initiative and motivation of direct stakeholders. Green development should be an operation of the whole building industry. Government can have some ownership and operation, but it can have much broader effects and more leverage of private investments by utilizing the other

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[34] J. Mark Schuster with John de Monchaux and Charles A. Riley II, editors, *Preserving the Built Heritage: Tools for Implementation*, 1997
[35] Ibid

four tools. *Regulation* can be applied more broadly and effective, but there are high costs to ensure compliance and there are *minimum* performance requirements, not *optimal.* Furthermore, not allowing trade-offs, it is not flexible. *Property rights* also have high compliance costs, while development rights transfer can be seen as a hybrid of a property right tool and an incentive tool. [36]

Information and *incentives*, which can save government the costs of ownership, compliance enforcement, and administration, are believed to be the least expensive and most effective tools. As identified earlier, most barriers to green development are more or less related to the lack of information. Therefore, *information* can serve as the right tool to facilitate public education and promote green development at a large scale. For affordable housing developers, it is already not an easy task to build affordable homes; *incentive* supports, rather than additional *regulatory* burdens, are much more favorable when the green affordable housing industry is at its early development stage.

Therefore, information and incentives have been chosen by the author for analysis as the first steps to promote green affordable housing development. Many of the efforts to promote green housing development can be mapped onto these two tools, and refined to encourage further green affordable housing development as problems or gaps are identified. The next two chapters will examine some information and incentives as tools to promote green affordable housing development. Some of them are offered by government and some by other organizations / companies that can serve as valuable tools that government may organize and leverage for future green development.

[36] Ibid

III. INFORMATION FOR GREEN AFFORDABLE HOUSING

A. Importance of Information

In order to promote green development, people need to know:

- ✓ What is *green*
- ✓ Why is *green* good?
- ✓ How to implement *green*?

Identified by Wisconsin's program administrator for a 4-year pilot renewable energy fund program, there are eight steps for renewable energy projects to succeed: awareness, information, training, facilitation, technical assistance, financing, finding a contractor, and installation[37], five of which are directly related to the availability of information.

Correspondingly, many of the barriers identified in the previous chapter are caused by the lack of understanding, false perceptions, uncertainties, inefficient marketing, etc., which are also directly related to information and resource issues. Many resources for green development are not well connected to stakeholders such as design and development professionals, investors, lenders, owners and renters. Sometimes, information is simply not readily available. Green practice is relatively new, not enough good case studies are well documented, and no statistically significant data on cost-benefit savings are available. Especially in the affordable housing development industry, there is relatively less awareness, understanding, and practice in green development.

Information is the basic and critical tool that needs to be well developed to facilitate the effectiveness of other tools like regulations, incentives, programs, etc. Such information needs to be clearly explained, widely disseminated, and adjusted based on feedback. Mass information distribution will notify the public of the importance of green development. For example, the following list of information may get people's attention and get them to look into more details of green housing development:

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[37] Ernest Orlando Lawrence Berkeley National Laboratory, *Innovation, Renewable Energy, and State Investment: Case Studies of Leading Clean Energy Funds*, September 2002

- "A typical U.S. family spends about $1,300 per year on utility costs, a large portion of which is actually wasted. Through a few inexpensive energy-efficient features, energy bills can be cut 10% to 50%[38]."
- "One hundred thousand homes have earned the Environmental Protection Agency's Energy Star® designation. Each home that meets the voluntary criteria uses an average of 30% less energy for heating, cooling, and water heating than a conventional home, saving homeowners about $200 to $400 annually. According to EPA, the program saves Americans $26 million in energy costs each year.[39]"
- "For the U.S., we estimate potential annual savings and productivity gains in 1996 dollars of $6 to $14 billion from reduced respiratory disease; $2 to $4 billion from reduced allergies and asthma, $15 to $40 billion from reduced symptoms of performance that are unrelated to health"[40]

It is important to identify, collect, and distribute information on green development, because information is one of the most cost-effective tools to promote green development in the long run. Different channels for information collection and distribution are discussed below.

B. Information Providers and Media

Information sources include rating agencies, government programs, architects, consultants, utility companies, manufacturers, universities, and other organizations that advocate for green development. With the rapid development of green products, independent organizations offering product certification and standards have sprung up to help people figure out the right green strategies for their projects. With the development of monetary incentives for green building projects, development consultants explore and collect available and applicable program information to assist decision making in green development. The approach here is not to describe every information source, but to give examples of efforts in different fields that utilize information as tools to identify, document,

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[38] Department of Energy, *Energy Savers – Tips on Saving Energy & Money at Home,* 2001
[39] NewsBrief - *Environmental Building News* June 2003
[40] Fisk W., "Estimates of Potential Nationwide Productivity and Health Benefits from Better Indoor Environments: An Update", Published in *Indoor Air Quality Handbook*, New York, NY, 1999.

and validate green projects and features in order to educate and assist the public and the building industry with green development.

Information about green development is collected and distributed through a wide range of media targeted at different groups of stakeholders. Public media such as newspapers, TV programs, radio broadcasting, and utility rebate newsletters are the main tools for public education about green development. For professionals in the building industry, books, journals, case studies, surveys, emails, conferences, university programs, rating and green design tools, etc., are major green resources. Word of mouth and web pages are both widely used among the general public as well as building professionals to effectively distribute available information. Although some media work more effectively than others, organizations and stakeholders often obtain or circulate information through multiple channels for maximum outreach. The following are examples of information providers that actively promote green development through information services and programs.

1. Rating agencies - LEED

   – *"When Green is The Colour of Money"*[41]

"Green-building advocates in the United states tried initially to sell their ideas in terms of saving the environment. They had almost no impact. But when the buildings could be rated for their performance and when cost savings could be proved, it was another story," said Rick Fedrizzi, a green development specialist and founding chairman of the U.S. Green Building Council: "We were trying to sell green buildings in the name of the environment, but we could have sold them better by making a solid business-performance case." He said that once the data was collected about green buildings' performance from an energy and water perspective, the increased productivity in the green buildings, and the superior marketability of the buildings, membership of the USGBC increased from 350 to 3500 in three years, after their green rating tool, the Leadership in Energy and Environmental Design (LEED), was launched in 2000. Currently the most recognized green building rating system in the U.S., LEED measures the energy performance of new and existing buildings based on their sustainable features, which would be a way to reward the developer through better marketability of their

[41] Tina Perinotto, Australian Financial Review, October 2003

projects. The LEED system has six categories: sustainable site, energy and atmosphere, water efficiency, material and resources, indoor environmental quality, and innovation and design process. Each category contains a number of credits that each carries one or more possible points. To earn LEED certification, the applicant project must satisfy all of the prerequisites and earn a minimum number of points to attain a LEED rating level [42](See Exhibit 3).

In 1998, the General Services Administration (GSA) first had a group of industry experts identify the potential cost premium of LEED, and found that a 2.5-7.0% construction cost premium is needed to achieve various levels of "green" performance for Federal buildings. In 2003, based on 33 individual LEED registered projects (25 office buildings and 8 school buildings), Gregory Kats' report claims that a Certified LEED rating can be achieved at little or no added cost, and "the average cost premium for these green buildings was almost 2%, or about $5/sf^2. Data indicate that cost of green buildings declines as public or private entities undertake multiple green buildings."[43]

Exhibit 3: LEED building vs. conventional building

LEED certification levels (Rating)	Earned points	Anticipated energy/environmental impact (energy, water, land improvements, etc.)	Average Green Cost Premium
Certified	26 – 32	30%	.66%
Silver	33 – 38	40%	2.11%
Gold	39 – 51	50%	1.82%
Platinum	52 – 69	70% +	6.5%
Source: USGBC			Source: USGBC, Capital E Analysis[44]

Although the data with 33 projects may not be statistically significant, in general, LEED-registered green buildings do not have to cost much more than conventionally-designed buildings, and there are a spectrum of green features that can incur different levels of green premiums.

[42] www.usgbc.org
[43] Greg Kat, Principal of Capital E, and Chair of LEED E&A TAG, "The Costs and Financial Benefits of Green Buildings", 2003.
[44] Ibid

It is also pointed out that "Going through the LEED process definitely adds to the soft costs associated with a building. There are registration and application fees, the design-team labor required for the application, and the time needed to optimize the design for energy efficiency and other green metrics. In terms of overall construction costs, however, a LEED building need not cost more than a standard building."[45]

Other green product certification and standards programs also include:

- EnergyStar by U.S. EPA (www.energystar.gov),
- Environmentally Preferable Purchasing by U.S. EPA, (www.epa.gov/opptintr/epp),
- Greenguard by Greenguard Environmental Institute (www.greenguard.org),
- Environmentally Preferable Products and Services (EPP) Scientific Certification Systems (www.scs1.com),
- Environmental Claims Certification Program Scientific Certification Systems (www.scs1.com),
- Green Seal (www.greenseal.org),
- Green Label Testing Program by Carpet and Rug Institute (www.carpet-rug.com),
- Building for Environmental and Economic Sustainability (BEES) by National Institute of Standards & Technology (www.bfrl.nist.gov),
- Cool Roof Rating Council (www.coolroofs.org),
- GreenSpec by Building Green Inc. (www.buldinggreen.com).

Other independent, third-party home verification programs also help to assure that energy rated homes have correctly designed and installed operating systems and help consumers compare different homes along a standard scale. They can also help to demonstrate the benefits of long-term savings.

For example, in the Upham's Corner Market project, KeySpan Energy Delivery provided a plan review, recommendations on mechanical equipment and building envelope changes for energy savings, and rebates for more energy-efficient equipment. Conservation Services Group, administrator of the EnergyStar Homes program, also

[45] Nadav Malin, senior editor of *Environmental Building News,* 2003

reviewed the plan and provided recommendations and funding to building envelope upgrades. Had there not been these two programs, the green features would have not been implemented into the Upham's Corner Market project, as will be discussed later.

2. Architects, manufacturers, and utility companies

Currently many major architecture firms are pursuing the design of green buildings. Per the interviews with architects at Graham Gund Architects and Mostue & Associates Architects, Inc., over 90% of their clients ask about implementing green features into their projects. These architects learn of green features and strategies through conferences, web research, utility companies, etc. Manufacturers and utility companies are more active in marketing their products and programs than other stakeholders in the green building industry. For example, Graham Gund Architects once had a project that got a grant from MTC's Energy Trust Fund, and then NSTAR identified it as a potential project and contacted the developer to offer utility rebates. Therefore, there is great potential to promote green development through both formal and informal references and information sharing.

3. Organizations - Rocky Mountain Institute

Established in 1982, Rocky Mountain Institute (RMI) has conveyed sustainable development ideas to both professional and general audiences through consulting services, numerous publications, professional seminars, and intern and visiting scholar programs:

"RMI teaches through the media and through direct outreach to the general public. RMI staff write op-eds, help journalists prepare stories, and are increasingly sought-after for broadcast interviews. Their newsletter, mailed three times a year to nearly 20,000 supporters and media outlets, reports on recent research and resource issues, and its articles are frequently reprinted. The RMI website offers extensive information for citizens, communities, and companies. The outreach department is a clearinghouse of information on resource efficiency, responding to calls and emails from individuals and organizations seeking advice on everything from home energy savings to sophisticated analysis of resource statistics."[46]

[46] www.rmi.org

Besides research papers, seminars, and consulting services, RMI also outreaches strategically to the general public through connections with political and industry leaders. "RMI tries to influence the influential by creating and exploiting 'teachable moments.' The senior RMI staff have addressed audiences such as the World Economic Forum, the World Bank, the Conference Board, the National Academy of Sciences, the Center for Strategic and International Studies, and the Council on Foreign Relations. They have provided private briefings or expert testimony to many heads of state, corporate boards, utility commissions, top military leaders and staff colleges, elite business and law schools, and governmental advisory boards. They routinely advise corporations and public-sector bodies that are well-placed to effect change through their leadership."[47]

4. Government – Wisconsin state clean energy fund program

Wisconsin has gone to greater lengths than most states to raise awareness and direct new renewable energy projects to completion through education, marketing, training, and project facilitation (technical assistance and project "hand holding")[48]. There is a full-time project facilitator to provide free phone consultation through a toll-free call center, on-site audits and site assessments for renewable energies. Fact sheets, case studies, Yellow Pages, workshops, and other educational events for renewable energy projects are offered. Besides serving the educational purposes, they also support Wisconsin's other program components such as rebates for projects and grants for feasibility studies. The four-year program has helped both the quality and quantity of potential projects increase over time. The programmatic elements, including the service of information, training, education, project facilitation, and technical assistance, not only are valuable resources to local renewable energy projects, but also provide important references to other government organizations to design effective renewable energy programs.

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[47] Ibid

[48] Ernest Orlando Lawrence Berkeley National Laboratory, *Innovation, Renewable Energy, and State Investment: Case Studies of Leading Clean Energy Funds*, September 2002

C. Issues with Information Tools

1. Lack of cost-benefit data

For example, since LEED certification does not require the tracking of long-term costs for its registered projects, does not provide a guarantee of the projects' performance, and does not necessarily result in a higher asset value, it tends to be educational and informative in nature, and currently does not provide enough economic incentives to promote green development. Many participants are applying for LEED registration only for strategic marketing purposes.

2. Additional costs of registration and documentation to be green

Besides additional design labor needed for the application and the time needed to optimize the application of green features, there is also an additional fee for registration that ranges from $750 to $7500. When the clients know of the LEED registration requirements and guidelines, they are not willing to apply for it because of the registration and documentation fees. These clients include not only the affordable housing developers, who do not have the budget for the registration cost, but also other commercial and institutional developers, who have fewer budget problems. They sometimes choose to follow LEED as the green design guidelines, but, without a formal commitment, many of the green features planned at the beginning of the projects have been left out through the design and development process.

Exhibit 4: LEED registration costs[49]

	Less than 75,000 sq. ft.	75,000-300,000 sq. ft.	More than 300,000 sq. ft.
Charges	Fixed rate	Based on sq. ft.	Fixed rate
Registration			
Members	$750	$0.01/sq. ft.	$3,000
Non-Members	$950	$0.0125/sq. ft.	$3,750
Certification			
Members	$1,500	$0.02/sq. ft.	$6,000
Non-Members	$1,875	$0.025/sq. ft.	$7,500

Source: USGBC

[49] Building Design &Construction, "White Paper on Sustainability", November 2003

In addition, LEED certification requires building system commissioning to ensure that a building system is put in place as specified and performs well. It is important to calibrate the building system and train staff, which is essential to the goals of energy efficiency and reliable performance, but the commissioning costs from $50 to $150,000 per project depending on its size. Although studies show the value of commissioning process through cost-benefit analysis and concluded that "a properly implemented Commissioning Process should pay for itself during the design phase"[50], this information may not be widely known or accepted. Considering commissioning as an unusual and significant expense, most affordable housing sponsors do not want to get LEED registered and committed to green design.

3. Lack of information and public education

The costs of advanced green features not only depend on the price of the components themselves, but also depend on an owner / operator's knowledge of construction and maintenance of these "newer" features, as well as people's acceptance of the "newer" concept of building and living. Poorly integrated design, careless construction, and inappropriate maintenance, can all adversely increase the operating and replacement cost of a project. However, sometimes even if a technology has been in use for a long period of time, there could be potential risks due to inappropriate design, construction and maintenance. For example, the Cambridge Cohousing project chose a Ground Source Heat Pump heating and cooling system to reduce energy cost. The concept of Ground Source Heat Pump technology is not new at all[51], but the design and construction teams were not well coordinated and there was a lack of knowledge about maintenance of the system. Consequently, the system broke down 3 years after its installation in 1998, and had to be replaced at a huge cost.

[50] Chad Dorgan, Robert Cox, and Charles Dorgan, "The Value of the Commissioning Process: Costs and Benefits".

[51] Developed by Lord Kelvin in 1852, the heat pump was known in the forties for its efficiency and was especially useful in the seventies.

IV. INCENTIVES FOR GREEN AFFORDABLE HOUSING

A. Importance of Incentives

Compared to direct ownership and operation, *incentives* can be used by the government and utility companies to leverage more private green development at lower cost. Utility companies want to improve customer service through energy efficiency, reducing black-outs and the need for additional generation capacity. Rating agencies and environmental organizations are interested in public education and promotion of sustainable development. Finally, manufacturers of green products can promote their products through incentive programs.

Incentives for green development include indirect incentives such as tax credits, low interest loans and mortgages, and public image/marketing, and direct monetary incentives such as utility rebates, subsidies, and grants. Direct monetary incentives are most favorable and popular among investors. Motivated by higher economic returns, investors are more willing to participate in green projects. It is expected that, with the incentive programs, more and more practices and experiences will be generated, and perceived risks and uncertainties can be lowered so that green development can become standard practice over time. However, there are identified mismatch, misleading and even conflicting incentives that have been used in an attempt to promote green development. Below are examples of the green incentives followed by issues identified.

B. Incentive Providers and Programs

1. Utility companies - Rebates

There are many programs that provide economic incentives to invest in energy efficient equipment around the U.S. and all over the world. In Massachusetts, the programs available to residential home buyers and developers include[52]:

[52] ICF Consulting

- Massachusetts ENERGY STAR New Homes Program that is sponsored by a consortium of utilities in Massachusetts and throughout New England
- Massachusetts Electric that offers rebates as incentives for ENERGY STAR light bulbs and fixtures, clothes washers, central & room air conditioners and heating systems
- Bay State Gas program for multifamily buildings that shares the cost of energy efficient features and may contribute 100% toward the installation of certain measures for low-income residents

2. Government - Grants and tax incentives

One good example of grants as direct incentives to the green projects is the clean energy fund available in many states in the U.S. Studies have been conducted to show the effectiveness and innovativeness of the programs in several states, which will be discussed in more detail later in this chapter. For instance, Massachusetts budgeted $28 million through 2004 to induce the incorporation of renewable energy systems into new building constructions. Leveraged with other utility and mortgage programs, the fund offers grants for public education, feasibility studies, design and construction for green buildings.

Tax Incentives for Energy Efficient Buildings Legislation S. 207 (R. Smith, R-NH; D. Feinstein, D-CA) / H.R. 778 (R. Cunningham, R-CA; E. Markey, D-MA) proposes tax incentives for energy efficient buildings and equipment including:

- "Efficient residential buildings, including manufactured housing, saving 30% or 50% of energy cost to the homeowner compared to national model codes, with a higher incentive for the higher savings,
- Efficient heating, cooling, and water heating equipment that reduces consumer energy costs, and, for air conditioners, reduces peak electric power demand, by about 20% (lower incentives) and 30%-50% (higher incentives) compared to national standards,
- New and existing commercial buildings, rental housing and schools, with 50% reductions in energy costs to the owner or tenant, and

- Solar hot water and photovoltaic systems. "[53]

Based on the overall performance of certain pieces of equipment, or the complete performance of whole buildings, the incentives trigger competitions among different technologies to minimize costs while achieving energy goals. "For houses, the duct sealing and leak sealing contractors will be competing with insulation contractors, window suppliers, passive solar design architects, concrete or masonry industry firms, and others, to meet the energy goal."[54]

Based on *performance*, not *expenditures*, these tax incentives will also foster competitions among suppliers of different technologies to meet the proposed target. With these tax incentives, energy can be saved at no extra cost, which could not happen with the tax credits of the 1970's when the incentives were based on part of the cost.

3. Rating agencies - Public image / Marketing

As introduced in the previous chapter, LEED is one of the most popular rating systems in the U.S. Many architecture firms, developers, companies, etc., are paying more attention to LEED certification, mainly because of more tangible measures of the green features and public image for marketing reasons. Some LEED points can be met with no additional cost, while others are much more complex and costly, but all the points are equally weighted in the rating system. Therefore, the easiest and/or least expensive are much more favorable to the developers. According to a survey of 38 LEED-NC projects[55], 16 features are identified as top LEED point-getters, while another 12 features are the least-employed LEED points as shown below:

Exhibit 5: Top LEED Point-getters and Least-employed LEED Point-getters

Top LEED point-getters (of 38 LEED-NC projects)	
# of projects earning this point	Description
38	Employ a LEED accredited professional
38	Use 20% of building materials manufactured within 500 miles
35	Use low-emitting carpets

[53] National Resource Defense Council, *Commentary and Q&A on Tax Incentives for Energy Efficient Buildings Legislation S. / H.R. 778,* 2001
[54] Ibid
[55] Rob Bolin, P.E., LAP, Syska Hennessy Group, August 2003

34	Install high-efficiency irrigation or reduce potable water for waste by 50%
33	Provide bicycle storage and changing facilities for x% of occupants
33	Recycled content
33	Use low-emitting adhesives
33	Various innovations to enhance sustainability
30	Site selection
30	Reduce design energy cost by 15%
30	Recycle or salvage 50% of construction and land debris waste
30	Use low-emitting paints and coatings
30	Provide a direct line of sight to windows from occupied spaces
28	Exceed local zoning open-space requirements by 25%
28	Utilized water-efficient landscaping
28	Reduce design energy cost by 30%

Least-employed LEED point-getters (of 38 LEED-NC projects)	
# of projects earning this point	Description
8	Innovative wastewater technology
7	Provide individual IEQ controls for 50% of occupants
7	Meet local urban development density goals
3	Supply 20% renewable energy
3	Supply 10% renewable energy
3	Supply 5% renewable energy
3	Brownfield redevelopment
2	Reduce design energy cost by 50%
2	Reduce design energy cost by 55%
2	Use rapidly renewable materials
1	Use salvaged or reused materials for 10% of materials usage
1	Reduce design energy cost by 60%

4. Lending agencies - Energy Efficient Mortgages

The 1979 EO signed by President Carter directed GSEs to develop energy loans[56]. Fannie Mae, Freddie Mac, Veterans Affairs (VA) and the Federal Housing Administration (FHA) have offered EEMs in the past, while three of them, FHA, Fannie Mae, and VA still have active programs[57].

[56] Michelle Desiderio, National Community Lending Center, *Fannie Mae's Energy Efficient Mortgages*
[57] Massachusetts Technology Collaborative, *Energy Efficient Mortgages*

Energy Efficient Mortgages (EEMs) are also known as "green mortgages", "clean energy mortgages," or "energy improvement mortgages." Home buyers of energy efficient homes can obtain additional financing through EEMs based on estimated utility bill savings. EEMs generally come in one of the following two formats: a loan covering additional value that is offset by lower utility bills, or a loan that stretches debt-to-income ratios based on utility savings[58].

Exhibit 6: Loan Covering Additional Value[59]

	Existing Home	With Energy Improvements
Home price (90% mortgage, 8% interest)	$150,000	$154,816
Loan amount	$ 135,000	$139,334
Monthly payment*	$ 991	$ 1,023
Energy bills	+$ 186	+$ 93
The true monthly cost of home ownership	$ 1,177	$ 1,116
Monthly savings	**-**	**$ 61**

Exhibit 7: Loan Stretching Debt-to-income Ratio[60]

	Existing home	With energy improvements
Buyer's total monthly income	$5,000	$5,000
Maximum allowable monthly payment 28% debt-to-income ratio (increased to 30% for EEM)	$1,400	$1,500
Maximum mortgage at 90% of appraised home value	$221,500	$237,300
Added Borrowing Power Due to EEM		**$15,800**
*Mortgage Rate of 7.5% · Down Payment of 10% · 30 Year Term Principal & Interest Only · Tax & Insurance Not Factored		

The energy improvement mortgages work similarly to the energy efficient mortgages. The key difference is that the energy rater works with the buyer to determine cost-effective energy improvements. When the improvements are done, the rater proves the improvements on which the mortgage is based.

[58] Ibid
[59] Ibid
[60] Ibid

Exhibit 8: processes for Energy Efficient Mortgages and Energy Improvement Mortgages[61]

Energy Efficiency Mortgages		Energy Improvement Mortgages
Buyer plans to purchase an energy efficient home		Buyer plans to purchase a home and implement energy efficiency improvements or current owner plans to refinance home and include energy improvements
↓		↓
Lender hires appraiser/energy rater to conduct an energy audit		Lender hires appraiser/energy rater to conduct an energy audit
↓		↓
Energy rater does analysis using HERS, Energy Star or other approved rating system to measure energy efficiency		Energy rater does analysis using HERS, Energy Star or other approved rating system to determine existing efficiency and recommend feasible improvements; buyer has to provide documentation that improvements will reduce utility bill more than increase in lending
↓		↓
Lender develops mortgage that accounts for anticipated utility savings or allows for additional income ratio (instead of 28% of monthly income, mortgage is set at 30% of monthly income)		Lender develops mortgage with additional financing for energy efficiency improvements
↓		↓
Buyer saves on energy bills, offsetting additional mortgage amount and is able to pay off mortgage earlier		Buyer saves on energy bills, offsetting additional mortgage amount and is able to pay off mortgage earlier
		↓
		Energy Rater confirms improvements have been made

These mortgages focus on energy and do not account for other green building elements such as green building materials. Another limitation of these mortgages is that the vast majority are offered only for single-family or small multifamily housing, and the EEM lending format for energy efficient multifamily housing types has not been well tested[62].

A study conducted by Power Shift came up with several conclusions regarding the benefits as incentives for EEMs lenders:

- "The market for solar products alone in the U.S. is $4 billion

[61] Ibid
[62] Ibid

- Lenders can make 10% more profit per mortgage on an EEM
- A lender holding the mortgage in its own portfolio earns $23,940 more per year; selling the mortgage to Fannie Mae or Freddie Mac earns $24,179 per year
- EEMs are eligible for Community Reinvestment Act Credits"[63]

The report also examined the benefits of EEMs for home buyers: "A report conducted by Power Shift concluded that 46% of homeowners can save money by purchasing energy efficient homes (lighting upgrades, insulation upgrades, Energy Star appliances, and other measures) with solar panels (for a total energy use reduction of 30%) through a standard energy efficient mortgage model. Savings varied by location; average savings in the 50 largest U.S. cities would be $164 per year. In addition, home value overall would increase by $20 for every $1 invested in energy efficiency upgrades. States with the highest consumer savings potential, based on climate, available incentives, and technology costs, are California, Hawaii, New York, New Jersey, Rhode Island and Illinois."[64]

In general, EEMs can provide financial benefits to promote green housing market from the demand side:

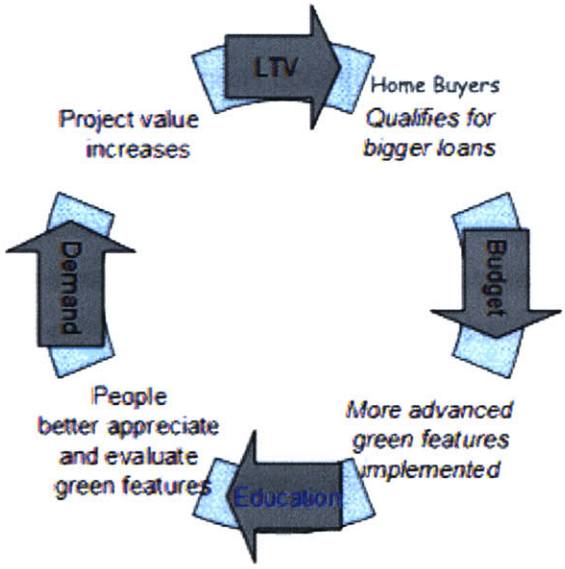

Figure 3: Promote green housing development from the demand side

[63] Ibid
[64] Ibid

5. Labeling program - Energy Star labeled homes

Benefits of Energy Star labeled new homes include lower utility costs and increased comfort, besides the label backed by the government. Furthermore, because of the energy savings, home buyers can qualify for more home options at the same income level, and there are other financial incentives include "cash back at closing, interest rate discounts, or the waiving of specified fees"[65]. Many studies also consistently show that energy-efficient homes have earned higher-than-average resale prices since the 1970's. Therefore, energy-efficient homes like the Energy Star labeled homes not only pay dividends through utility savings every month, but also can be a smart investment with higher potential return.

6. Energy Advocates - SystemVision™ Guarantee[66]

Founded in 1980 by the North Carolina Utilities Commission, Advanced Energy is a North Carolina Corporation that advocates for energy efficiency and conservation. It launched the SystemVision initiative in 2000 that offers SystemVision standards. It claims that "Houses built with SystemVision use half as much energy for heating and cooling and are more comfortable and healthier for the families who live in them."

Since 2001, a guarantee, SystemVision Home Program Comfort and Energy Use Guarantee, has been in place to ensure the energy usage for heating and cooling for two years. It also guarantees the comfort, defined as "a temperature differential of no greater than plus or minus 3 degrees F from the thermostat location to the center of any conditioned room within the zone."[67] If the actual energy usage exceeds the guaranteed usage, the program will reimburse 100% of the difference to the homeowner; if there is a comfort question, the program will repair the defects after evaluation. Limitations are also addressed to protect the guarantee program through adjustments based on changing energy rates and unusual weather conditions, and agreements on homeowners' responsibilities.

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[65] http://energystar.gov
[66] Per interview with Arnie Katz, Advanced Energy
[67] http://www.advancedenergy.org

Till now, 350 green affordable homes have been successfully completed, certified, and guaranteed. Although there were several claims of more energy usage than the amount guaranteed, they are found not to be the problems of the building systems but because of the tenants' own reasons. For example, a resident has to set the temperature lower than 68 degrees F in summer for medical reason, while home owners are responsible to maintain thermostat settings no lower than 76 degrees F according to the program agreement. However, the current homes under guarantee are mostly single families where the program has good experience with. With more homes, especially multi-family homes, under construction, more claims on energy over usage are expected.

Currently the guarantee costs $1050 per subsidized affordable home, including fees for plan review, training for contractors and subcontractors, quality control, utility monitoring, etc. This cost is not paid by developers but covered by the government through North Carolina Housing Finance Agency. It is believed that green homes are nothing special but good design with equipment correctly installed and maintenance staff well trained, so the risk for the guarantee is lower than conventionally perceived. If a home can work well for the first two years, it can work well afterwards and there is no need to pay extra for the guarantee. Identified issues are:

- Most homes are single families, and there are very limited experience and practices to develop green multi-families.
- Currently the program is based on a very basic green platform with the basic energy efficiency, indoor environment quality, and durability features, and more advanced green features need to be implemented. For example, energy efficient light appliances are supposed to saving operating costs, but the replacement costs sometimes may be too high to be justified; better water heating system with solar panel may be promoted, but the cost of renewable energy is still too high to be widely used without substantial subsidy.
- Product warrantee is for 2-5 years and the guarantee is for 2 years. There is still a mismatch between the guaranteed period and the investment horizon for lenders.

7. Communities - Cohousing development with resource sharing

Cohousing originated in Denmark around 30 years ago. It describes neighborhoods that combine the autonomy of private dwellings with the advantages of shared resources and community living[68]. Over 60 cohousing projects have been completed in North America since 1991 and another 130 plus are under development. Cohousing is designed to facilitate shared responsibilities and resources for child care, meals, driving, etc.

Cohousing projects often have the inherited advantage of incentives to promote sustainable development. Most residents are willing to live in smaller apartments and share other resources including guest rooms and cars. Furthermore, the sense of community helps to better align home owners' interests in reducing energy usage and optimizing maintenance costs. Some groups also maximize their use of sustainable building materials and energy efficient systems. More importantly, since the residents have both the initial design and development input and long-term stake in the projects, investment decisions on green strategies can, relatively speaking, be rationally evaluated over the life cycle of the projects.

For example, the Cambridge Cohousing project, completed in January 1998 in Cambridge, Massachusetts, is a typical cohousing project that promotes sustainable development. It won Award for Environmental Awareness in 2000. The sustainable features include:

- Underground parking greatly reduces the amount of impervious surfaces covering the site and the runoff and heat island impacts;
- All of the open spaces and the variegated building faces are oriented towards the South to optimize the passive solar gain;
- Amenities and resources including guest rooms, dining room, wood shop, living room, etc., are shared by the community so that each unit can be smaller and more efficient. Meanwhile, there are several large units that are occupied by smaller households mainly for cultural reasons. Several households do not use the community guest rooms and maintain empty rooms in their own homes for that purpose. Other resource sharing, including tools, musical instruments, exercise

[68] Cohousing Development Consulting

equipment, books, videos, cooking equipment, the wood shop ,and bicycles, help to lower households budget and foster the sense of community;

- Modular construction has significant savings. Less material was wasted, and recycled glass was one of the optional bathroom tile choices;
- Ground Source Heat Pump heating and cooling system is used to reduce energy cost;
- Four years after completion, the community and individual households voluntarily replaced 90% of the incandescent bulbs with compact fluorescents, through a program subsidized by NStar to reduce electricity usage[69].

However, since some owners may consume many more resources than others, fairness needs to be achieved. For example, an owner at Cambridge Cohousing uses his residence as office, so he pays an extra utility cost share. But excessive usage may occur since costs are shared and not all extravagant resource usage can be easily identified, initial screening of applicants and additional measures to monitor utility usage may help to mitigate the resource/cost sharing problem.

C. Incentives/Regulations for Affordable Housing Development

There are federal, state, and local housing programs including the HOPE VI public housing redevelopment program, the Low Income Housing Tax Credit Program, the HOME program, tax-exempt bond financing, and other non-profit organizations that have fund for low interest rate financing for affordable housing development; in addition, there are financing tools for home buyers such as first home buyer mortgages, soft second loans, etc., to increase affordability on the demand side. However, the above development funds are scarce, the loan amounts are often limited, and projects need to meet many requirements to qualify for financing. Therefore, oftentimes there need to be many lenders to support one affordable housing project. For example, the Upham's Corner Market project has the following financing structure:

[69] Robert Coherd, trustee of the Cambridge Cohousing

Exhibit 9: The Upham's Corner Market project financing structure

Tax credit Equity (LIHTC & Historic)	$	4,206,621	48%
City of Boston Economic Development loan	$	1,292,226	15%
DHCD/HOME Grant	$	600,000	7%
NCS/McKinney	$	240,056	3%
CEDAC Loan/Housing Innovations Fund	$	500,000	6%
MHFA first mortgage loan	$	1,600,000	18%
Deferred Developer Fee	$	278,863	3%
Total	$	8,717,766	100%

D. Issues with Incentive Tools

1. Information about incentives not well distributed.

For example, there is a serious lack of marketing for the Energy Efficient Mortgages. Most of EEMs are run by national government departments or organizations, so they can be easily accessed through the banks affiliated with the programs. But "none of the corporate banks listed as program affiliates have descriptions of this mortgage option on their own websites, though several smaller and internet-based mortgage lenders do. This lack of marketing is noted in many analyses of the energy efficiency mortgage structure. "[70] Well designed but not effectively promoted in the market, EEMs have very limited best practices. For some long-existing EEMs, there have been no cases processed.

2. Limited rating programs appropriate for multi-family housing projects and affordable housing projects

Energy modeling tools used by energy programs such as Keyspan Energy Delivery and EnergyStar Homes do not have appropriate models for multifamily housing projects. The models were adjusted for single families to make estimations for the Upham's Corner Market project, a multifamily housing project, but the results are hard to justify. Although the actual gas usage for the first year matched the estimation, there was a significant difference in the second year. This fluctuation needs to be taken care of to

[70] Massachusetts Technology Collaborative, *Energy Efficient Mortgages*

validate the projected utility usage, because the cost-benefit characteristics of green features are critical to incentivize stakeholders.

LEED registration for residential properties is still under development. Furthermore, even if there is a LEED registration targeted at affordable housing, affordable housing projects may not benefit from it. As discussed in the previous chapter, without requirements for cost-benefit data, LEED registration serves as a marketing and education tool. However, affordable housing developers and owners have a long waiting list of low-income home buyers and renters, so they do not have the concern of vacancy rates, turn-over rates, and lack of buyers; instead, because of low margins and limited funding resources, they often have to make decisions based on affordable housing financing tools and regulations.

3. Conflicts between regulations for affordable housing programs and the benefits of green housing projects.

Green features will help to reduce operating expenses but may increase initial construction cost; conversely, affordable housing programs often put a limit on initial costs and require a conservative projection of future operating expenses. Therefore, the underwriting process of the loan programs does not reflect the cost and benefit characteristics of green housing projects. The additional property value because of the future savings in operating expenses cannot be reflected in the market due to this mismatch.

When tenants have tenant-based vouchers, utility allowances are calculated based on average utility costs for average housing projects. Energy savings cannot be reflected, so there are no incentives for sponsors to implement energy-efficient features for tenants.

4. Misleading Incentives

LEED points are broken down into detailed categories, but features with different costs and levels of ease to implement are equally weighted. Therefore, certain features are more or less favored not because of their green benefits, but because of the not-well-balanced rating mechanism. Furthermore, many green features really work as a whole and should not be evaluated separately; however, the LEED points are counted

independently from each other, indicating the independence of the green features and not reflecting the collaborative nature of the green design method.

5. Free-rider issues of incentive programs

The objective of incentive programs is to motivate people to actively participate in green development, but sometimes developers will implement green features even without such incentive programs. This free-rider issue may be avoided by offering recoverable grants and recapturing operating savings, but it may require additional administrative work and it may make the green project less attractive, since grant, subsidy, rebate, and other direct monetary incentives are so far the most favorable programs that promote green building development, according to the interviews with two architecture firms.

6. Examples of hurdles for renewable energy programs

A study[71] funded by the Assistant Secretary of Energy Efficiency and Renewable Energy of the U.S. Department of Energy, reviewed sixteen programmatic and five administrative practices of state clean energy funds to promote renewable energy. It summarized some of the innovative actions and the hurdles of the program completions, which are of value for future program design. The hurdles include the mismatch of demand and supply, market uncertainties, regulatory issues, funding uses, etc.

[71] Ryan Wiser and mark Bolinger (Environmental Energy Technologies Division), Lewis Milford (Clean Energy Group), Kevin Porter (Exeter Associates, Inc.) and Roger Clark (Clean Energy Group), *Innovation, Renewable Energy, and State Investment; Case Studies of Leading Clean Energy Funds*, September 2002

Exhibit 10: Examples of incentive programs for renewable energy projects

Program	Results	Hurdles identified
Production Incentive Auctions to Support Large-Scale Renewables Projects in California	More than half of all funded projects (representing more than 80% of total funded capacity) have not been built	**Lack of credit-worthy power purchasers, permitting delays and general market uncertainty**
The U.K. NFFO and Ireland AER Competitive Bidding Systems	Solved the "PPA dilemma" faced by some U.S. funds, through proper linkage between fund solicitations and long-term PPAs; while incentives for speculative bidding and permitting hurdles have resulted in a large number of failed projects.	**No penalties for non-performance and lengthy development times:** generators were encouraged to bid speculatively based on assumptions of declining technology costs in the future; **Permitting hurdles**: developers naturally looked to the strongest wind sites that often coincide with prominent features of the landscape, so numerous projects faced permit denials after winning an NFFO contract
Use of low-interest, subordinated debt to finance a wind project in Pennsylvania	Subordinated debt allows the funds to earn a 5% return over the 10 years and is an improvement over capital grants in encouraging project performance. The existence of the financing played a positive role in the negotiation of a 20-year power purchase agreement with the wholesale buyer	For a given amount of capacity, it **takes a greater amount of debt** to provide the same level of support as a production incentive; **funds would be tied-up** in a project and returned slowly over the debt term. In order to have the debt-based incentives in effect, there also **need to be external debt requirements and a senior lender**, which are not the case for many corporations.

In general, incentive programs have been carefully designed and carried out. But in order to further promote green development, information of incentives needs to be more widely distributed into the building industry, so that issues of the incentive programs could be identified with details through practice. Interests of different stakeholders have to be carefully examined in order to achieve collaborative efforts both in the short run and in the long run. For example, subsidy programs can provide immediate motivation for green products, but they need to be designed in a way that can sustain the green subsidy programs over time. They may motivate conventional developers and owners to consider green features by rebates or grants, while assist experienced green developers and owners through recoverable grant or other means that not only support the green projects but also share the future green savings.

V. RECOMMENDATIONS

A. Key Factors to Promote Green Affordable Housing Development

1. The application of information

a. Data collection for green affordable housing cases and green technologies

Green building is increasingly popular and practiced, but it is still far from standard practice. Similar to the barriers to other new technologies, green building development faces the challenge of lack of information and education, risk aversion related to uncertainty, and perceived higher-than-traditional cost.

As shown in a survey conducted by Building Design & Construction magazine, only 2% of 485 building practitioners, who attended the initial Greenbuild conference in Austin in 2002, thought that no reforms or changes are needed to promote sustainable development. About half of the respondents thought that more case-study descriptions of successful projects, more training and education programs, directories of independently rated green products, and better marketing materials could be done to promote sustainable design more effectively. Of the respondents, 59% suggested independent validation of the cost-benefit of green buildings and 48% recommended greater reliance on life-cycle analysis in evaluating products.

However, because of lack of awareness and attention to data collection, there are very limited data available to conduct the life-cycle cost-benefit analysis. For example, when the Green CDCs Initiative sent out survey forms to collect cost-benefit data for green affordable housing, even the organizations that have close financing relationships with the initiative members did not respond in a timely manner, partly because that the data had not been readily available and the organizations had other more urgent and important work, and the survey was not taken as priority. Furthermore, even the most popular green rating program, LEED, does not require tracking the performance of green projects. Keyspan and EnergyStar programs do make estimations but do not want to guarantee the energy savings; their tools are designed for energy modeling for single families, so the models may not provide validated data when used for multifamily apartments.

Several studies show that LEED certified or silver buildings need not have higher initial costs than comparable conventional buildings[72]. Costs also often depend on the planning process, where more guidance is needed in terms of information on the green features as well as related costs and benefits. More data not only will help to conduct mathematic cost-benefit analysis but also, in a way, will help investors, home buyers, and other stake holders to better understand and appreciate green development. Even if the data may prove that some green features do not make economic sense under certain conditions, these information can still promote green development, since the stakeholders can feel more comfortable and make rational decisions with more reliable data available. Perceived risks of green development are thus lower because of fewer uncertainties in green development.

b. Ranking lists and checklists of green features

On the supply side, in Maia's thesis, investment opportunities of sustainable construction materials were ranked into 3 categories: mature opportunities, emerging opportunities, and potential opportunities that are listed in the appendix. Although the lists were based on the construction market in 1998, the ranking of sustainable opportunities has not changed dramatically, and the way that the green features are prioritized can be very helpful to analyze the current investment opportunities.

On the demand side, energy efficiency is the most favored green features because of the tangible benefits, relatively mature market mechanisms, and funding tools. All the stakeholders also have interests in other green features that have intangible benefits, but the cost-benefit analysis is even harder to conduct to justify these benefits.

Some green features can be implemented quite simply, while others are more complicated and costly. But gradually, costs of green housing decrease as costs of products and materials go down and development teams accumulate experience through practice. There are software programs that help to identify the most cost-effective features to be implemented in a project. For example, Graham Gund Archtiects uses Green Building Advisor, a program developed by Sandra Mendler, to initialize a list of applicable green features, generated after input of basic project information such as the location, type, and size of the building, as well as characteristics of the site. The features can also

[72] Christine Ervin, the first president/CEO of the U.S. Green Building Council

be further sorted. After identify certain features during the early design stage, the architects then go to consultants for implementation help.

c. LCC analysis

Life Cycle Cost (LCC) is generally defined as the sum of the initial cost and the operational costs over the life span of a building. Life Cycle Cost for affordable housing is particularly important, because housing needs to be affordable not just when it is built, but also through the life of its use. During the life of the housing, homebuyers have to be able to afford the expenses for housing, and non-profit organizations that lease the houses have to maintain positive cash flows. As shown in Figure 4, the maintenance cost of housing takes much higher proportion (75%) of the total life-cycle costs than the initial cost (25%).

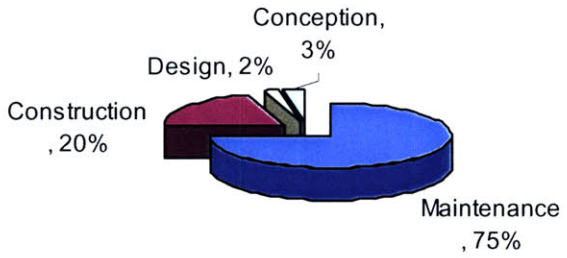

Figure 4: Composition of Life Cycle Cost

Especially for affordable housing projects, developers are very sensitive to cost considerations, but mainly in initial costs. The margins for affordable housing projects are low, and as mentioned earlier, many lenders of the projects are distributing limited sources of funding; therefore, there are often strict requirements for the maximum initial cost and minimum projected operating costs. Reasonable evaluation of the green features over the long run would greatly help to overcome the regulatory barriers to promote green affordable housing development.

In building-related project analysis, economic analysis results are usually presented in terms of Payback Period (PB) or Internal Rate of Return (IRR). To cover all aspects of an economic analysis, building economists also use measures of Net Savings (NS) and Savings-to-Investment Ratio (SIR). For example, the Simple Payback Period

method is often used in evaluating energy efficiency features. It is very convenient as a back-of-envelope calculation to give investors a quick number, but the drawback is that it does not take into consideration the residual value after the pay back period.

LCC analysis is widely accepted as a valuable tool to evaluate the economic benefit of water and energy conservation projects. This tool is also useful when analyzing green building features where the initial cost should be evaluated with the benefits of future savings and positive environment impact in the long run. The diagram (see Figure 5) shows a concept of economic efficiency in the LCC analysis.

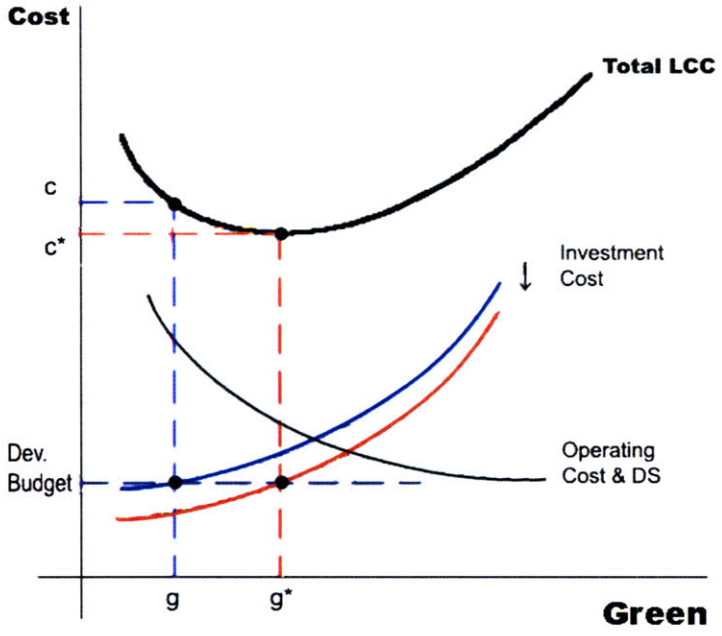

Figure 5: When more green features are implemented (increase from g to g*), the investment cost is higher and the operating cost is lower, and the total LCC (the sum of the investment cost and the PV of operating cost plus debt service) is actually lower (decreases from c to c*). With monetary support, the investment cost curve shifts downwards; therefore, with the same amount of development budget, a higher level of *green* can be achieved and the total LCC decreases.

LCC analysis is based on Present Value calculation by discounting future cash flows to the same point of time to be comparable. The study period need to be decided according to the time over which the effects of a project are of interest to decision makers,

when ownership and operations expenses are to be evaluated. It ranges from twenty to forty years, depending on building types, investor profile, etc. The discount rate is "the rate of interest reflecting the investor's time value of money"[73]. Because of different investment activities, levels of risk aversion and capital structures, each investor has different Opportunity Cost of Capital. Specifically, private developers may have a higher discount rate than CDCs.

Certain green features have not been tested over a long period of time, and warranty periods for most products are around 1 - 5 years, which are much shorter than the study period. Incidences of green features may result in huge replacement costs and further raise the mistrust of the green development. In addition, the inputted data are obtained at the early stage of the project with uncertainty, so sensitivity analysis may be a way to address the issue of accuracy. Several scenarios with different assumptions such as discount rates, future energy prices, and replacement periods, should also be compared to evaluate the sensitivity of property value to the future uncertainties.

2. The application of incentives

More incentives are needed to identify and align stakeholders' interests in development process to correct the current mismatch and catch missing opportunities to implement green features. All the stakeholders need to be motivated to participate collaboratively to promote the green building industry smoothly as a whole.

Figure 6: Development of green building industry needs collaborative efforts from all disciplines

[73] *Life Cycle Costing for Design Professionals*, 2nd Edition.

Recommendations regarding incentive issue include:

a. Stimulate the green housing market.

Increase publicity and advocate for best practices, green development participants, and green building benefits among professionals and general public.

b. Support manufacturers to develop green products.

Provide financing tools to lower production costs and create partnerships with other stakeholders to streamline the implementation process of green products and ensure purchasers.

c. Incentivize architects and engineers to design appropriately.

Minimize a project's LCC with properly-sized equipment and systems by composing professional fees of a minimum fee and an incentive fee based on performance. The elements of a performance-based fee include[74]:

- A clear goal, along with a specification, of how performance relative to that goal is to be measured.
- A schedule showing how the fee relates to success in meeting the goal.
- A method of evaluating the design.
- A protocol for resolving disputes without expensive litigation.

d. Align short-term and long-term stakeholders' interests.

Adjust the regulatory requirements of housing programs to reflect the higher initial cost and lower operating expenses of green housing projects, and take into account the long-term operating savings for the underwriting of green projects.

e. Encourage lenders to fund green projects.

Offer guarantee programs for loans and mortgages to lower default risks associated with green features.

f. Motivate tenants to save energy.

Install individual meters and sensors, and adjust gross rents if the actual utility usage is much higher than the average range.

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[74] Editors: Andrea Keenan, Danielle Georges, Mary Greene, RSMeans Construction Publishers & Consultants, *Green building: project planning & cost estimating: a practical guide for constructing sustainable buildings,* 2002.

B. Promote a Green Guarantee Program

Many of the recommendations to promote green affordable housing development can, in practice, be implemented into a green guarantee program. Specifically, this guarantee program will provide technical assistance through the design and development process, certify the green features upon project completion, and guarantee the physical performance and financial savings of the green homes. With conditions of prudent usage, the program will guarantee:

- Energy savings in heating and cooling, and comfortableness (defined as the maximum difference between room temperatures and thermostat settings), for the first two years, similar to what is currently guaranteed by the SystemVision program, and
- Longevity of the green systems during the life of the building.

The ultimate beneficiaries will be the lenders that underwrite future green operating savings into project value. If the energy usage in heating and cooling is higher than guaranteed, the difference between the guaranteed utility cost and the actual cost will be reimbursed to ensure enough cash flow to pay off the debt. The program will ensure that the building systems are appropriately installed and provide training to maintenance staff. If a green system breaks down beyond the manufacturers' warranty period but within the guaranteed replacement period, the program will cover a reasonable portion of the replacement cost after investigation of the problem.

More details of the proposed guarantee program are presented below:

1. Goals the guarantee program is to accomplish

Addressing many of the information and incentive issues identified earlier, the green guarantee program can be an effective way to incentivize sustainable development by standardizing and stabilizing the green lending activities. Ensuring energy usage and longevity of green features, the program can greatly reduce perceived risks to conventional homebuyers and lenders to invest in green homes. The program can be carried out with expertise from developers, architects, engineers, contractors, utility companies, rating agencies, government programs, etc., so that green development

models can be tested, adjusted, and replicated with technical and financial support in economies of scale. Goals that the guarantee programs is to accomplish are:

a. Collect and apply information/data more efficiently

There will be a network of expertise in all disciplines for green affordable housing development, which can have stronger outreach power to collect and distribute information more efficiently. This network can also circulate information within the guarantee program team to validate and digest data in order to improve the quality of data application. With increasing acknowledgement of the *tangible* benefits of green homes, it is hoped that green features providing *intangible* green benefits can also be evaluated and more actively promoted in the future.

b. Smooth the green design and development process through a vertically integrated team of professionals, with well-aligned incentives

Compared to the general real estate industry, consensus based on green features can be reached with better understanding and communication *within* the program network, so that green design methods can be applied effectively with collaborative efforts.

c. Promote a whole system design

Furthermore, in the green guarantee program a bundle of green features will be promoted as a whole system, unlike utility rebate programs, where green features are separately evaluated and implemented.

d. Facilitate better loan terms and simplify deals to incentivize developers and investors

The guarantee program can help to translate green features into future operating savings. With this guarantee program as backup, investors will feel more comfortable with the non-conventional green investment. Especially when there are several lenders for a affordable housing project, the standardization of a project is critical to bring everyone on board in a timely manner. The concept is similar to the use of the FHA guarantee in home mortgages in terms of reducing default risks by a guarantee program with government's backup, and to the use of securitization in real estate financing in terms of increasing non-experts' confidence through standardized and simplified transactions. Therefore, like

other loan guarantee programs, this green guarantee can facilitate lower interest rates and/or higher Loan to Value ratios (LTVs), to incentivize developers and lenders.

e. Reduce both costs and risks for green development with concentrated expertise, accumulated experience, and a diversified portfolio of green features

The green guarantee program can hire or conveniently consult experts to better understand and design green projects, accumulate experience, and document more cost-benefit data through practice concentrated on green affordable housing projects. With more expertise and experience, the team led by the guarantee program can develop green housing with lower cost and risks than individual developers.

Furthermore, everything cannot go wrong at the same time. The overall investment risks will be much lower for a portfolio of green housing projects with diversified green features, than the risk of several green features to a single green housing project. For example, the collapse of Ground Source Heat Pump heating and cooling system in Cambridge Cohousing and the Heat Recovery Ventilator in the Upham's Corner Market project, would have been relatively less economically disastrous, were they part of a green portfolio that had stronger economic base to absorb the replacement costs. Meanwhile, the failures can serve as valuable experience for other projects in the portfolio.

f. Serve as a pilot/seed program with working models to build up acknowledgement and confidence of green development in the affordable housing industry and public

When the general affordable housing industry is still not confident enough to participate in green development, this guarantee program could serve as a pilot program and set up a working model that proves the feasibility and benefits of green affordable housing through practice, and attracts more and more participants and public attention.

g. Enable a higher leverage of private financing sources

Compared to other possible financing tools, such as below market lending and subordinate debt, the guarantee program will need less funding and will have more leverage of private financing. Outlay does not occur unless under-performance happens.

In general, the green guarantee program can address many of the green development barriers identified in chapter II, as shown in Exhibit 11:

Exhibit 11: The green guarantee programs can address many barriers to green affordable housing development

	Barriers	How the guarantee program may help to address the issues
General Building Industry Issues	a. Conservative building professionals	Best practices supported by the green guarantee program will serve as working models to promote green development.
	b. Code barriers	The program can facilitate adjustments of building codes through accumulated experience.
Lack of Information	a. Limited information	The professionals within the guarantee network will have stronger outreach power for information collecting, validating, and distributing.
	b. Performance uncertainties	More cases will facilitate better understanding of green features and a bigger portfolio of green products will diversify investment risks.
	c. Perceived higher initial costs	Green features are evaluated over the life of the project rather than solely on initial cost, so the perceived higher initial cost can be shifted or out weighted by future savings.
Design / development	a. Limited capacity and lack of public education about green features	The expert team can serve as out-sourcing for developers and facilitate public education with strong green expertise.
	b. Lack of Collaborative efforts among professionals	The development process is vertically integrated within the green guarantee program, so the team of experts in different professional disciplines can work more collaboratively.
	c. Lack of incentives for design professionals	Part of an "avant-garde" development team, architect and engineer firms can have PR benefits; fees based partly on performance can mitigate the disincentives to down-size systems.
Financing	a. Long-term operating savings not reflected in the market	Long-term savings can be taken into account of project values in the new underwriting standards with loan guarantees.
	b. Interests not well-aligned	By implementing green features, developers can have better access to financing and higher property value, and owners can have the long term operating savings: a win-win situation.
	c. Lack of marketing for financing tools	The guarantee program can be paired up with other green financing tools, developing and sharing marketing resources. Other professionals in the guarantee program can also help to reach out through different industry channels.
	d. Subsidy/rebate programs as double-edged swords	The green guarantee program should also work even without subsidies, which, to certain extent, proves the self-efficient characteristics of green features.
For affordable housing development	Regulatory burdens	Government may provide the guarantee program regulatory support.
	Limited development / maintenance capacity and resources	The guarantee program can provide technical assistance to non-profit organizations for green affordable housing development and staff training.

2. Entities/pilot programs to lead the green guarantee program

- Whose problem is green development?

As is argued in chapter II, government, although may not be the most effective party to promote green development, is responsible and can provide strong regulatory and financial support.

In 1977, the Department of Energy was created to address the issues of energy usage. In 1993, sustainability was chosen as the theme of the UIA/AIA World congress, and the newly elected U.S. president, Bill Clinton, announced plans to make the White House "a model for efficiency and waste reduction," which achieved an annual saving of $300,000 in energy, water, solid-waste costs, and landscape expense. In 1999, the President's Council on Sustainable Development recommended 140 actions, many of which are about building sustainability.

However, mostly through *ownership and operations*, these efforts achieved less effect on the green building industry evolution than other *information* and *incentive* programs that are supported by the government (e.g. Energy Star, a joint effort by DOE and EPA).

- Who should take the lead? What is the government's role?

As shown in previous chapters, there are already many programs and incentives in place, and should be built upon. The guarantee program should also take advantage of the existing green programs, advocates, memberships, partnerships, rather than create everything from scratch.

With increasing national popularity and acceptance, USGBC can be a perfect carrier of the proposed guarantee program. It has 1) LEED registration for broad categories of green features that can be implemented into the guarantee program in the long run and 2) a diversity of membership around the country to ensure maximum collaboration of expertise and industry acknowledgement.

1) Although at the beginning, the guarantee program mainly ensures the energy-efficient green features, which are the most tangible, easy-to-measure, and fast-payback green strategies, many other green features will be attempted to build into the program gradually in the long run as the market and technologies mature. LEED was developed by examining various building rating models (Texas's, Austin's, a Canadian model, etc.), and trying to adopt some already-in-use national standards including EPA/DOE's Energy Star Benchmarking Tool and other less well known standards to set the LEED standards. Meanwhile, LEED has a comparatively broader set of goals for energy impacts, so new standards were also created in the new categories. Therefore, LEED has a most conclusive set of green strategies that are valuable to the guarantee program.

2) As shown in Exhibit 12[75], there is a good composition of building professionals, research organizations/institutes, government agencies, and utility companies, so that communication and collaboration among the stakeholders can be facilitated. The guarantee program can start with green-award-winning development teams that already have some relevant experience, and in regions that have relatively more programs and practices, and bigger market for green buildings. The green guarantee program will facilitate an optimized learning curve for participants with accumulated experience through practice. Eventually, there will be a core team of development consultants to maximize the utilization of available resources for green development (Figure 7).

Exhibit 12: Who belongs to the USGBC?

Professional firms	2256
Contractors, builders	410
Product manufacturers	244
Nonprofit organizations	134
State and local governments	118
Universities, research institutes	96
Building owners, real estate firms	35
Federal agencies	25
Utilities	19
Corporate and retail	11
Retail	11
Financial, insurance firms	3
Total	**3376**

Source: U.S. Green Building Council, October 2003

[75] Building Design &Construction, "White Paper on Sustainability", November 2003

Figure 7: Green building development with consultants serve as coordinators between available promotion tools and development teams

The guarantee program can also borrow experience from or build partnership with existing guarantee programs (e.g. SystemVision Guarantee) and energy rating programs (e.g. Energy Star labeled homes), both of which already have many successful cases and best practices. Government can provide support in regulatory adjustments, code modifications, financial backup, etc., to help both the start up and long term sustainability of the guarantee program, but huge outlay from federal budget is not needed. Since the actual risks of green development are lower than the risks perceived by conventional lenders, there are profit margins that the green guarantee program can obtain. By charging a premium based on financing savings, the program can be self-sustainable over the long run.

Government can provide financial support through quasi-public corporations like Fannie Mae to back up the guarantee program. It is also possible to build a secondary market for the green loans to facilitate risk sharing in the future.

3. Proposed development process

a. Development stages

As shown in Exhibit 10, in the three real estate development stages, different types of financing are needed and associated with different levels of investment risks. Because of uncertainties of site condition, financial feasibility, community approvals, etc., projects have the highest risks during the pre-development phase. Since construction loans are conditioned upon permanent financing "take-out" commitment, they have the lowest investment risk. Permanent financing generally has the longest duration and project pro-forma can only serve as a reference rather than an accurate future cash flow guarantee. Over the long run, fluctuating utility expenses and management issues can have great effect on future cash flows available to pay off the loan, so there is certain amount of risk associated with permanent financing.

Exhibit 13: Real estate development phases (Mathew Thall, 2003)

Stage:	**Pre-development**	**Construction**	**Operations**
What happens	Project planned, Design completed, Construction and permanent financing arranged, approvals obtained, (usually) property purchased	Project built Project marketed Project occupied	Project managed and maintained; Capital items replaced over time At the end project sold or re-financed
Type of financing	Pre-development loans; Acquisition loan owner/developer equity	Construction loan Owner/developer equity (sometimes) investor equity	Permanent loan(s) Owner/developer equity (sometimes) investor equity
Duration	6 months- 2years	9 - 18 months	15 - 30 years
Risk level	Highest	Lowest	Moderate

In order to identify the form of support that the green guarantee program should prioritize, for each stage, possible funding source problems that may occur because of green features and potential benefits of better loan terms that can promote green development are discussed in the following paragraphs.

At the *pre-development* stage, there are community development loan funds and community lending intermediaries (e.g. Local Initiatives Support Corporation, the Enterprise Foundation, and the Neighborhood Reinvestment Corporation) that provide

predevelopment funding to non-profit developers to develop affordable housing. Also, attempts for green features may not defer the availability of these pre-development funding sources. In addition, favorable loan terms for pre-development fund may not provide significant savings/benefits to incentivize developers, since the loan amount is relatively small.

With the commitment of permanent loans, *construction* loan lenders may not be worried about green features, which should only have modest impact on the availability of construction financing sources. Meanwhile, since construction loan amount is about 75% of the appraised property value, savings from lower interest rates through the guarantee program can provide stronger incentive to developers to implement green features.

For *permanent* financing, loan amount is large and lending term is longer (15-30 years) with performance uncertainties of the green features. As discussed before, conventional lenders do not feel comfortable to translate future green savings into present project values. Therefore, the green guarantee program can promote green affordable housing development through increased accessibility of permanent financing sources and significant financing savings.

Therefore, the guarantee program should start with permanent financing guarantees. Meanwhile, it can lower overall project risk by providing technical assistance throughout the development process and maintenance consulting or training after completion to ensure construction quality and increase the longevity of the green features implemented.

b. Proposed development process

As shown in figure 8, in addition to developers and consultants that follow the whole development process, rating agencies and A/E professionals also participate in many stages of the project as a team to ensure the quality of the whole-system green design throughout the process. With the certification, the green guarantee program will ensure future operating savings in dollars that can be discounted into Present Values, so that a green projects can be a turn-key investment for the permanent loan lenders. The green homes can also be appraised at higher values with the guarantee to mitigate potential risks associated with green features.

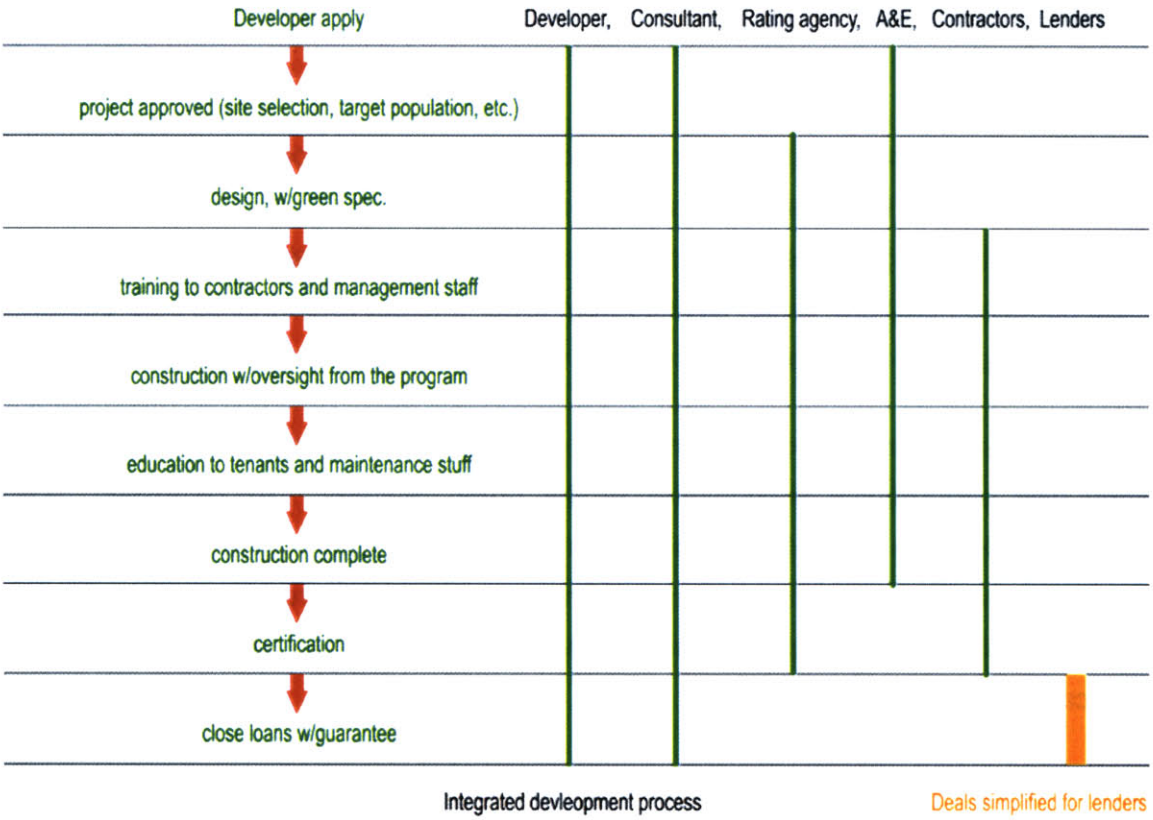


Figure 8: Process of green development with the green guarantee program

4. Financial role of the guarantee program

According to a survey, uncertainty and lack of expertise to understand the green deals are among the biggest barriers of green development. Therefore, by translating the green features into conventional underwriting language and taking the risk of future performance of the green features, the green guarantee program will enable the green projects to have more access to conventional lending sources.

a. For developers and investors

– Benefit from Higher Loan to Value ratios (LTV) and/or lower interest rates

The higher the Opportunity Cost of Capital (OCC) is, more savings there will be. Therefore, for for-profit real estate investors, the option with higher LTVs will be more favorable, since they have higher OCC and can have higher leverage and return of capital. Non-profit developers like Community Development Corporations (CDCs) have lower OCC. Because of low profit margin and limited institutional and debt capacity, they do not want to take too much debt through a higher LTV, but prefer the option with lower mortgage rates to minimize financing costs. The savings from both options are shown in Exhibit 13.

b. For the green guarantee program

– Maintain self-sustainability by charging fees as percentage of financing savings

Exhibit 14: Savings of financing fee with the green guarantee program

Lower Interest Rate with Guarantee

Property Value	$ 1,000			
LTV	0.7			
OCC (Opportunity Cost of Capital)	10.0%			
	Rate	**Term (Yrs)**	**PV**	**Pmt/Yrs**
Conventional Loan Underwriting	6.5%	25	$ 700	$ (57)
Loan Underwriting with Guarantee	6.0%	25	$ 700	$ (54)
PV of Savings	10.0%	25	$ 24	$ (3)
NPV	**$ 24**			
Savings as % of Property Value	**2.4%**			
Savings as % of Loan Amount	**3.4%**			

Higher LTV with Guarantee

Property Value	$ 1,000					
LTV w/Guarantee	0.8					
OCC (Opportunity Cost of Capital)	10.0%					
	Rate	**Term (Yrs)**		**PV**		**Pmt/Yrs**
Conventional Loan Underwriting	6.5%	25	$	700	$	(57)
Loan Underwriting with Guarantee	6.5%	25	$	800	$	(65)
PV of Savings	10.0%	25	$	(74)	$	8
NPV	**$ 26**					
Savings as % of Property Value	**2.6%**					
Savings as % of Loan Amount	**3.3%**					

* Note: cells in shade are assumptions

With the green guarantee program, for every $1,000 of property value, the savings of debt servicing fees through a lower mortgage rate of 6.0% instead of 6.5% have a present value (PV) of $24, which equals 2.4% of the property value ($1000) or 3.4% of the loan amount ($700), while the savings from a higher LTV of 0.8 rather than 0.7 will have a PV of $26, which equals 2.6% of the property value ($1000) and 3.3% of the loan amount ($800), assuming a 25 year term loan, fully amortized monthly. The green guarantee program can be self-sustainable over time by collecting premiums based on the 2.4% - 3.4% savings of debt servicing fees.

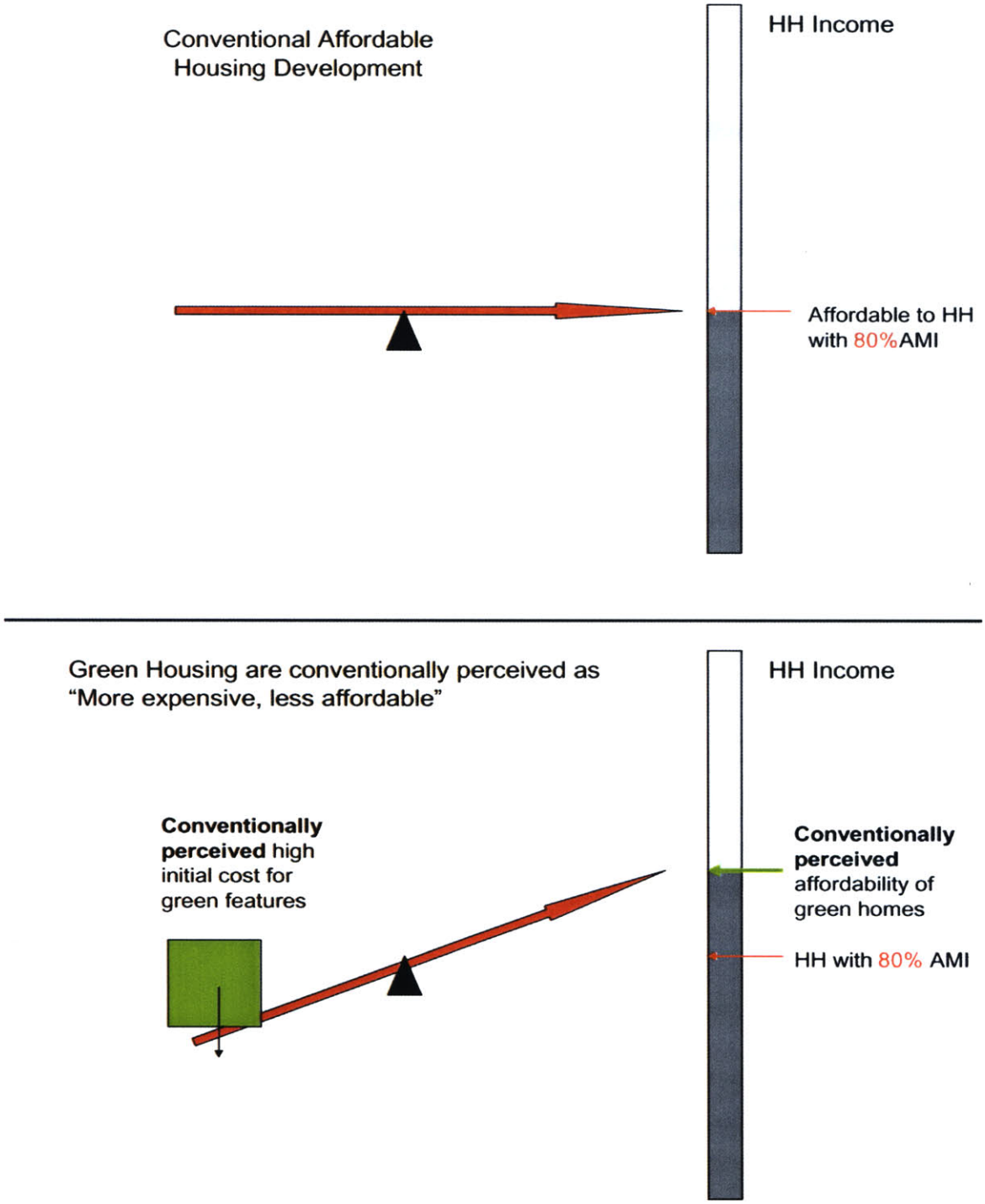
5. Barriers and other concerns

   a. New government regulations/incentives may be needed to clear up some of the code and regulation barriers for the guarantee program. Government may back the program financially for a period that is long enough to test the new green features' longevity.
   b. Residents' interest need to be aligned and their responsibilities (prudent use, maximum thermostat settings, etc.) clearly defined as conditions of the guarantee.
   c. LEED rating for residential properties are still under development, and there may be additional issues to be address for affordable homes.

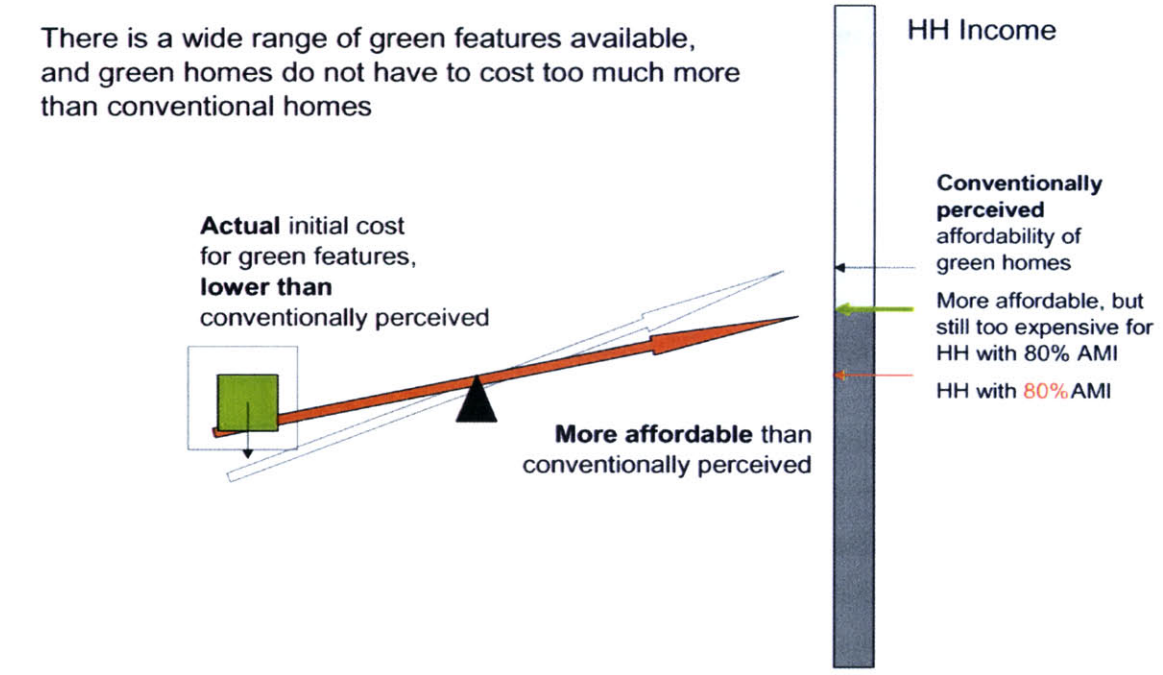
VI. CONCLUSIONS

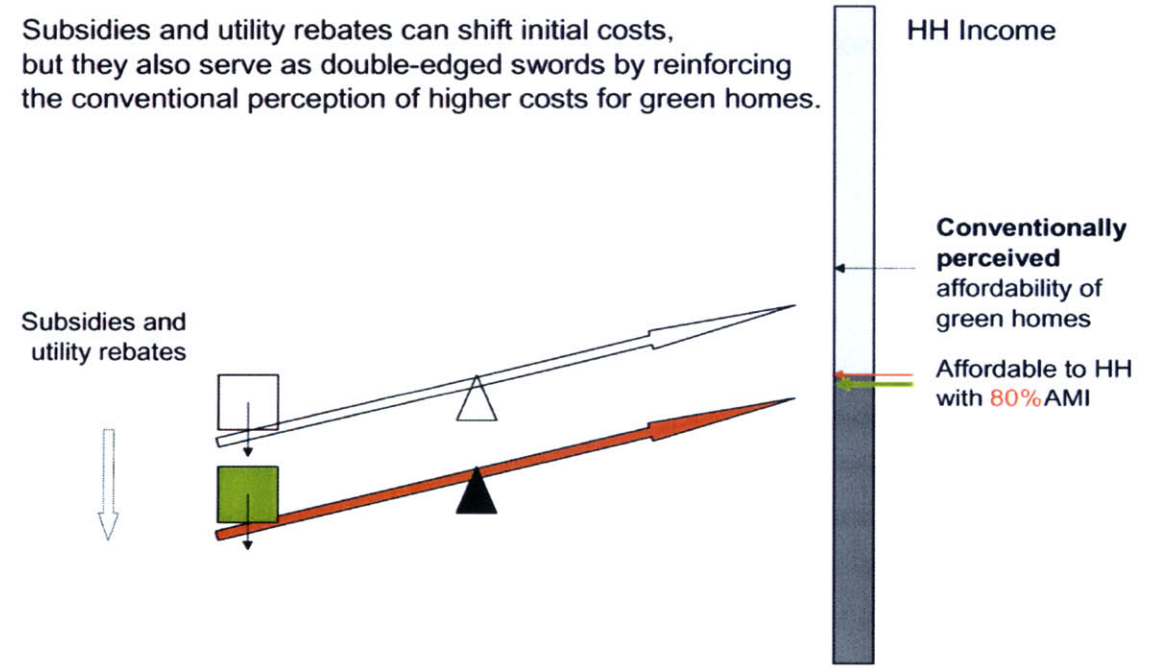
A. Summary of Findings

This thesis demonstrates that it is important to design and develop sustainable housing and that with the available technologies and financing tools, green features not only make environmental sense, but also make economic sense when applied to affordable housing.

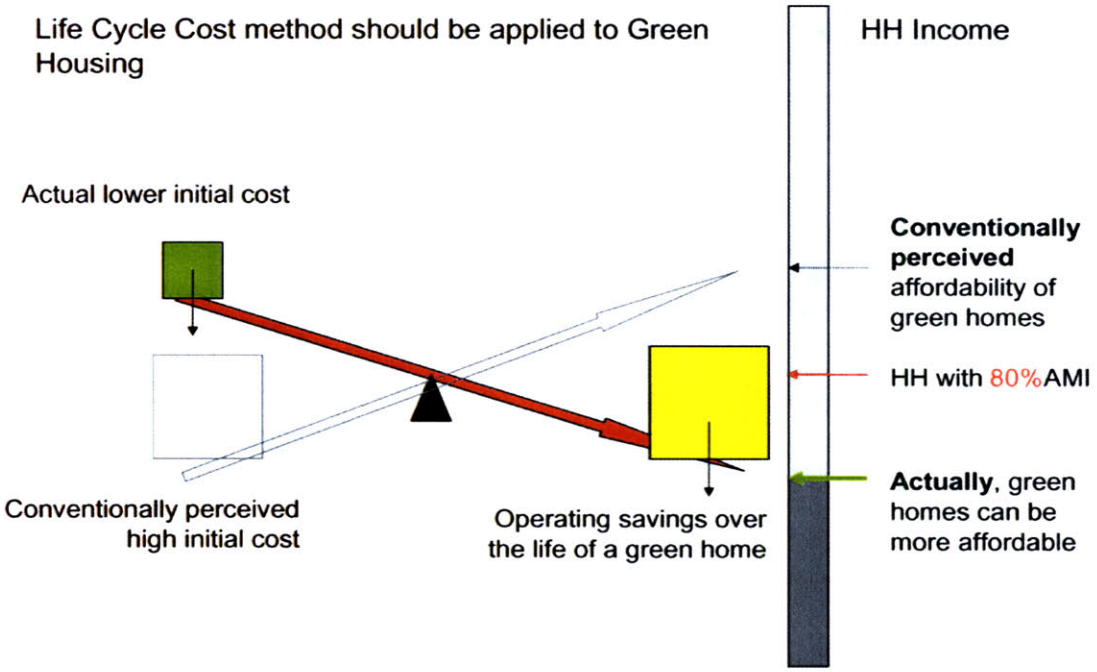


Figures 9 - 10: It is conventionally perceived that the implementation of green features will increase housing costs and lower affordability.





Figures 11 - 12: Actual initial costs for green homes are lower than perceived, while subsidies and rebates can lower the costs to make the homes affordable.



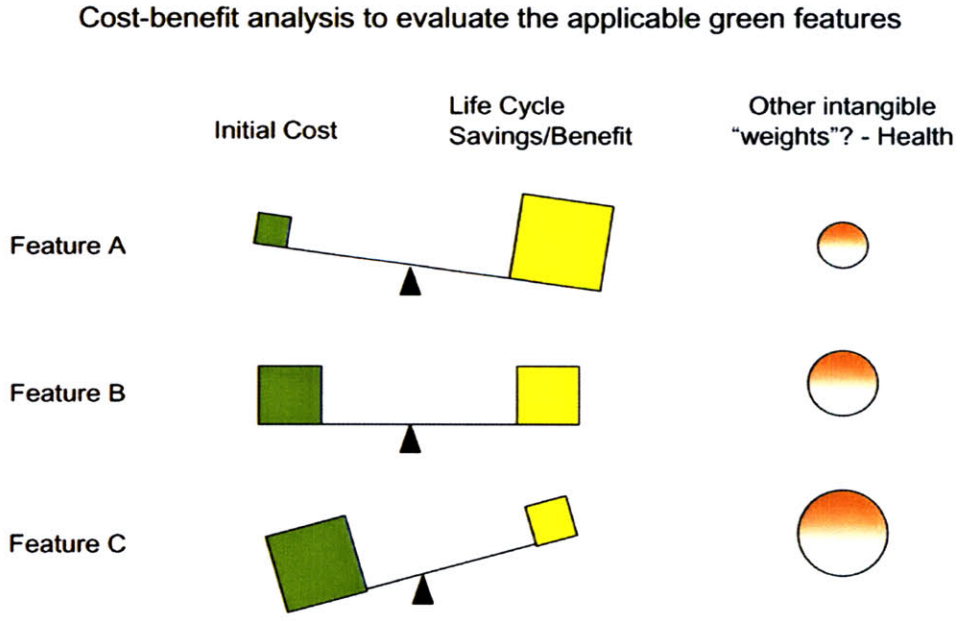


Figure 13 - 14: Some green features can lower the life cycle costs of green homes, while ranking of green features based on life cycle analysis can help decision makers to prioritize certain features ***within*** limited development budgets.

However, besides benefits and monetary support, there are barriers to green affordable housing development. Taking a green affordable housing project, the Upham's Corner Market project, as an example, there are not only the general barriers to green building development, green affordable housing development faces additional barriers such as regulatory burdens, complexity of financing, organizational capacity, and sensitivity to costs. Green information and incentives, as important tools to promote green development, are closely examined with suggestions to collect and use information efficiently and to design and apply incentives more effectively. A green guarantee program is proposed as an example to standardize and simplify the green affordable housing development process with effectively collected and distributed information and well aligned incentives for stakeholders.

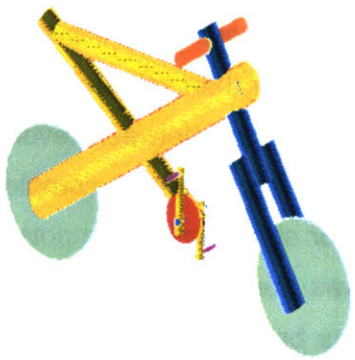


Figure 15: A "bicycle" made (almost) entirely out of paper products. Image from Stanford University, Center of Design Research.

Developing green buildings can be likened to designing and building a paper bicycle. All parts are explicitly designed with "special" paper manufactured with advanced technologies. People may be curious at first and want to see how others can make and ride paper bicycles. Some parts may not fit in the system, and not only the parts themselves but also the way that they are connected are different from the conventional ones. All the parts need to work together and fit in the whole system to make the bicycle work. However, every individual part may be dependent on the assumption that all other parts are robust and working well. Therefore, when there is any problem with one component, the whole system fails. As in the case of the Upham's Corner Market project, high insulation was specified, with the assumption that the HRV system could provide good ventilation, so when HRV failed, the whole system suffered. Levels of dependency and redundancy of the parts needs to be well balanced.

Not only need all parts be well designed and put together with appropriate redundancy, but also riders need to be educated to use and maintain the innovative paper bicycle in the right condition, not the same as for other traditional bicycles made of metal. For example, riding a paper bicycle in the rain is probably not a good idea.

Similarly, players in the green affordable housing industry can also be likened to parts of a bicycle: all stakeholders have to do their jobs to make sure green homes are designed, financed, constructed, marketed, sold, and maintained properly; while everyone works on the condition that other's jobs are done right to successfully develop the green homes. In this context, the proposed guarantee program serves as a lubricant to smooth the development process and provide redundancy to this process to mitigate development risks, so that the paper bicycle can be put into practice and improved over time.

B. Recommendations for Future Research

Originally the thesis was intended to quantify the cost-benefit characteristics of green features for affordable housing development through life-cycle cost analysis for several cases from the Green CDCs Initiative survey. However, data were not readily available to conduct the study in time. The survey was carefully designed and everyone was committed, but every procedure of the survey has taken longer than scheduled. The survey form had to be revised several times to achieve the balance between levels of details and numbers of potential respondents; test run of the survey cannot be completed in a timely manner due to the delayed feedback; responses for about half of the potential cases have been received one month after the survey was sent out, without all the required information completed. Some data is missing in the break-down cost of green features, some missing in the energy savings part, while the performance of the building seems not well stabilized or as estimated.

More research and surveys on existing green housing projects are recommended to provide more statistically reliable results to stimulate the green affordable housing market, so that barriers and risks can be identified to benefit future development. For example, currently many of the green features are in place only because of the rebate and grant programs, as in the case of the Upham's Corner Market project; had there been more reliable data and guarantees of green savings, more financing for green features could have been obtained through traditional lenders.

More examination and comparison of existing green programs is also recommended. As attached in appendix, there are many programs in place, and it is important to identify the best practices and share experience for success as well as for failure. Some programs were designed carefully but not carried out as planned. Had the

barriers been identified, shared and addressed appropriately, there would have more effective programs in place.

Green affordable housing development has not been actively discussed until recently, and there is still a long way to gather information and test run development models. More government agencies, professionals in different disciplines, and tenants need to be interviewed or surveyed to scrutinize different stakeholders' interests at different stages of green affordable housing development, so that incentives can be better aligned with collaborative efforts. Intangible benefits of green homes through improved indoor air quality should be identified and evaluated over the long run.

For future green advocates, leadership, government's support, and education may be three key factors to promote green development.

- *Leadership in the industry* - Organizations that actively collect and distribute information and research data, aggressively carry out implementation of green features, and set up working models with best practices, can greatly affect the building industry.
- *Support by the government* - Government's sustained support of green development in terms of regulations, grants, tax incentives, and guarantee programs can significantly promote green projects with higher return and lower risks.
- *Education for green development* - Public media, emails, and flyers can be useful in public education about green buildings; architectural schools should put more emphasis on sustainable design education; more architects should be LEED-certified.

In conclusion, green affordable housing is feasible. It provides both environmental and economic benefits to the affordable housing owners and renters. Besides the huge development potentials, it also has many barriers to be addressed through more efficient application of information and incentives in the green building and the affordable housing industries.

VII. APPENDIX

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- Owner/investor/developer – Robert Cowherd (Cambridge Cohousing)
- Researcher on cohousing – Jason Robert Brown
- Renewable Energy Fund manager – Phil Holahan, Dick Tinsman (MTC)
- Green modular homes manufacturer – Quincy Vale
- Researcher on the Upham's Corner Market project – Kimberly Vermeer
- Architect / LEED(TM) Accredited Professional – Anna (Graham Gund)
- Architect – Iric Rex and Steven Rowland (Mostue & Associates Architects, Inc.)
- Arnie Katz (Advanced Energy, System Vision Guarantee program)

3. List of green building programs

(From a National Association of Homebuilders study done with the Renewable Energy Lab in 2002)

List of Green Building Programs

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16. City of Frisco (TX) Green Building Program
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20. Vermont Built Green (in progress)
21. Southern Arizona Green Building Alliance (in progress)
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40. New Mexico Build America Partner Program, New Mexico
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4. Checklist of green buildings

    a. Green Affordable Housing Checklist

       (By the City of Santa Monica)

GREEN AFFORDABLE HOUSING CHECKLIST

Purpose and Use of the Green Affordable Housing Checklist

The City of Santa Monica Housing and Redevelopment Division strongly encourages the use of environmentally sensitive ("green") building materials and systems in affordable housing developments.

This checklist is intended to encourage developers to consider green building methods and practices in the earliest stages of project planning. On the checklist are a number of recommended green practices, including practices related to energy efficiency; landscaping; framing and carpentry; indoor air quality; and other building systems and materials. Keeping in mind the intended scope of each project, budgetary constraints, availability of materials, and other factors, our goal is that as many of these practices as possible be incorporated into each project.

It should be noted that many green building systems and materials are evolving and becoming increasingly available. Therefore, this checklist is a living document, to be updated as technology and construction practices change.

Costs

Some of these practices involve no additional costs. Others may involve marginally or significantly higher initial costs. Please do not dismiss some items just because they may cost more, as the City may be willing to fund the increased cost in the interest of promoting a healthy environment.

Contractor Bid Packages

If you do not have, or cannot obtain, current costs for certain items on the checklist, please include these as alternatives as part of the contractor bid package in order to determine the cost.

Completing the Checklist

Please complete this checklist to show which green building practices will be included in the project. If you do not intend to include certain practices, or if the practice is not applicable to the project, please provide an explanation on the checklist. Also, please indicate which items will be included as alternatives in the contractor bid package. To facilitate completion of the checklist, the City's Project Analyst is available to assist you.

City of Santa Monica Housing and Redevelopment Division - Green Affordable Housing Checklist -						
Item and Santa Monica Green Building Design and Construction Guideline (SMGBD&CG) reference	*Description*	*Benefit*	*Included in Project*			
			Yes	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
Energy Efficiency						
Energy Efficient Lighting *SM GBD&CG-ES2*	Energy efficient exterior lighting, such as high-pressure sodium. Should be appropriately sized for the location. Interior fluorescent bulbs and (where practical and appropriate) fixtures produce light quantity and quality that is comparable to incandescents, while expending less energy.	Energy efficient lighting reduces energy consumption and lowers utility bills. One compact florescent bulb will pay itself back over ten times over the course of its life through reduced energy use.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Resource Efficient Appliances *SM GBD&CG-WS1*	Refrigerators, water heaters, stoves, dishwashers, and washing machines that are designed to use less energy and water. Most efficient appliances qualify for Energy Star designation.	Appliances, particularly refrigerators and water heaters, are some of the major sources of residential energy use. Reducing energy and water use lowers utility bills while benefiting the environment.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						

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Combined Hydronic Heating *SM GBD&CG-HS8*	This system uses hot water from the water heater for space heating. Applicable for new construction and major rehab only.	Using the water heater for two purposes uses energy more efficiently.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Landscaping						
Low-Water Landscape Designs *SM GBD&CG-LA3* *See Zoning Ordinance Section 9.04.010.04.110 Water Conservation Landscaping*	Low-water landscape designs, such as xeriscape, reduce water use by emphasizing native and/or drought tolerant plants, elimination of turf areas, and minimizing maintenance.	Low-water designs reduce water and maintenance bills and impacts on local water supply infrastructure.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						

City of Santa Monica Housing and Redevelopment Division - Green Affordable Housing Checklist -						
Item and Santa Monica Green Building Design and Construction Guideline (SMGBD&CG) reference	*Description*	*Benefit*	*Included in Project*			
			Yes	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
Water-Efficient Irrigation *SM GBD&CG-LAb*	Water efficient systems, such as drip irrigation, place the correct amount of water directly at the base of each plant thus reducing water use and waste from overwatering.	Water efficient systems help plant growth and overall health by eliminating over watering or excessive drying. They also lower water bills and reduce impacts on water supply infrastructure.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Engineered Lumber and Wood Alternatives						
Oriented Strand Board (OSB) *SM GBD&CG-MA3*	OSB is an alternative to plywood for sheathing, flooring, and roofing.	Plywood requires the use of large-size, typically old growth trees. OSB is made from small pieces of wood, thus eliminating or reducing impacts to forests.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Wood I-Beam *SM GBD&CG-MA3*	Wood I-Beams are an alternative to 2x6s or 2x8s used for floor and roof joists.	Wood I-Beams are engineered to use less wood to perform the same function and are often straighter, thus minimizing wood waste.				
If included, please describe how the item will be used in the project.						

City of Santa Monica Housing and Redevelopment Division **- Green Affordable Housing Checklist -**						
Item and Santa Monica Green Building Design and Construction Guideline (SMGBD&CG) reference	*Description*	*Benefit*	*Included in Project*			
			Yes	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
If not included, please describe why.						
Laminated Wood Fiber Products *SM GBD&CG-MA3*	Gluelam, parlam, microlam, etc. are alternatives to large dimension lumber for trusses, beams, and headers.	Laminate products provide the same strength while eliminating the need to use large-dimension lumber from old-growth sources.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Certified Wood *SM GBD&CG-MA6*	Certified wood is used like conventional lumber for framing, etc. Based on 2001 availability, may be appropriate for new construction and major rehab projects only.	Wood certified by the Forest Stewardship Council has been monitored from the forest to the local supplier to ensure that the wood is harvested, milled, and delivered under environmentally, and socially responsible conditions.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						

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Item and Santa Monica Green Building Design and Construction Guideline (SMGBD&CG) reference	*Description*	*Benefit*	*Included in Project* *Yes*	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
Plastic Lumber *SM GBD&CG-Mab* *SM GBD&CG-LA7*	Plastic lumber is made from recycled plastic products. It can be used as an alternative to wood in non-structural applications such as decking and fencing, depending on field conditions.	Plastic lumber is highly durable and is not susceptible to rot or termite damage. It is also an excellent use of recycled plastics.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Fiber-Cement Siding *SM GBD&CG-Mab* *SM GBD&CG-MA4*	Fiber cement siding can be used as an alternative to redwood or other types of siding.	Fiber cement siding is not susceptible to rot or termites and is fire resistant.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						

City of Santa Monica Housing and Redevelopment Division - Green Affordable Housing Checklist -						
Item and Santa Monica Green Building Design and Construction Guideline (SMGBD&CG) reference	*Description*	*Benefit*	*Included in Project* *Yes*	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
Indoor Air Quality						
No-VOC (volatile organic compound) Paint *SM GBD&CG-MA7*	No-VOC paint is used exactly like conventional paint. Current no-VOC paints are suitable for indoor use only, subject to ongoing maintenance viability.	No-VOC paint does not emit odors related to VOCs. Organic chemicals are widely used as ingredients in household products like paint, adhesives, cleaning supplies, etc. VOCs can cause eye, nose, and throat irritation, loss of coordination, and potentially damage the liver and central nervous system. Outside, VOCs can bond with other pollutants and create ground-level ozone.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Carbon Monoxide Detector	Carbon monoxide detectors monitor the level of this gas in individual dwelling units.	Carbon monoxide is a common indoor air pollutant created by the combustion of natural gas from stoves and heaters and is harmful to human health.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						

City of Santa Monica Housing and Redevelopment Division **- Green Affordable Housing Checklist -**						
Item and Santa Monica Green Building Design and Construction Guideline (SMGBD&CG) reference	*Description*	*Benefit*	*Included in Project* *Yes*	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
Seal Exposed Particle Board *SM GBD&CG-MA7*	Particleboard typically includes formaldehyde. Sealing with a flat, latex-based primer or other suitable material can prevent the off gassing of formaldehyde.	EPA ranks formaldehyde as a probable human carcinogen. Exposure to formaldehyde can cause eye, nose and throat irritation, skin rashes, headaches, nosebleeds, and nausea.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Formaldehyde-Free Cabinets and Counters *SM GBD&CG-MA7*	Particleboard or medium density fiberboard (MDF) in cabinets and counters can be substituted with formaldehyde-free MDF alternatives or products such as strawboard and wheatboard made from agricultural waste.	Cabinets and counters are typically made of particleboard that uses formaldehyde as the binding agent. Minimizing or eliminating formaldehyde-based materials has a positive impact on indoor air quality.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Building Materials						

City of Santa Monica Housing and Redevelopment Division **- Green Affordable Housing Checklist -**						
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			Yes	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
Ceramic Tile *SM GBD&CG-MA4*	Ceramic tile can be used in kitchen and bathroom and counter tops. May be applicable to new construction and major rehab only.	Ceramic tile is long lasting and does not off gas.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						
Linoleum Flooring *SM GBD&CG-MA4*	Linoleum flooring is made of natural, renewable substances such as amber, chalk, cork, and jute. It can be used as an alternative to sheet vinyl, vinyl composite tiles, or carpet.	Most flooring products such as sheet vinyl and carpet off gas volatile organic compounds (VOCs) and are made from non-renewable petroleum-based products. In contrast, linoleum minimizes off gassing and is made from renewable substances.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						

City of Santa Monica Housing and Redevelopment Division **- Green Affordable Housing Checklist -**						
Item and Santa Monica Green Building Design and Construction Guideline (SMGBD&CG) reference	*Description*	*Benefit*	*Included in Project* *Yes*	*No*	*Not Sure--Will Include in Bid Package to Determine Cost*	*N/A*
Recycled Content Insulation *SM GBD&CG-MAb*	Both fiberglass and blown cellulose insulation have recycled content. Fiberglass products are used identically to standard products. Blown cellulose (made of recycled newsprint) requires a special installer.	Recycled-content products support Statewide solid waste diversion goals. Cellulose insulation provides a tighter enclosure than fiberglass.				
If included, please describe how the item will be used in the project.						
If not included, please describe why.						

Green Affordable Housing Bid Checklist

This checklist is to be completed upon conclusion of the bidding process. This information will be used to determine how any remaining project contingencies will be allocated.

Please list below those items that were identified in the Green Affordable Housing Checklist for inclusion in the bid package along with the bid price and the price for the comparable conventional item.

City of Santa Monica Housing and Redevelopment Division - Green Affordable Housing Bid Checklist -			
Green Item	*Bid Cost*	*Standard Item*	*Bid Cost*

b. Greening Portland's Affordable Housing, Design and Construction Guidelines to Improving Environmental Performance, Tenant Health, and Long-Term Durability in Affordable Housing

(By Portland Development Commission and City of Portland Green Building Initiative)

Greening Portland's Affordable Housing

Design and Construction Guidelines to Improving Environmental Performance, Tenant Health, and Long-Term Durability in Affordable Housing

Prepared by Portland Development Commission
And City of Portland Green Building Initiative

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Mission

The purpose of these guidelines is to establish goals and standards to increase the environmental performance and durability for all affordable housing in Portland. The guidelines represent cost effective options that go beyond current codes and standards. Buildings designed and built using these standards will become the models for healthier, environmentally responsive design and construction where occupants collectively enjoy the benefits of decent and healthy housing regardless of income level.

Sustainable Development

The significance of the environmental footprint of buildings is becoming both better and more widely understood by building designers, operators, and owners. According to the Portland Chapter of the American Institute of Architect's Committee on the Environment, the statistics are overwhelming. The construction and operation of buildings consume 35% of total U.S. energy output. More than 60% of the electricity generated in the U.S. is consumed by buildings, accounting for at least 35% of carbon dioxide (CO_2) emissions. Buildings use over 35% of all materials produced in the U.S. and more than 25% of the world's harvested wood. More than 210 million tons of solid waste is generated and disposed of annually, a substantial portion of which is attributed to construction site and building use waste. In the Portland region, delicate wetland areas are being eliminated by construction at the rate of one acre per day. Portland is one of the first metropolitan areas in the country to be challenged with an Endangered Species Act listing within its urban core, further challenging the building industry to reduce impacts to salmon habitats.

Designing, building, and maintaining buildings that are sustainable is an ambitious long-term goal that will require a long-term process of rethinking building design and construction and learning from our experiences. In most instances this is a common sense approach to development that prevents further depletion of natural resources, water quality, air pollution, and global warming. These guidelines were developed to help affordable housing providers to set measurable goals and performance specifications to better design and evaluate projects. With very limited funds and resources, it is important to invest in practices and technologies that measurably improve building's health and durability over the long term. The goal is to develop affordable housing that:

- Are durable and long lasting
- Are cost effective to build and practical to maintain
- Use natural resources and materials efficiently; use materials and products based on their life-cycle environmental impacts.
- Conserve water usage, reduce runoff, and treat waste on-site.
- Maximize energy conservation and efficiency; use renewable energy resources.
- Reduce building footprints, simplify building shapes, and maximize space efficiency (smaller is better).
- Optimize building orientation; integrate natural daylight and ventilation.
- Are healthy by eliminating toxic and harmful materials and finishes in facilities and their surrounding environment.
- Support transportation alternatives.
- Reduce, reuse and recycle materials in all phases of construction and deconstruction; reduce harmful waste products produced during construction.

- Apply maintenance and operational practices that reduce or eliminate harmful effects on people and the natural environment.
- Is designed for future flexibility, expansion, and building demolition; capable of safe and efficient deconstruction

Integrated and Total Systems Approach

The most important element to building a building that achieves environmental goals in a cost-effective manner is using an integrated or total systems approach in its design and construction. The guidelines solidify systems thinking by organizing goals into strategies that should be addressed from the moment the developer sits down with its architect, engineer, and contractor. It is never too early to integrate the strategies into the building's RFP bid process, design strategies, and construction schedule and specs. By developing goals early, first costs can be better contained by making appropriate trade-offs that reduce the likelihood of sensible strategies being value engineered out.

- Retaining professional development team (developer, architect, engineer, landscape architect, contractor, and project manager) knowledgeable and eager to apply environmentally sensitive building principles and practices
- Integrate planning and design process.
- Select qualified contractors by developing a selective bidding process.

Execution

These guidelines are meant to help guide the design and construction of more efficient, healthy, and durable buildings. While not a complete resource - the criteria are designed to help affordable housing providers develop a framework for increased success. The many strategies give the developer, design team, and contractor a variety of options to develop creative solutions and to not preclude rapidly changing technologies and practices. The guidelines are broken into six major categories. Each category area contains a number of cost effective thresholds as indicated in bold. They represent a new base level of performance. **These new thresholds have been integrated into the PDC Rental Housing RFP process as required criteria. All RFP project proposals must demonstrate and commit to the comprehensive inclusion of these threshold criteria to receive funding awards through the RFP process.** The remaining criteria are voluntary. They provide flexibility to weigh how applicants address green building. PDC encourages every applicant to explore cost-effective ways to maximize the number of strategies incorporated into a project. Like other performance criteria, the more strategies incorporated into a proposed project, the more likely it will be funded. However, PDC reserves the right, at its sole discretion, to approve any and all non-threshold criteria (voluntary criteria) contained in a project proposal.

Please see the Rental Housing RFP for a complete description of RFP required information.

Criteria Categories

1. **Enhanced Design & Site:** Sustainable design and site planning integrates design and construction strategies to minimize environmental site impacts, reduce construction costs, maximize energy and resource conservation, improve operational efficiencies, and promote alternative transportation by providing good access to transit, pedestrian, and bike systems.

2. **Energy Conservation:** Energy conservation helps maximize tenant comfort and reduce utility bill Conservation measures also slow the accumulative impacts of energy production and delivery; extraction of non-renewable natural resources, degradation of regional air quality, global warming and increased concentration of pollutants.
3. **Water Conservation:** Water conservation practices help reduces both water and the energy used to deliver and heat water for tenant use. In addition water conservation cuts down on the amount of water discharged from a building, lessening the amount of untreated discharges into the Columbia and Willamette Rivers and the stress on the City's wastewater treatment facilitates.
4. **Conserving Materials & Resources:** Reducing, reusing, and recycling building materials helps conserve local and regional natural resources. There are many green building products on the market and techniques like advanced framing that contribute to more durable and less toxic buildings.
5. **Enhanced Indoor Air Quality** - Minimize exposure of construction and building occupants to toxi materials. Use safe, biodegradable materials and alternatives to hazardous materials. Require and monitor safe handling and disposal of any hazardous materials.
6. **Operations & Maintenance:** The most overlooked element of green building is operations and maintenance (O & M) practices. O & M practices impact both the bottom line building owner's costs and tenants health, comfort, and safety. Green building O & M practices enhances both environmental quality and the economic performance. Building O & M goals should protect the tenant health; maintaining proper building temperature and humidity; promote the ventilation, dilution, and removal of airborne contaminants; eliminate the use of toxic cleaners and pesticides, and provide appropriate lighting and acoustics. In addition, appropriate O & M by tenants and building occupants.

Technical Assistance

- Michael O'Brien, Green Building Specialist, Office of Sustainable Development - Green Building Services, 503-823-5494, mobrien@ci.portland.or.us
- Greg Acker, Architect, Office of Sustainable Development – Green Building Services, 503-823-5431, gacker@ci.portland.or.us
- Michael Prothe, Architect / Construction Coordinator, Portland Development Commission, 503-823-3277, prothem@portlanddev.org

Green Building Criteria for Affordable Housing

Category	Strategies	New	Rehab	Code Required	CSI Division	Cost Premium*
ENHANCED DESIGN & SITE						
site inventory	**Threshold: Inventory site's sunlight, wind/natural cooling capacity and prospects. Survey existing site conditions including structures, lead and/or asbestos, ground contamination, building orientation(s), adjacent buildings, sewer, and water lines. Confirm easements, street and curbs, curb cut locations, gutter and sidewalk. Review locations for storm sewer, surface water drainage pattern, trees and shrubs. Review of trees to be saved should include existing drip line, and required root/drainage protection.**				02	0%
soil & vegetation protection	**Threshold: When surveying site, verify conditions with a minimum level 1 survey to determine soil condition. This should include water table, underground water streams, drainage conditions, compaction, and overall soil quality and/or fill capable for supporting structural footings, slabs, new drainage, and surface pavement. Minimum overall soil condition should not require substantial replacement with clean, uncontaminated and supporting fill without prior knowledge of cost impact. A level 2 survey may be required if undetermined through a level 1 base study.**				02	0%
	Threshold: Evaluate health and viability of existing trees and shrubs on site. Protect root system of any trees and plants to be preserved. Fence drip zones. Do not allow excavation, piling of soil or vehicles to enter the fenced zones. Trees over 8" caliper will be retained unless hazardous or cannot be incorporated into site plan. Such trees will be replaced 1-to-1 in landscaping. Plants may be relocated to provide for efficient use of the site. Specify shade trees whenever possible. Preserve existing street trees or plant new ones at appropriate intervals.				02	0%
	Do not apply herbicides or pesticides during site prep.				02	
	Protect and enhance green space - create landscaping plan that provides for bird and insect habitat, west and south side shading, and tenant gardening. Create native plant associations and communities.				02	
building design & orientation	**Threshold: 1. For new construction, design roof eaves (where applicable to building type and location) to overhang exterior walls and exterior surfaces (12 " minimum). 2. For rehab, construct patios, decks, windowsills, and thresholds to properly drain water away from buildings.**	(1)	(2)		02,06,07,09	< 5%
	Threshold: Design building orientation to maximize solar exposure in winter and shade building from summer sun. Design and dimension building overhangs to protect windows, doors, and people from sun and weather. Plant trees to shade structure's south and west sides where possible.				02,06,07,09	0%
	When possible, reuse large portions of existing structures during renovation or redevelopment.				02,06,07,08,09	
	Reduce building footprint, simplify building shapes, and maximize space efficiency.				02	
Stormwater management and water pollution	**Threshold: Protect site from runoff erosion during construction. Design site erosion control plan based to City of Portland's Erosion Control Manual specifications.**				02	0%
	Threshold: Maximize onsite drainage and water catchment capacity. Design on-site stormwater facilities to City of Portland's Stormwater Manual specifications.				02	0%
	Specify and install permeable surfaces and paving in low traffic areas (fire access, overflow parking, pathways, etc.).				02,03,04	
Transportation access	**Threshold: Provide secure bicycle parking.**				02	0%

	Size parking capacity to meet only minimum local zoning requirements.				02	
	Site building within ¼ mile of mass transit and within ½ mile of stores and services.				02	
ENERGY CONSERVATION						
building envelop & weatherization	**Threshold: In new construction, install high recycled-content insulation with following R values: R-38 ceilings/R-21 walls/R-30 floors/R-15 slab edge. Rehab insulation values depend on preexisting conditions.**				07	< 5%
	Threshold: Specify and install double glazed, low-e windows and sliding doors with U value 0.35 or less.				08	0%
	Threshold: Flash and seal all penetrations between interior spaces and outside. Seal all penetrations for ducting, wiring, plumbing, lights, and fans.				07	0%
	Perform blower door test to determine cost-effective air sealing and combustion safety.				06,07	
	Increase insulation and reduce heat loss on one- and two-story walls with normal loads by using 2x6 @24" on center framing module for exterior walls.				06,07	
	Specify and install exterior insulated core doors.				08	
	Specify and install insulated concrete forms.				03,07	
	Insulate perimeter edge of concrete slab floor with code approved foam board. Insulate between heated space and garage slab.				07	
heating systems	**Threshold: Install radiant/hydronic heating with digital thermostat located in main living area. Systems may include: hydronic baseboard, radiant cove heaters, water heater / water boiler supplied fan assisted heaters. (i.e. "Turbonics"). Size heat supply based on weatherization measures (gas preferred).**				11, 15, 16	5%
	Preferred Path: Install high efficiency gas sealed combustion forced air furnaces (minimum 92% Efficiency Rating) with digital thermostat in main living area. Systems may include gas furnace, gas furnace with integrated water heater. Size heat supply based on weatherization measures.				11, 15, 16	
	Install ductwork inside conditioned space OR seal ductwork in crawls and attics with mastic. Design short runs. Use flex only for straight runs; otherwise use metal.				15	
	Thermally separate living areas from less energy consuming zones like entry, storage, mechanical, and utility areas.				15	
electrical and lighting	**Threshold: Specify and install Energy Star-rated appliances if available, fixtures and lighting systems.**				11,12,15 ,16	< 5%
	Threshold: Specify and install efficient outdoor lighting (30 lumens per watt or better) with low temperature ballasts. Install lamps with automated controls including but not limited to photo sensors, timers, and motion control sensors.				16	< 5%
Renewables	Install solar water heating system.				10,11,15 ,16	
	Purchase green power from local utility.				15,16	
WATER CONSERVATION						
Plumbing	**Threshold: Install water conserving plumbing fixtures: 2.0 gpm showerheads & 1.5 gpm faucet aerators.**				15	< 5%
	Threshold: Install high energy factor water heater (.60 for gas, .93 for electric).				15,16	< 5%
	Threshold: Insulate bottom of hot water tank. Set electric tank on foam board; set gas tank on raised platform. Insulate hot water pipes.				07	< 5%
Irrigation	**Threshold: Use only native and low maintenance plant materials for landscaping, except for edible landscaping, street trees, and lawn. Minimize total area of turf.**				02	0%
	Install high efficiency drip irrigation system.				02, 15	
	Install rainwater catchment system for non-potable water reuse.				02, 15	

CONSERVING MATERIALS & RESOURCES						
waste management & recycling	**Threshold: Develop a waste minimization plan, establishing targets for demolition and construction waste recycling by types of materials. Set up on-site storage for wood, drywall, metal, cardboard, rubble, and organic debris or contract with recycling provider to handle mixed waste. (goal: 80% total waste reuse and recycling by weight).**				01, 02	0%
	Minimize non-recyclable/non-reusable packaging during construction.				01	
foundation	Specify concrete mix with 25% fly ash substitution for Portland cement. Specify recycled aggregate base.				03	
framing	**Threshold: Specify and install engineered structural lumber products.**				06	< 5%
	Threshold: In wood framing, employ advanced framing techniques. This includes 24" framing modules and box headers.				06	0%
	Specify and install salvaged, recycled, and/or certified sustainably harvested lumber products. Do not specify old growth lumber, other than "recovered" or "reused" materials.				06	
	Specify and install regionally manufactured building materials when possible (within 500 miles).				01	
roof & skin	**Threshold: Specify and install durable and recycled content roof and siding with a 25 - 50 year lifetime warranty. When using asphalt composition shingles, install moss inhibitor component such as 'Algae Block'. Install roofing underlay with a minimum 30 lb. building paper. Install siding air infiltration barrier such as Tyvek or Typar per manufacturer's specifications.**				07	< 5%
materials & finishes	**Threshold: If dropped ceiling panels are specified, install panels with recycled content.**				09	0%
	Install formaldehyde-free or low-formaldehyde composites. Replace particleboard with plywood or MDF (e.g., Medite II or Medex) in underlayment, cabinets and storage units.				09,10,12	
	For cabinets and other finish woodwork, use certified sustainably grown wood and				12	
	Specify and install low-toxic, decay-resistant, (no persistent compounds or heavy metals) outdoor materials (ACQ treated wood, plastic lumber, etc.). When possible, consider patio treatment instead of decking.				02,03,04 ,06,09	
	Specify and install recycled content drywall. Install hard surface drywall in high-wear areas.				09	
flooring	**Threshold: Use natural linoleum, tile, or other vinyl alternative in kitchen and bathrooms (if vinyl is necessary, specify vinyl composition tile).**				09	< 5%
	Threshold: Specify and install solid floor finishes and/or nylon or PET carpeting with fiber or waffle pad.				09	< 15%
	Specify and install formaldehyde free underlayment (no particleboard).				06, 09	
ENHANCED INDOOR AIR QUALITY						
finishes	**Threshold: Specify and install solvent free, no VOC or low VOC (below 20 g/liter) paints and primers. Specify and install water-based wood finishes and stains.**				09	< 5%
	Threshold: Specify and install low toxic adhesives and sealants.				09	0%
fresh air ventilation	**Threshold: Specify and install continuous exhaust ventilation OR central exhaust fan ducted to bath. Provide make-up air vents. Specify rated fans with delayed timer controls. Install medium efficiency air filters in ducted forced air systems.**				15,16	< 5%
	Threshold: Properly ventilate building prior to occupancy.				01	0%
	Install kitchen range hood or ceiling exhaust fan to remove excess moisture and odors OR install multi-port attic fan to exhaust kitchen and bathroom.				15,16	
	Use operable windows AND mechanical ventilation systems to assure ample fresh air for building occupants.				08	
	Encourage no smoking policy for building (during construction & occupancy).				01	

OPERATIONS & MAINTENANCE						
	Threshold: Develop maintenance and tenant "operating manual" with specific actions. Provide an operating manual outline with project submittal.				01	0%
	Threshold: Provide adequate space for comprehensive tenant recycling.				01	0%
	Threshold: Develop O & M plan for scheduled maintenance of vents, filters, plumbing, and combustion equipment.				01	0%
	Threshold: Eliminate pesticides and herbicide use on and around building.				01	0%
	Threshold: Use low toxic or citrus based cleaning supplies. Eliminate use of solvents.				01	0%
	Threshold: Design properly ventilated separate storage area for cleaning supplies and paints.				01	0%
	Threshold: Eliminate wet carpet cleaning (steam OK). Use HEPA filters on vacuum cleaners.				01	0%

Bold indicates required Threshold Criteria.

*Cost premium column identifies our best attempt to approximate the cost premium-per-measure. The percentages indicate the cost premium above standard practice or code. Zero-percent indicates cost neutral measures. Costs vary depending on local design and construction costs, materials availability, etc. All cost premium information was verified in discussions with industry practitioners, vendors, developers, and contractors, recognizing that costs will vary from project to project. When properly packaged together, many of the threshold criteria's cost premiums are reduced due to favorable payback periods (payback = the time it takes to pay down/off capital investments through utility and operations & maintenance savings over time).

Construction Specification Institute References (C.S.I. Divisions)

DIVISION 01: General Data
DIVISION 02: Site Work
DIVISION 03: Concrete
DIVISION 04: Masonry
DIVISION 05: Metals
DIVISION 06: Wood & Plastics
DIVISION 07: Thermal & Moisture Protection
DIVISION 08: Doors & Windows
DIVISION 09: Finishes
DIVISION 10: Specialties
DIVISION 11: Equipment
DIVISION 12: Furnishings
DIVISION 13: Special Construction
DIVISION 14: Conveying Systems
DIVISION 15: Mechanical
DIVISION 16: Electrical

c. Home Builder Self-Certification, Remodeler Self-Certification, and Multifamily Self-Certification Checklist

(by Built Green)

HOME BUILDER Self-Certification Checklist

Check items you will be including in this project to qualify for a BUILT GREEN™ star rating. Version 2003

Requirements to Qualify at 1-Star Level (All ★ items plus orientation)

- Program Orientation (one time only)
- Section 1: Build to "Green" Codes & Regulations
- Earn 25 points from Sections 2 through 6, any items
- Prepare/post a jobsite recycling plan (Action Item 5-19)
- Provide an Operations & Maintenance Kit (Action Item 6-1)

Requirements to Qualify at 2-Star Level (100 points minimum)

- Meet 1-Star requirements
- Earn 75 additional points from Sections 2 through 6, with at least 6 points from each Section
- Attend a BUILT GREEN™ approved workshop within past 12 months prior to certification

Requirements to Qualify at 3-Star Level (180 points minimum)

- Meet 2-Star requirements plus 105 additional points

Section One: Build to Green Codes/Regulations

(★) 1-1. Meet Washington State Wtr Use Effcy Stds
(★) 1-2. Meet Stormwater/Site Development Stds
(★) 1-3. Meet Washington State Energy Code
(★) 1-4. Meet Washington State Ventilation/IAQ Code

Section Two: Site and Water

SITE PROTECTION

Overall

(3) 2-1. Build on an infill lot to take advantage of existing infrastructure and reduce development of virgin sites
(10) 2-2. Build in a BUILT GREEN™ development

Protect Site's Natural Features

(3) 2-3. Limit heavy equipment use zone to limit soil compaction
(3) 2-4. Preserve existing native vegetation as landscaping
(3) 2-5. Take extra precautions to protect trees during construction
(3) 2-6. Preserve and protect wetlands, shorelines, bluffs, and other critical areas during construction
(5-10) 2-7. Set aside percentage of site to be left undisturbed

Protect Natural Processes On-Site

(2) 2-8. Install temporary erosion control devices and optimally maintain them
(3) 2-9. Use compost to stabilize disturbed slopes
(2) 2-10. Protect topsoil with mulch or plastic
(3) 2-11. Balance cut and fill, while maintaining original topography
(3) 2-12. Limit grading to 20 ft outside building footprint
(4) 2-13. Amend disturbed soil to a depth of 8 to 10 inches to restore soil environmental functions
(3) 2-14. Replant or donate removed vegetation for immediate reuse
(3) 2-15. Grind landclearing wood and stumps for reuse
(5) 2-16. Use a water management system that allows groundwater to recharge
(5) 2-17. Design to achieve effective impervious surface equivalent to 0% for 5 acres and above; <10% for less than 5 acres
(5) 2-18. Use pervious materials for at least one-third of total area for driveways, walkways, patios
(10) 2-19. Bonus Points: Install vegetated roof system (e.g. eco-roof) to reduce impervious surface
(10) 2-20. Bonus Points: Construct no impervious surfaces outside house footprint

Eliminate Water Pollutants

(1) 2-21. Take extra care to establish and maintain a single stabilized construction entrance (quarry spall or crushed rock)
(1) 2-22. Take extra precautions to install and maintain sediment traps

HOW TO USE THE CHECKLIST

☐ (2) 2—33. Construct tire wash

- Action item to be implemented (★ items are required)
- Order action item appears in Section (numerical)
- Section where action item description appears
- Point value of action item (when range of points, refer to Part I narrative.)
- Check (✓) when completed

(1) 2-23. Establish and post clean up protocol for tire wash
(1) 2-24. Take extra precautions to not dispose of topsoil in lowlands or wetlands
(1) 2-25. Wash out concrete trucks in slab or pavement subbase areas
(1) 2-26. Prohibit burying construction waste
(1) 2-27. When construction is complete, leave no part of the disturbed site uncovered or unstabilized
(1) 2-28. Recycle antifreeze, oil, and oil filters at appropriate outlets
(1) 2-29. Dispose of non-recyclable hazardous waste at legally permitted facilities
(1) 2-30. Establish and post clean up procedures for spills to prevent illegal discharges
(1) 2-31. Reduce hazardous waste through good jobsite housekeeping
(2) 2-32. Provide an infiltration system for rooftop runoff
(2) 2-33. Construct tire wash
(2) 2-34. Use slow-release organic fertilizers to establish vegetation
(2) 2-35. Use less toxic form releasers
(3) 2-36. Use non-toxic or low-toxic outdoor lumber for landscaping (e.g. plastic, least-toxic treated wood)
(4) 2-37. Phase construction so that no more than 60% of site is disturbed at a time and to prevent adverse impacts on adjoining properties or critical areas
(5) 2-38. No clearing or grading during winter months
(2) 2-39. No zinc galvanized ridge caps, copper flashing or copper wires for moss prevention

DESIGN ALTERNATIVES

(4) 2-40. Bonus Points: Provide an accessory dwelling unit or accessory living quarters
(5) 2-41. Bonus Points: Build north area of the lot first, retaining south area for outdoor activities
(5) 2-42. Bonus Points: Provide a front porch
(5) 2-43. Bonus Points: Position garage so it is not in front of house
(2-5) 2-44. Bonus Points: Minimize garage size

_____ Subtotal for Section Two

Section Three: Energy Efficiency

ENVELOPE

Thermal Performance

(10-40) 3-1. Document envelope improvements beyond code (component performance approach)
(1-55) 3-2. Document envelope improvements beyond code (prescriptive approach)
(5) 3-3. Bonus Points: Participate in a program that provides third-party plan review and inspection (e.g., ENERGY STAR®, BUILT SMART)

Air Sealing

(1) 3-4. House wrapped with an exterior air infiltration barrier to manufacturer's specifications
(3) 3-5. Airtight Drywall Approach for framed structures
(3) 3-6. Use airtight building method, such as SIP or ICF
(5) 3-7. Blower door test

Reduce Thermal Bridging

(2) 3-8. Use insulated headers
(2) 3-9. Fully insulate corners (requires 2-stud instead of 3-stud corners)
(2) 3-10. Fully insulate at interior/exterior wall intersection
(1) 3-11. Use energy heels of 6 in. or more on trusses to allow added insulation over top plate
(2) 3-12. Use structural insulated panels
(2) 3-13. Use insulated exterior sheathing
(3) 3-14. Use advanced wall framing—24-in OC, w/double top plate

Solar Design Features

(2) 3-15. Provide south shading—install properly sized overhangs on south facing glazing
(2) 3-16. Orient windows to make the best use of passive solar
(2) 3-17. Provide east and west shading—use glazing with solar heat gain coefficient less than 0.40 or provide natural shading with landscaping
(1-4) 3-18. Demonstrate a reduction in space conditioning energy, using approved energy modeling software

HEATING/COOLING

Distribution

(1) 3-19. Centrally locate heating / cooling system to reduce the size of the distribution system
(1) 3-20. Two properly supported ceiling fan pre-wires
(1) 3-21. Use advanced sealing of ducts using low toxic mastic
(5) 3-22. Performance test duct for air leakage meets third-party review and certification
(5) 3-23. Locate heating / cooling equipment and the distribution system inside the heated space

Controls

(1) 3-24. Install thermostat with on-switch for furnace fan to circulate air

(2) 3-25. Install 60-minute timers or humidistat for bathroom and laundry room fans

(2) 3-26. Install programmable thermostats

Heat Recovery

(3) 3-27. Install a heat recovery ventilator

WATER HEATING

Distribution

(2) 3-28. Locate water heater within 20 pipe feet of highest use

(1) 3-29. Insulate hot and cold water pipes within 3 feet of the hot water heater

Drainwater Heat Recovery

(3) 3-30. Drainwater heat recovery system (DHR)

LIGHTING

Natural Light

(1) 3-31. Light-colored interior finishes

(2) 3-32. Use clerestory for natural lighting

(2) 3-33. Use light tubes for natural lighting and to reduce electric lighting

Solar Powered Lighting

(1) 3-34. Solar-powered walkway or outdoor area lighting

EFFICIENT DESIGN

(2) 3-35. Use building and landscaping plans that reduce heating/cooling loads naturally

ALTERNATIVE SYSTEMS (Bonus Points)

(5) 3-36. Bonus Points: Solar water heating system

(10) 3-37. Bonus Points: More than 2% of house powered by photovoltaic

_____Subtotal for Section Three

Section Four: Health and Indoor Air Quality

OVERALL

(5) 4-1. Assist homeowners with chemical sensitivities to identify preferred IAQ measures and finishes

(5) 4-2. Bonus Points: Builder certified to have taken American Lung Association (ALA) of Washington "Healthy House Professional Training" course

(15) 4-3. Bonus Points: Certify house under ALA Health House Program

JOB-SITE OPERATIONS

(1) 4-4. Use less-toxic cleaners

(1) 4-5. Require workers to use VOC-safe masks

(2) 4-6. Take measures during construction operations to avoid moisture problems later

(2) 4-7. Take measures to avoid problems due to construction dust

(3) 4-8. Ventilate with fans after each new finish is applied

(2) 4-9. No use of unvented heaters during construction

(2) 4-10. Clean duct and furnace thoroughly just before owners move in

(4) 4-11. Involve subs in implementing a healthy building job-site plan for the project

LAYOUT AND MATERIAL SELECTION

(2) 4-12. If using carpet, specify CRI IAQ label

(2) 4-13. Install low pile or less allergen-attracting carpet and pad

(3) 4-14. Limit use of carpet to one-third of home's square footage

(3) 4-15. Optimize air quality in family bedrooms

(2) 4-16. If using carpet, install by tacking (no glue)

(5) 4-17. Detached or no garage OR garage air-sealed from house with automatic exhaust fan

(3) 4-18. Use formaldehyde-free fiberglass insulation

(3) 4-19. Use low-VOC, low-toxic, water-based, solvent-free sealers, grouts, mortars, caulks and adhesives inside the house

(3) 4-20. Use plywood and composites of exterior grade or formaldehyde-free (for interior use)

(3) 4-21. Install cabinets made with formaldehyde-free board and low-toxic finish

(3) 4-22. Use ceramic tile for flooring

(3) 4-23. Use polyethylene piping for plumbing (no PVC)

(3) 4-24. Install natural fiber carpet (e.g. jute, sisal, wool)

(3) 4-25. Use low-VOC /low-toxic interior paints and finishes for large surface areas

(10) 4-26. Bonus Points: No carpet

MOISTURE CONTROL

(1) 4-27. Grade to drain away from buildings

(1) 4-28. Seal at doors, windows, plumbing and electrical penetrations against moisture and air leaks
(1) 4-29. If slab is used, install poly barrier properly; if no slab, bottom of floor is sufficient height above backfilled dirt
(1) 4-30. Vent attic over code requirements to reduce moisture buildup
(1) 4-31. Use roof gutters to drain out onto splash blocks or approved system to drain water away from building
(1) 4-32. Roofs are pitched and flashed properly
(1) 4-33. Design wall system to allow water to drain out in the event of possible water penetration
(2) 4-34. Install "radon" type vent system to eliminate potential moisture problems

AIR DISTRIBUTION AND FILTRATION

(1) 4-35. Prohibit use of electronic filter
(2) 4-36. Install return-air ducts in every bedroom
(1) 4-37. Install ducting/damper for fresh air intake
(3) 4-38. Use medium-efficiency pleated filter or better
(3) 4-39. Balance airflow system based on filter being used
(3) 4-40. Install furnace and/or duct-mounted air cleaner or high efficiency air filter (non-electronic)
(3) 4-41. Install central vacuum, exhausted to outside
(2) 4-42. Provide for cross ventilation using operable windows
(3) 4-43. Install CO detector

HVAC EQUIPMENT

(1) 4-44. Install and test bath, laundry, pool, hot tub, and kitchen exhaust fans (if range top and/or oven are gas fired), vented to outside
(1) 4-45. Install crank timer switches for bath exhaust fans
(2) 4-46. Install bath fan with smooth ducting, minimum 4 in.
(2) 4-47. Install exhaust fans in rooms where office equipment is used
(3) 4-48. Install sealed combustion heating and hot water equipment
(3) 4-49. Install power venting for combustion furnaces and water heating equipment
(3) 4-50. Install exhaust fan in attached garage on timer or wired to door opener
(2) 4-51. Install whole house fan
(2) 4-52. Bonus Points: Provide balanced or slightly positive indoor pressure using controlled ventilation
(10) 4-53. Bonus Points: Install a ductless heating system

_____ Subtotal for Section Four

Section Five: Materials Efficiency

OVERALL

(5) 5-1. OMITTED per 2002 Revisions
(10) 5-2. Enroll project in King County *ConstructionWorks* Program OR in Snohomish County, meets equivalent criteria
(5-25) 5-3. Limit project size

JOBSITE OPERATIONS

Reduce

(1) 5-4. Use suppliers who offer reusable or recyclable packaging
(1) 5-5. Provide weather protection for stored materials
(2) 5-6. Create detailed take-off and provide as cut list to framer
(2) 5-7. Use central cutting area or cut packs
(2) 5-8. Require subcontractors to participate in waste reduction efforts

Reuse

(1) 5-9. Reuse building materials
(1) 5-10. Reuse dimensional lumber
(1) 5-11. Use reusable supplies for operations, such as construction fences, tarps, refillable propane tanks
(1) 5-12. Move leftover materials to next job or provide to owner
(1) 5-13. Reuse spent solvent for cleaning
(1) 5-14. Sell or give away wood scraps
(1) 5-15. Sell or donate reusable items
(1) 5-16. Use reusable forms
(2) 5-17. Purchase used building materials for your job
(2) 5-18. Save and reuse site topsoil

Recycle

(★) 5-19. Prepare jobsite recycling plan and post on site
(2) 5-20. Require subcontractors to participate in recycling efforts
(1) 5-21. Recycle cardboard
(2) 5-22. Recycle metal scraps
(3) 5-23. Recycle wood scrap and broken pallets
(3) 5-24. Recycle packaging
(3) 5-25. Recycle drywall
(3) 5-26. Recycle concrete/asphalt rubble, rock, and brick
(3) 5-27. Recycle paint
(4) 5-28. Recycle asphalt roofing
(5) 5-29. Recycle carpet/carpet padding and upholstery foam
(5) 5-30. Recycle fluorescent lights and ballasts
(5) 5-31. Recycle landclearing and yard waste, soil and sod

DESIGN AND MATERIAL SELECTION

Overall

(1) 5-32. Use standard dimensions in design of structure
(1) 5-33. Install materials with longer life cycles

(2) 5-34. Install locally produced materials
(3) 5-35. Use re-milled salvaged lumber
(3) 5-36. Use wood products certified by FSC or other recognized agency as "sustainable"

Framing

(1) 5-37. Use stacked floor plans
(2) 5-38. Use engineered structural products
(2) 5-39. Use structural insulated panels
(3) 5-40. Use cementitious foam-formed walls with flyash concrete
(3) 5-41. Use finger-jointed framing material (e.g. plates and studs)
(3) 5-42. Use (R-19) 2x6 intermediate framing
(6) 5-43. At least 50% of dimensional lumber is certified sustainable wood (FSC or equal)
(10) 5-44. At least 90% of dimensional lumber and 50% of sheathing is certified sustainable wood (FSC or equal)

Foundation

(1) 5-45. Use regionally produced block
(1) 5-46. Use flyash in concrete
(2) 5-47. Use recycled concrete, asphalt, or glass cullet for base or fill

Sub-Floor

(1) 5-48. Use recycled-content underlayment

Doors

(1) 5-49. Use reconstituted or recycled-content doors
(1) 5-50. No luan doors
(2) 5-51. Use domestically-grown wood interior doors

Finish Floor

(1) 5-52. If using vinyl flooring, use product with recycled content
(1) 5-53. Use recycled-content carpet pad
(3) 5-54. Use recycled-content or renewed carpet
(3) 5-55. Use recycled-content ceramic tile
(3) 5-56. Use linoleum, cork, or bamboo flooring

Interior Walls

(1) 5-57. Use drywall with recycled-content gypsum
(1) 5-58. Use recycled or "reworked" paint and finishes

Exterior Walls

(1) 5-59. Use recycled-content sheathing
(1) 5-60. Use siding with reclaimed or recycled material
(2) 5-61. Use 50-year siding product
(2) 5-62. Use salvaged masonry brick or block
(2) 5-63. Use locally-produced stone or brick

Windows

(1) 5-64. Use wood/composite windows
(1) 5-65. Use finger-jointed wood windows

Cabinetry and Trim

(2) 5-66. If using hardwood trim, use domestic products
(2) 5-67. Use finger-jointed trim
(5) 5-68. Use tropical hardwood trim or cabinets only if FSC certified or equal as "sustainable"
(3) 5-69. Use domestic hardwood trim that is FSC certified or equal

ROOF

(2) 5-70. Use recycled-content roofing material
(2) 5-71. Use 30-year roofing material
(3) 5-72. Use 40-year roof material

INSULATION

(2) 5-73. Use recycled-content insulation
(3) 5-74. Use environmentally friendly foam building products (formaldehyde-free, CFC-free, HCFC-free)

OTHER EXTERIOR

(2) 5-75. Use reclaimed or salvaged material for landscaping walls
(3) 5-76. Use recycled-content plastic or wood polymer lumber for decks and porches
(5) 5-77. Bonus points: Use least toxic pressure treatment for pressure-treated wood (no CCA)

_____ Subtotal for Section Five

Section Six: Promote Environmentally Friendly Homeowner O&M

HOMEOWNER'S KIT

(★) 6-1. Provide owner with operations & maintenance kit

WATER PROTECTION

Outdoor Conservation

(2) 6-2. Mulch landscape beds with 2 in. organic mulch
(1) 6-3. Use grass type requiring less irrigation and minimal maintenance
(3) 6-4. Use compost soil amendments to establish turf and other vegetation with less irrigation
(3) 6-5. Limit use of turf grass to 25% of landscaped area
(3) 6-6. Landscape with plants appropriate for site topography and soil types, emphasizing use of plants with low watering requirements
(4) 6-7. Plumb for greywater irrigation
(5) 6-8. Install rainwater collection system (cistern) for reuse
(10) 6-9. Bonus Points: Install irrigation system using recycled water
(10) 6-10. Bonus points: No turf grass

Indoor Conservation

(1) 6-11. Select bathroom faucets with GPM less than code
(1) 6-12. Select kitchen faucets with GPM less than code
(1) 6-13. Select toilets that meet code, work with the first flush
(3) 6-14. Install (tankless) instant hot water systems (where appropriate)
(5) 6-15. Bonus points: Stub-in plumbing to use greywater water for toilet flushing
(10) 6-16. Bonus points: Use greywater water for toilet flushing
(10) 6-17. Bonus points: Install composting toilets

Eliminate Water Pollutants

(1) 6-18. Educate homeowners about fish-friendly moss control
(4) 6-19. Provide food waste chutes and compost or worm bins instead of a food garbage disposal

ENERGY

Heating/Cooling

(3) 6-20. Select ENERGY STAR® heating / cooling equipment
(2) 6-21. No gas fireplaces, use direct vent gas or propane hearth product (AFUE rating)
(2) 6-22. No fireplaces or only high efficiency units (Rumsford or Russian fireplace, masonry heater)
(2) 6-23. No air conditioner

Water Heating

(2) 6-24. Passive or on-demand hot water delivery system installed at farthest location from water heater
(3) 6-25. Upgrade electric water heater efficiency from EF of .88 to .93
(3) 6-26. Upgrade gas or propane water heater efficiency from EF of .55 to .60
(4) 6-27. Install the water heater inside the heated space (electric, direct vent, or sealed venting only)
(4) 6-28. Upgrade electric water heater to exhaust air heat pump water heater or de-superheater: EF 1.9
(4) 6-29. Upgrade gas or propane water heater from EF of .55 to .83

Appliances

(1) 6-30. Provide an outdoor clothesline
(1) 6-31. Install gas clothes dryer
(3) 6-32. Install a horizontal-axis or ENERGY STAR® washing machine
(1) 6-33. Install an extra-efficient dishwasher (ENERGY STAR®)
(1) 6-34. Install ENERGY STAR® refrigerator

Efficient Lighting

(1) 6-35. Furnish four compact fluorescent light bulbs to owners (req'd if installing screw-in compacts, See Action Item 6-38)
(1) 6-36. Halogen lighting substituted for incandescent down-lights
(2) 6-37. Install ltg dimmer, timers, and/or motion detectors
(2-5) 6-38. Use compact fluorescent bulbs, ballast, or fixtures in three high-use locations (kitchen, porch/outdoors, and one other location)

Health and Indoor Air Quality

(1) 6-39. Build a lockable storage closet for hazardous cleaning & maint. products, separate from occupied space
(1) 6-40. If installing water filter at sink, select one with biodegradable carbon filter
(1) 6-41. Install showerhead filter

Recycling

(2) 6-42. Provide garage sorting bins for recyclable materials
(2) 6-43. Provide built-in kitchen or utility room recycling ctr

_____ Subtotal for Section Six

EXTRA CREDIT

(1-10) A-1. Extra credit for innovation

_____ **Total Points for Project**

Program Level Obtained:

1-Star ★ 2-Star ★★ 3-Star ★★★

By my signature, I certify that I have performed all Action Items checked above:

_____

(Home Builder Signature and Date)

2002 Revision Note

The point values on this checklist have been revised effective January 1, 2002. Because Parts I and II have *not* yet been revised, the point values as they appear in the narrative of Parts I and II may differ from the checklist. ***Use this checklist for the correct point assignments.***

Appendix A 2003 Revisions

A-1 Extra Credit for Innovation 1-10 Points

This Action Item recognizes builders for using innovation and emerging technologies, practices, and products that fulfill the intentions of the program, but are not called out in the checklist.

Builders can earn up to 10 points by submitting a short written justification for the extra credit points to the Built Green™ Executive Committee for review, approval, and award of points. Builders are encouraged to recommend point values (up to 10) for their submittals in line with the Home Builder Program. The Executive Committee will evaluate the submittal and recommended points, then they will determine final point awards. For instance, an innovative educational poster for the Model may be valued at 2 points, while creating a full-scale low-watering, low-maintenance demonstration landscape at the model may be valued at ten points. Other ideas include a program to donate usable building materialsand incorporating emerging energy efficiency technologies.

A-1 Extra Credit for Innovation (Resources)

See Built Green™ Resource Library.

REMODELER Self-Certification Checklist

Check items you will be including in this project to qualify for a BUILT GREEN™ star rating.

Requirements to Qualify at 1-Star Level (All H items plus orientation)

- Program Orientation (one time only)
- Section 1: Build to "Green" Codes & Regulations
- Earn 15 points from Sections 2 through 6, any items
- Prepare/post a jobsite recycling plan (Action Item 5-20)
- Provide an Operations & Maintenance Kit (Action Item 6-1)

Requirements to Qualify at 2-Star Level (60 points minimum for addition/remodel; 45 points for small remodel)

- Meet 1-Star requirements
- Earn 45 additional points from Sections 2 through 6 (30 additional points for small remodel), with at least 3 points from each Section
- Attend a BUILT GREEN™ approved workshop within past 12 months prior to certification

Requirements to Qualify at 3-Star Level (130 points minimum for addition; 100 points for remodel)

- Meet 2-Star requirements plus 70 additional points

Section One: Build to Green Codes/Regulations

- ☐ (H) 1-1. Meet Washington State Water Use Efficiency Standards
- ☐ (H) 1-2. Meet Applicable Stormwater/Site Development Standards
- ☐ (H) 1-3. Meet Washington State Energy Code
- ☐ (H) 1-4. Meet Washington State Ventilation/IAQ Code

Section Two: Site and Water

SITE PROTECTION

Protect Site's Natural Features

- ☐ (3) 2-1. Limit heavy equipment use zone to limit soil compaction
- ☐ (3) 2-2. Preserve existing native vegetation as landscaping
- ☐ (3) 2-3. Take extra precautions to protect trees during construction
- ☐ (3) 2-4. Preserve and protect wetlands, shorelines, bluffs, and other critical areas during construction

Protect Natural Processes On-Site

- ☐ (1) 2-5. Install temporary erosion control devices and optimally maintain them
- ☐ (1) 2-6. Use compost to stabilize disturbed slopes
- ☐ (1) 2-7. Protect topsoil with mulch or plastic
- ☐ (3) 2-8. Balance cut and fill, while maintaining original topography
- ☐ (3) 2-9. Limit grading to 20 ft outside building footprint
- ☐ (4) 2-10. Amend disturbed soil to a depth of 8 to 10 inches to restore soil environmental functions
- ☐ (5) 2-11. Replant or donate removed vegetation for immediate reuse
- ☐ (5) 2-12. Use a water management system that allows groundwater to recharge
- ☐ (5) 2-13. Design to reduce effective impervious surface
- ☐ (5) 2-14. Use pervious materials for any new driveways, walkways, patios
- ☐ (5) 2-15. No increase to the building footprint
- ☐ (10-15) 2-16. Bonus Points: Install vegetated roof system (e.g. eco-roof) to reduce impervious surface
- ☐ (3) 2-17. Bonus Points: Construct no additional impervious surfaces outside house footprint

HOW TO USE THE CHECKLIST

☐ (5) 2—35 Bonus Points: Provide a front porch

- Action item to be implemented (H items are required)
- Order action item appears in Section (numerical)
- Section where action item description appears
- Point value of action item (when range of points, refer to Part I narrative.)
- Check (✓) when completed

Eliminate Water Pollutants

- ☐ (1) 2-18. Take extra care to establish and maintain a single stabilized construction entrance (quarry spall or crushed rock)
- ☐ (1) 2-19. Take extra precautions to install and maintain sediment traps
- ☐ (1) 2-20. Take extra precautions to not dispose of topsoil in lowlands or wetlands
- ☐ (1) 2-21. Wash out concrete trucks in slab or pavement subbase areas
- ☐ (1) 2-22. Prohibit burying construction waste
- ☐ (1) 2-23. When construction is complete, leave no part of the disturbed site uncovered or unstabilized
- ☐ (1) 2-24. Recycle antifreeze, oil, and oil filters at appropriate outlets
- ☐ (1) 2-25. Dispose of non-recyclable hazardous waste at legally permitted facilities
- ☐ (1) 2-26. Establish and post clean up procedures for spills to prevent illegal discharges
- ☐ (2) 2-27. Reduce hazardous waste through good jobsite housekeeping
- ☐ (2) 2-28. Provide an infiltration system for rooftop runoff
- ☐ (2) 2-29. Use slow-release organic fertilizers to establish vegetation
- ☐ (2) 2-30. Use less toxic form releasers
- ☐ (3) 2-31. Use non-toxic or low-toxic outdoor lumber for landscaping (e.g. plastic, least-toxic treated wood)
- ☐ (5) 2-32. No clearing or grading during winter months
- ☐ (5) 2-33. No zinc galvanized ridge caps, copper flashing or copper wires for moss prevention

DESIGN ALTERNATIVES

- ☐ (5) 2-34. Bonus Points: Provide an accessory dwelling unit or accessory living quarters
- ☐ (5) 2-35. Bonus Points: Provide a front porch
- ☐ (5) 2-36. Bonus Points: If adding a garage, position garage so it is not in front of house
- ☐ (2-5) 2-37. Bonus Points: If adding a garage, minimize garage size

_____ Subtotal for Section Two

Section Three: Energy Efficiency

ENVELOPE

Thermal Performance

- ☐ (10-40) 3-1. Improve overall energy efficiency of entire building, including addition, and document envelope improvements of addition beyond code (component performance approach)

Air Sealing

- ☐ (1) 3-2 Inspect and install weatherstripping
- ☐ (1) 3-3. Addition wrapped with an exterior air infiltration barrier to manufacturer's specifications
- ☐ (2) 3-4. Airtight Drywall Approach for framing in addition/remodel structures
- ☐ (2) 3-5. Use airtight building method, such as SIP or ICF, in addition/remodel structures
- ☐ (2) 3-6. Blower door test

Reduce Thermal Bridging

- ☐ (1) 3-7. Add wall, ceiling, and/or floor insulation
- ☐ (1) 3-8. Use insulated headers in addition/remodel structures
- ☐ (1) 3-9. Fully insulate corners (requires 2-stud instead of 3-stud corners) in addition/remodel structures
- ☐ (1) 3-10. Fully insulate at interior/exterior wall intersection in addition/remodel structures
- ☐ (1) 3-11. Use energy heels of 6 in. or more on trusses to allow added insulation over top plate in addition/remodel structures
- ☐ (2) 3-12. Use structural insulated panels in addition/remodel structures
- ☐ (2) 3-13. Use insulated exterior sheathing in addition/remodel structures
- ☐ (2) 3-14. Use blown-in insulation
- ☐ (3) 3-15. Use advanced wall framing—24-in OC, w/double top plate in addition/remodel structures
- ☐ (3) 3-16. Use NFRC certified windows with a U-factor of 0.35 or better for new or replaced windows (0.45 or below for new or replaced skylights)

Solar Design Features

- ☐ (2) 3-17. For south-facing addition/remodel, provide south shading—install properly sized overhangs on south facing glazing
- ☐ (2) 3-18. For addition/remodel, orient windows to make the best use of passive solar
- ☐ (2) 3-19. Provide east and west shading in addition/remodel —use glazing with solar heat gain coefficient less than 0.40 or provide natural shading with landscaping
- ☐ (1-4) 3-20. Demonstrate an overall reduction in space conditioning energy using approved energy modeling software

HEATING/COOLING

Distribution

- ☐ (1) 3-2. Centrally locate heating / cooling system to reduce the size of the distribution system
- ☐ (1) 3-22. One or more properly supported ceiling fan pre-wires in addition/remodel
- ☐ (2) 3-23. If existing duct insulation is less than R-6, insulate ducts to R-11
- ☐ (3) 3-24. Seal ducts using low toxic mastic
- ☐ (3) 3-25. Performance test duct for air leakage meets third-party review and certification
- ☐ (5) 3-26. Locate heating / cooling equipment and the distribution system inside the heated space
- ☐ (5) 3-27. Comprehensive crawl space improvement

Controls

☐ (1) 3-28. Install thermostat with on-switch for furnace fan to circulate air

☐ (1) 3-29. Install 60-minute timers or humidistat for bathroom and laundry room fans

☐ (2) 3-30. Install programmable thermostats with nighttime setback

Heat Recovery

☐ (2) 3-31. Install a heat recovery ventilator

WATER HEATING

Distribution

☐ (1) 3-32. Locate water heater within 20 pipe feet of highest use

☐ (1) 3-33. Insulate hot and cold water pipes within 3 feet of the hot water heater

Drainwater Heat Recovery

☐ (3) 3-34. Drainwater heat recovery system (DHR)

LIGHTING

Natural Light

☐ (1) 3-35. Light-colored interior finishes in addition/remodel

☐ (2) 3-36. Use clerestory for natural lighting in addition/remodel

☐ (2) 3-37. Use light tubes for natural lighting and to reduce electric lighting in addition/remodel

Solar Powered Lighting

☐ (1) 3-38. Replace electric outdoor lighting with solar-powered walkway or outdoor area lighting

EFFICIENT DESIGN

☐ (3) 3-39. For addition/remodel, use building and landscaping plans that reduce heating/cooling loads naturally

ALTERNATIVE SYSTEMS (BONUS POINTS)

☐ (5) 3-40. Bonus Points: Add solar water heating system

☐ (10) 3-41. Bonus Points: Install photovoltaic system so that more than 2% of house powered by PV

_____Subtotal for Section Three

Section Four: Health and Indoor Air Quality

OVERALL

☐ (5) 4-1. Assist homeowners with chemical sensitivities to identify preferred IAQ measures and finishes

☐ (5) 4-2. Bonus Points: Builder certified to have taken American Lung Association (ALA) of Washington "Healthy House Professional Training" course

JOB-SITE OPERATIONS

☐ (1) 4-3. Use less-toxic cleaners

☐ (1) 4-4. Require workers to use VOC-safe masks

☐ (1) 4-5 Isolate construction from non-construction spaces

☐ (2) 4-6. Take measures during construction operations to avoid moisture problems later

☐ (2) 4-7. Take measures to avoid problems due to construction dust

☐ (2) 4-8 Protect exterior building components from water or moisture damage; address existing problems

☐ (3) 4-9. Ventilate with fans after each new finish is applied

☐ (3) 4-10. No use of unvented heaters during construction

☐ (3) 4-11. Clean duct and furnace thoroughly at job completion

☐ (4) 4-12. Involve subs in implementing a healthy building job-site plan for the project

LAYOUT AND MATERIAL SELECTION

☐ (1) 4-13. If using carpet, specify CRI IAQ label

☐ (1) 4-14. Install low pile or less allergen-attracting carpet and pad

☐ (3) 4-15. No carpet in addition/remodel

☐ (3) 4-16. Optimize air quality in family bedrooms

☐ (3) 4-17. If using carpet, install by tacking (no glue)

☐ (3) 4-18. If garage is attached, air-seal it from house and install automatic exhaust fan

☐ (3) 4-19. Use formaldehyde-free fiberglass insulation

☐ (3) 4-20. Use low-VOC, low-toxic, water-based, solvent-free sealers, grouts, mortars, caulks and adhesives inside the house

☐ (3) 4-21. Use plywood and composites of exterior grade or formaldehyde-free (for interior use in addition/remodel)

☐ (3) 4-22. If replacing or installing cabinets, use cabinets made with formaldehyde-free board or exterior grade plywood and low toxic finish

☐ (3) 4-23. Use ceramic tile for flooring in addition/remodel

☐ (3) 4-24. Use polyethylene piping for plumbing (no PVC)

☐ (3) 4-25. If installing and/or replacing carpeting, install natural fiber carpet (e.g. jute, sisal, wool)

☐ (5) 4-26. Use low-VOC /low-toxic interior paints and finishes for large surface areas

☐ (10) 4-27. Bonus Points: No carpet in home

MOISTURE CONTROL

☐ (1) 4-28. Provide cleanable doormat and shoe racks at entry(ies) to home

☐ (1) 4-29. Grade to drain away from home

☐ (1) 4-30. Seal at doors, windows, plumbing and electrical penetrations against moisture and air leaks

☐ (1) 4-31. If slab is used for addition, install poly barrier properly; if no slab, bottom of floor is sufficient height above backfilled dirt with vapor barrier properly installed

☐ (1) 4-32. Add vents to increase attic venting over code requirements to reduce moisture buildup

☐ (1) 4-33. Use roof gutters to drain out onto splash blocks or approved system to drain water away from building

☐ (1) 4-34. New roofs are pitched and flashed properly

☐ (1) 4-35. For new/disturbed exterior walls, design wall system to allow water to drain out in the event of possible water penetration

AIR DISTRIBUTION AND FILTRATION

☐ (1) 4-36. Prohibit use of electronic filter

☐ (1) 4-37. Install return-air ducts in new bedroom(s)

☐ (1) 4-38. Install ducting/damper for fresh air intake

☐ (3) 4-39. "Tune up" air distribution system

☐ (3) 4-40. Test the performance of ventilation systems

☐ (3) 4-41. Upgrade filters to medium-efficiency pleated filter or better

☐ (3) 4-42. Balance airflow system based on filter being used

☐ (3) 4-43. Install furnace and/or duct-mounted air cleaner or high efficiency air filter (non-electronic)

☐ (3) 4-44. Install central vacuum, exhausted to outside

☐ (3) 4-45. Provide for cross ventilation using operable windows in addition/remodel

☐ (3) 4-46. Install CO detector(s)

☐ (3) 4-47. Re-work existing windows that have been painted shut

HVAC EQUIPMENT

☐ (1) 4-48. Install and test bath, laundry, pool, hot tub, and kitchen exhaust fans (if range top and/or oven are gas fired), vented to outside

☐ (1) 4-49. Install crank timer switches for bath exhaust fans

☐ (1) 4-50. Install bath fan with smooth ducting, minimum 4-in. diameter (new baths)

☐ (2) 4-51. Install exhaust fans in rooms where office equipment is used

☐ (2) 4-52. Install sealed combustion heating and hot water equipment

☐ (2) 4-53. Install power venting for combustion furnaces and water heating equipment

☐ (2) 4-54. Install exhaust fan in attached garage on timer or wired to door opener

☐ (2) 4-55. Size new or replaced space heating and/or cooling equipment to no greater than 150% of design heating and cooling loads

☐ (3) 4-56. Replace existing vent fans with higher efficiency units, which are quiet and rated to 1.5 sonos or less

☐ (4) 4-57. Install whole house fan

☐ (5) 4-58. Bonus Points: Provide balanced or slightly positive indoor pressure using controlled ventilation

☐ (5) 4-59. Where appropriate, install furnace fan motor with an electrically commutated (ECM) motor

☐ (10) 4-60. Bonus Points: Seal the forced air heating system with mastic OR install a ductless heating system

☐ (10) 4-61. For pre-1991 homes, upgrade to a whole house ventilation system

_____ Subtotal for Section Four

Section Five: Materials Efficiency

OVERALL

☐ (5) 5-1. Enroll project in King County *ConstructionWorks* program at "Regular" level OR in Snohomish County, meets equivalent criteria

☐ (10) 5-2. Enroll project in King County *ConstructionWorks* Program at "Distinguished" level OR in Snohomish County, meets equivalent criteria

☐ (5-25) 5-3. Limit project size for additions

JOBSITE OPERATIONS

Reduce

☐ (1) 5-4. Use suppliers who offer reusable or recyclable packaging

☐ (1) 5-5. Provide weather protection for stored materials

☐ (2) 5-6. Create detailed take-off and provide as cut list to framer

☐ (2) 5-7. Use central cutting area or cut packs

☐ (3) 5-8. Require subcontractors to participate in waste reduction efforts

Reuse

☐ (1) 5-9. Reuse building materials

☐ (1) 5-10 Reuse, sell, or give away non-code windows for unheated spaces

☐ (1) 5-11. Reuse dimensional lumber

☐ (1) 5-12. Use reusable supplies for operations, such as construction fences, tarps, refillable propane tanks

☐ (1) 5-13. Move leftover materials to next job or provide to owner

☐ (1) 5-14. Reuse spent solvent for cleaning

☐ (1) 5-15. Sell or give away wood scraps

☐ (1) 5-16. Sell or donate reusable items

☐ (2) 5-17. Use reusable forms

☐ (2) 5-18. Purchase used building materials for your job

☐ (2) 5-19. Save and reuse site topsoil

Recycle

☐ (H) 5-20. Prepare jobsite recycling plan and post on site

☐ (3) 5-21. Require subcontractors to participate in recycling efforts

☐ (1) 5-22. Recycle cardboard

☐ (2) 5-23. Recycle metal scraps

☐ (3) 5-24. Recycle wood scrap and broken pallets

☐ (3) 5-25. Recycle packaging

☐ (3) 5-26. Recycle drywall

☐ (3) 5-27. Recycle concrete/asphalt rubble, rock, and brick

☐ (3) 5-28. Recycle paint

☐ (4) 5-29. Recycle asphalt roofing

☐ (5) 5-30. Recycle carpet/carpet padding and upholstery foam

☐ (5) 5-31. Recycle fluorescent lights and ballasts

☐ (5) 5-32. Recycle landclearing and yard waste, soil and sod

Hazardous Waste

☐ (2) 5-33. Follow "best practices" for removal/disposal of asbestos-containing materials

☐ (2) 5-34. Follow "best practices" for removal/disposal of lead-containing materials

DESIGN AND MATERIAL SELECTION

Overall

☐ (1) 5-35. Use standard dimensions in design of addition/remodel

☐ (1) 5-36. Install materials with longer life cycles

☐ (2) 5-37. Install locally produced materials

☐ (3) 5-38. Use re-milled salvaged lumber

☐ (3) 5-39. Use wood products certified by FSC or other recognized agency as "sustainable"

Framing

☐ (1) 5-40. Use stacked floor plans

☐ (1) 5-41. Use engineered structural products

☐ (2) 5-42. Use structural insulated panels

☐ (3) 5-43. Use cementitious foam-formed walls with flyash concrete

☐ (3) 5-44. Use finger-jointed framing material (e.g. plates and studs)

☐ (3) 5-45. Use (R-19) 2x6 intermediate framing

☐ (6) 5-46. At least 50% of dimensional lumber is certified sustainable wood (FSC or equal)

☐ (10) 5-47. At least 90% of dimensional lumber and 50% of sheathing is certified sustainable wood (FSC or equal)

Foundation

☐ (1) 5-48. Use regionally produced block for new foundation

☐ (1) 5-49. Use flyash in concrete for new foundation

☐ (2) 5-50. Use recycled concrete, asphalt, or glass cullet for base or fill for new foundation

Sub-Floor

☐ (1) 5-51. Use recycled-content underlayment for new sub-floor

Doors

☐ (1) 5-52. Use reconstituted or recycled-content doors

☐ (2) 5-53. No luan doors in addition/remodel

☐ (2) 5-54. Use domestically grown wood interior doors

Finish Floor

☐ (1) 5-55. If installing new or replacing existing vinyl flooring, use product with recycled content

☐ (1) 5-56. If installing new or replacing existing carpet, use recycled-content carpet pad

☐ (3) 5-57. If installing new or replacing existing carpet, use recycled-content or renewed carpet

☐ (3) 5-58. Reuse existing wood flooring

☐ (5) 5-59. If installing new tile, use recycled-content ceramic tile

☐ (5) 5-60. If installing new or replacing existing flooring, use linoleum, cork, salvaged wood, or bamboo flooring

Interior Walls

☐ (1) 5-61. Use drywall with recycled-content gypsum

☐ (1) 5-62. Use recycled or "reworked" paint and finishes in addition and for any re-painted surfaces

Exterior Walls

☐ (1) 5-63. Use recycled-content sheathing where new sheathing is used

☐ (1) 5-64. Use siding with reclaimed or recycled material for new or replaced siding

☐ (2) 5-65. Use 50-year siding product for new or replaced siding

☐ (2) 5-66. Use salvaged masonry brick or block for new or replaced exterior

☐ (2) 5-67. Use locally produced stone or brick for new or replaced exterior

Windows

☐ (1) 5-68. Use wood/composite windows for new or replaced windows

☐ (1) 5-69. Use finger-jointed wood windows for new or replaced windows

Cabinetry and Trim

☐ (2) 5-70. If using hardwood trim, use domestic products for new or replaced cabinetry and trim

☐ (2) 5-71. Use finger-jointed trim for new or replaced cabinetry and trim

☐ (3) 5-72. For new or replaced cabinetry / trim, use domestic hardwood trim that is FSC certified or equal

☐ (5) 5-73. For new or replaced cabinetry / trim, use tropical hardwood trim or cabinets only if FSC certified or equal as "sustainable"

Roof

☐ (2) 5-74. Use recycled-content roofing material for new/replaced roofing

☐ (2) 5-75. Use 30-year roofing material for new/replaced roofing

☐ (3) 5-76. Use 40-year roof material for new/replaced roofing

Insulation

☐ (1) 5-77. Use recycled-content insulation

☐ (4) 5-78. Use environmentally friendly foam building products (formaldehyde-free, CFC-free, HCFC-free)

Other Exterior

☐ (2) 5-79. Use reclaimed or salvaged material for landscaping walls

☐ (3) 5-80. Use recycled-content plastic or wood polymer lumber for decks and porches

☐ (5) 5-81. Bonus points: Use least toxic pressure treatment for pressure-treated wood (no CCA)

_____ Subtotal for Section Five

Section Six: Promote Environmentally Friendly HO O&M

HOMEOWNER'S KIT

☐ (H) 6-1. Provide owner with operations & maintenance kit

WATER PROTECTION

Outdoor Conservation

☐ (1) 6-2. Mulch landscape beds with 2 in. organic mulch
☐ (1) 6-3. Use grass type requiring less irrigation and minimal maintenance
☐ (1) 6-4. Use compost soil amendments to establish turf and other vegetation with less irrigation
☐ (1) 6-5. Limit use of turf grass to 25% of landscaped area
☐ (2) 6-6. Landscape with plants appropriate for site topography and soil types, emphasizing use of plants with low watering requirements
☐ (4) 6-7. Plumb for greywater irrigation
☐ (5) 6-8. Install rainwater collection system (cistern) for reuse
☐ (10) 6-9. Bonus Points: Install irrigation system using recycled water
☐ (10) 6-10. Bonus points: No turf grass

Indoor Conservation

☐ (1) 6-11. For new/replaced bathroom faucets, select fixtures with GPM less than code
☐ (1) 6-12. For new/replaced kitchen faucets, select fixtures with GPM less than code
☐ (1) 6-13. For new/replaced toilets, select fixtures that meet code, work with the first flush
☐ (3) 6-14. Install (tankless) instant hot water systems (where appropriate)
☐ (5) 6-15. Bonus points: Stub-in plumbing to use greywater water for toilet flushing
☐ (10) 6-16. Bonus points: Use greywater water for toilet flushing
☐ (10) 6-17. Bonus points: Install composting toilets

Eliminate Water Pollutants

☐ (1) 6-18. Educate homeowners about fish-friendly moss control
☐ (4) 6-19. Provide food waste chutes and compost or worm bins instead of a food garbage disposal

ENERGY

Heating/Cooling

☐ (2) 6-20. Select ENERGY STAR® heating / cooling equipment
☐ (2) 6-21. No gas fireplaces, use direct vent gas or propane hearth product (AFUE rating)
☐ (2) 6-22. No fireplaces or only high efficiency units (Rumsford or Russian fireplace, masonry heater)
☐ (3) 6-23. No air conditioner

Water Heating

☐ (1) 6-24. Passive or on-demand hot water delivery system installed at farthest location from water heater
☐ (3) 6-25. Upgrade electric water heater efficiency from EF of .88 to .93
☐ (3) 6-26. Upgrade gas or propane water heater efficiency from EF of .55 to .60
☐ (4) 6-27. Install the water heater inside the heated space (electric, direct vent, or sealed venting only)
☐ (4) 6-28. Upgrade electric water heater to exhaust air heat pump water heater or de-superheater: EF 1.9
☐ (4) 6-29. Upgrade gas or propane water heater from EF of .55 to .83

Appliances

☐ (1) 6-30. Provide an outdoor clothesline
☐ (1) 6-31. Install gas clothes dryer
☐ (2) 6-32. Install a horizontal-axis or ENERGY STAR® washing machine
☐ (3) 6-33. Install an extra-efficient dishwasher (ENERGY STAR®)
☐ (3) 6-34. Install ENERGY STAR® refrigerator

Efficient Lighting

☐ (1) 6-35. Furnish four compact fluorescent light bulbs to owners (req'd if installing screw-in compacts, See Action Item 6-38)
☐ (1) 6-36. Halogen lighting substituted for incandescent down-lights
☐ (2) 6-37. Install lighting dimmer, timers, and/or motion detectors
☐ (2-5) 6-38. Use compact fluorescent bulbs, ballast, or fixtures in three high-use locations (kitchen, porch/outdoors, and one other location)

Health and Indoor Air Quality

☐ (1) 6-39. Build a lockable storage closet for hazardous cleaning & maintenance products, separate from occupied space
☐ (1) 6-40. If installing water filter at sink, select one with biodegradable carbon filter
☐ (1) 6-41. Install showerhead filter

Recycling

☐ (2) 6-42. Provide garage sorting bins for recyclable materials
☐ (4) 6-43. Provide built-in kitchen or utility room recycling ctr

_____ Subtotal for Section Six

_____ **Total Points for Project**

Program Level Obtained:

o 1-Star H o 2-Star HH o 3-Star HHH

By my signature, I certify that I have performed all Action Items checked above:

_____

(Remodeler Signature and Date)

MULTI-FAMILY Self-Certification Checklist

Check items you will be including in this project to qualify for a BUILT GREEN™ star rating.

Requirements to Qualify at 1-Star Level (All ★ items plus orientation)

- Program Orientation (one time only)
- Section 1: Build to "Green" Codes & Regulations
- Earn 40 points from Sections 2 through 6, any items
- Prepare/post a jobsite recycling plan (Action Item 5-17)
- Provide an Operations & Maintenance Kit (Action Item 6-1)

Requirements to Qualify at 2-Star Level (150 points minimum)

- Meet 1-Star requirements
- Earn 110 additional points from Sections 2 through 6 with at least 10 points from each Section
- Attend a BUILT GREEN™ approved workshop within past 12 months prior to certification

Requirements to Qualify at 3-Star Level (300 points minimum for addition; 100 points for remodel)

- Meet 2-Star requirements plus 150 additional points

SECTION ONE: BUILD TO GREEN CODES/REGULATIONS

- ☐ (★) 1-1. Meet Washington State Water Use Efficiency Standards
- ☐ (★) 1-2. Meet Stormwater/Site Development Standards
- ☐ (★) 1-3. Meet Washington State Energy Code
- ☐ (★) 1-4. Meet Washington State Mechanical Ventilation/IAQ Code

SECTION TWO: SITE AND WATER

SITE PROTECTION

Overall

- ☐ (3) 2-1. Build on an infill lot to take advantage of existing infrastructure and reduce development of virgin sites
- ☐ (10) 2-2. Build in a planned BUILT GREEN™ development

HOW TO USE THE CHECKLIST

☐ (2) 2—32. Construct tire wash

- Action item to be implemented (★ items are required)
- Order action item appears in Section (numerical)
- Section where action item description appears
- Point value of action item (when range of points, refer to Part I narrative.)
- Check (✓) when completed

Protect Site's Natural Features

- ☐ (3) 2-3. Limit heavy equipment use zone to limit soil compaction
- ☐ (3) 2-4. Preserve existing native vegetation as landscaping
- ☐ (3) 2-5. Take extra precautions to protect trees during construction
- ☐ (3) 2-6. Preserve and protect wetlands, shorelines, bluffs, and other critical areas during construction
- ☐ (5-10) 2-7. Set aside percentage of site to be left undisturbed

Protect Natural Processes On-Site

- ☐ (2) 2-8. Install temporary erosion control devices and optimally maintain them
- ☐ (3) 2-9. Use compost to stabilize disturbed slopes
- ☐ (3) 2-10. Retain all native topsoil, and protect stockpiles from erosion
- ☐ (3) 2-11. Balance cut and fill, while maintaining original topography
- ☐ (4) 2-12. Amend disturbed soil to a depth of 8 to 10 inches to restore soil environmental functions
- ☐ (3) 2-13. Replant or donate removed vegetation for immediate reuse
- ☐ (3) 2-14. Grind landclearing wood and stumps for reuse
- ☐ (5) 2-15. Use a water management system that allows groundwater to recharge
- ☐ (5) 2-16. Design to achieve effective impervious surface equivalent to 0% for 5 acres and above; <10% for less than 5 acres
- ☐ (5) 2-17. Use pervious materials for at least one-third of total area for driveways, walkways, patios

☐ (10) 2-18. Install vegetated roof system (e.g. eco-roof) to reduce impervious surface

☐ (10) 2-19. Construct no impervious surfaces outside building footprint

☐ (10) 2-20. On-site wastewater treatment

Eliminate Water Pollutants

☐ (1) 2-21. Take extra care to establish and maintain a single stabilized construction entrance (quarry spall or crushed rock)

☐ (1) 2-22. Take extra precautions to install and maintain sediment traps

☐ (1) 2-23. Establish and post clean up protocol for tire wash

☐ (1) 2-24. Take extra precautions to not dispose of topsoil in lowlands or wetlands

☐ (1) 2-25. Wash out concrete trucks in slab or pavement subbase areas

☐ (1) 2-26. Prohibit burying construction waste

☐ (1) 2-27. When construction is complete, leave no part of the disturbed site uncovered or unstabilized

☐ (1) 2-28. Recycle antifreeze, oil, and oil filters at appropriate outlets

☐ (1) 2-29. Dispose of non-recyclable hazardous waste at legally permitted facilities

☐ (1) 2-30. Establish and post clean up procedures for spills to prevent illegal discharges

☐ (1) 2-31. Reduce hazardous waste through good jobsite housekeeping

☐ (2) 2-32. Construct tire wash

☐ (2) 2-33. Use slow-release organic fertilizers to establish vegetation

☐ (2) 2-34. Use less toxic form releasers

☐ (2) 2-35. Provide an infiltration system for rooftop runoff

☐ (2) 2-36 Install low-mercury T-8 lamps

☐ (3) 2-37. Use non-toxic or low-toxic outdoor lumber for landscaping (e.g. plastic, least-toxic treated wood)

☐ (5) 2-38. No clearing or grading during winter months

☐ (2) 2-39. No zinc galvanized ridge caps, copper flashing or copper wires for moss prevention

DESIGN ALTERNATIVES

☐ (1) 2-40. Integrate landscaping with parking area beyond compliance

☐ (1-3) 2-41. Foster the appreciation of/connection to the natural world through land use and building design

☐ (3) 2-42. Build north area of the lot first, retaining south area for outdoor activities

☐ (3) 2-43. Cluster buildings and design site roadways and parking to preserve open space

☐ (3) 2-44. Choose location to reduce the dependence on automobiles

☐ (3) 2-45. Promote community and security through site and building design

☐ (5-26) 2-46. Create a "mixed use" development

_____ Subtotal for Section Two

SECTION THREE: ENERGY EFFICIENCY

ENVELOPE

Thermal Performance

☐ (10-40) 3-1. Document envelope improvements beyond code (component performance approach)

☐ (1-55) 3-2. Document envelope improvements beyond code (prescriptive approach)

☐ (5) 3-3. Participate in a program that provides third-party plan review and inspection (e.g., ENERGY STAR®, Built Smart)

Air Sealing

☐ (1) 3-4. Building wrapped with an exterior air infiltration barrier to manufacturer's specifications

☐ (3) 3-5. Airtight Drywall Approach for framed structures

☐ (3) 3-6. Use airtight building method, such as SIP or ICF

☐ (3) 3-7. Compartmentalization strategy for air leakage reduction

☐ (5) 3-8. Blower door test on each unit

Reduce Thermal Bridging

☐ (2) 3-9. Use insulated headers

☐ (2) 3-10. Fully insulate corners (requires 2-stud instead of 3-stud corners)

☐ (2) 3-11. Fully insulate at interior/exterior wall intersection

☐ (2) 3-12. Use energy heels of 6 in. or more on trusses to allow added insulation over top plate

☐ (2) 3-13. Use insulated exterior sheathing

☐ (2) 3-14. Use blown-in insulation

☐ (3) 3-15. Use advanced wall framing—24-in OC, w/double top plate

Solar Design Features

☐ (2) 3-16. Provide south shading—install properly sized overhangs on south facing glazing

☐ (2) 3-17. Orient windows to make the best use of passive solar

☐ (2) 3-18. Provide east and west shading—use glazing with solar heat gain coefficient less than 0.40 or provide natural shading with landscaping

☐ (1-4) 3-19. Demonstrate a reduction in space conditioning energy, using approved energy modeling software

HEATING/COOLING

Distribution

☐ (1) 3-20. Centrally locate heating / cooling system to reduce the size of the distribution system

☐ (1) 3-21. Two properly supported ceiling fan pre-wires

☐ (1) 3-22. Install ceiling fans

☐ (1) 3-23. Use advanced sealing of ducts using low toxic mastic

☐ (5) 3-24. Performance test duct for air leakage meets third-party review and certification

☐ (5) 3-25. Locate heating / cooling equipment and the distribution system inside the heated space

Controls

☐ (1) 3-26. Install thermostat with on-switch for furnace fan to circulate air

☐ (1) 3-27. Install thermostat for non-ducted electric heat

☐ (2) 3-28. Install 60-minute timers or humidistat for bathroom and laundry room fans

☐ (2) 3-29. Install programmable thermostats

Heat Recovery

☐ (3) 3-30. Install a heat recovery ventilator

WATER HEATING

Distribution

☐ (2) 3-31. Locate water heater within 20 pipe feet of highest use

☐ (1) 3-32. Insulate hot and cold water pipes within 3 feet of the hot water heater

Drainwater Heat Recovery

☐ (3) 3-33. Drainwater heat recovery system (DHR)

LIGHTING

Natural Light

☐ (1) 3-34. Light-colored interior finishes

☐ (2) 3-35. Use clerestory for natural lighting

☐ (2) 3-36. Use light tubes for natural lighting and to reduce electric lighting

Efficient Lighting

☐ (1) 3-37. Halogen lighting substituted for incandescent downlights

☐ (1) 3-38. Use Energy-Star compliant lighting fixtures

☐ (1) 3-39. Install lighting dimmer, timers, and/or motion detectors

☐ (1-3) 3-40. Use compact fluorescent bulbs, ballast, or fixtures in hallways

☐ (2) 3-41. Avoid excessive outdoor light levels while maintaining adequate light for security and safe access

☐ (3) 3-42. Use a comprehensive approach to high-quality lighting design

Solar Powered Lighting

☐ (1) 3-43. Solar-powered walkway or outdoor area lighting

EFFICIENT DESIGN

☐ (2) 3-44. Use building and landscaping plans that reduce heating/cooling loads naturally

ALTERNATIVE SYSTEMS/METHODS

☐ (3) 3-45. Ultra high efficiency central water heating

☐ (5) 3-46. Solar water heating system for laundry facilities

☐ (5-10) 3-47. Building systems commissioning

☐ (10) 3-48. More than 2% of building powered by photovoltaic

_____ Subtotal for Section Three

SECTION 4: HEALTH AND INDOOR AIR QUALITY

OVERALL

☐ (5) 4-1. Builder certified to have taken American Lung Association (ALA) of Washington "Healthy House Professional Training" course

JOB-SITE OPERATIONS

☐ (1) 4-2. Use less-toxic cleaners

☐ (1) 4-3. Require workers to use VOC-safe masks

☐ (2) 4-4. Take measures during construction operations to avoid moisture problems later

☐ (2) 4-5. Take measures to avoid problems due to construction dust

☐ (3) 4-6. Ventilate with fans after each new finish is applied

☐ (2) 4-7. No use of unvented heaters during construction

☐ (2) 4-8. Clean duct and furnace thoroughly at job completion

☐ (4) 4-9. Involve subs in implementing a healthy building job-site plan for the project

LAYOUT AND MATERIAL SELECTION

☐ (2) 4-10. If using carpet, specify CRI IAQ label

☐ (2) 4-11. Install low pile or less allergen-attracting carpet and pad

☐ (2) 4-12. Avoid carpet in environments where it can get wet

☐ (3) 4-13. Limit use of carpet to one-third of unit's square footage

☐ (3) 4-14. Optimize air quality in family bedrooms

☐ (3) 4-15. If using carpet, install by tacking (no glue)

☐ (3) 4-16. Use formaldehyde-free fiberglass insulation

☐ (3) 4-17. Use low-VOC, low-toxic, water-based, solvent-free sealers, grouts, mortars, caulks and adhesives inside the building

☐ (3) 4-18. Use plywood and composites of exterior grade or formaldehyde-free (for interior use)

☐ (3) 4-19. Install cabinets made with formaldehyde-free board and low-toxic finish

☐ (3) 4-20. Use ceramic tile for flooring

☐ (3) 4-21. Use polyethylene piping for plumbing

☐ (3) 4-22. Install natural fiber carpet (e.g. jute, sisal, wool)

☐ (3) 4-23. Use low-VOC /low-toxic interior paints and finishes for large surface areas

☐ (10) 4-24. No carpet

MOISTURE CONTROL

☐ (1) 4-25. Grade to drain away from buildings

☐ (1) 4-26. Seal at doors, windows, plumbing and electrical penetrations against moisture and air leaks

☐ (1) 4-27. If slab is used, install poly barrier properly; if no slab, bottom of floor is sufficient height above backfilled, poly covered dirt

☐ (1) 4-28. Use roof gutters to drain out onto splash blocks or approved system to drain water away from building

☐ (1) 4-29. Roofs are pitched and flashed properly

☐ (1) 4-30. Design wall system to allow water to dry out when water penetrates

☐ (2) 4-31. Install "radon" type vent system to eliminate potential moisture problems

AIR DISTRIBUTION AND FILTRATION

☐ (1) 4-32. Provide ideal relative humidity and air circulation to prevent IAQ problems

☐ (1) 4-33. Ensure ceiling plenums contain no hazardous/unhealthy materials

☐ (1) 4-34. No stud or joist cavities used as plenums

☐ (1) 4-35. Prohibit use of electronic filter

☐ (2) 4-36. Install return-air ducts in every bedroom

☐ (1) 4-37. Install ducting/damper for fresh air intake

☐ (1) 4-38. Make sure air intakes are placed to avoid intake from air pollutant sources

☐ (1) 4-39. No parking within 40 feet of building air intakes

☐ (3) 4-40. Use medium-efficiency pleated filter or better

☐ (2) 4-41. No fiberglass or fibrous materials in airstream

☐ (3) 4-42. Install furnace and/or duct-mounted air cleaner or high efficiency air filter (non-electronic)

☐ (2) 4-43. Provide for cross ventilation using operable windows

☐ (3) 4-44. Install CO detectors in units with combustion appliances

☐ (2) 4-45. Install CO_2 detectors in community rooms

HVAC EQUIPMENT

☐ (1) 4-46. Design to ensure accessibility of all system components

☐ (1) 4-47. Design to prevent standing water in HVAC system

☐ (1) 4-48. Install and test bath, laundry, pool, hot tub, and kitchen exhaust fans (if range top and/or oven are gas fired), vented to outside

☐ (1) 4-49. Install crank timer switches for bath exhaust fans

☐ (2) 4-50. Install bath fan with smooth ducting, minimum 4 in. diameter

☐ (1) 4-51. Reduced or zero use of ozone-depleting compounds in refrigeration and fire suppression systems

☐ (3) 4-52. Install sealed combustion heating and hot water equipment

☐ (10) 4-53. Install a ductless heating system

_____Subtotal for Section Four

SECTION FIVE: MATERIALS EFFICIENCY

OVERALL

☐ (5) 5-1. OMITTED per 2002 Revisions

☐ (10) 5-2 Enroll project in King County *ConstructionWorks* Program OR in Snohomish County, meet equivalent criteria

☐ (5-25) 5-3. Construct buildings that optimize the use of interior space

JOBSITE OPERATIONS

Reduce

☐ (1) 5-4. Use suppliers who offer reusable or recyclable packaging

☐ (1) 5-5. Provide weather protection for stored materials

☐ (2) 5-6. Create detailed take-off and provide as cut list to framer

☐ (2) 5-7. Use central cutting area or cut packs

☐ (3) 5-8. Require subcontractors to participate in waste reduction efforts

Reuse

☐ (1) 5-9. Reuse building materials

☐ (1) 5-10. Reuse dimensional lumber

☐ (1) 5-11. Use reusable supplies for operations, such as construction fences, tarps, refillable propane tanks

☐ (1) 5-12. Move leftover materials to next job or provide to owner

☐ (1) 5-13. Reuse spent solvent for cleaning

☐ (1) 5-14. Sell or give away wood scraps

☐ (1) 5-15. Sell or donate reusable items

☐ (1) 5-16. Use reusable forms

☐ (1) 5-17. Use used building materials

Recycle

☐ (★) 5-18. Prepare jobsite recycling plan and post on site

☐ (1) 5-19. Recycle cardboard

☐ (2) 5-20. Recycle metal scraps

☐ (3) 5-21. Recycle wood scrap and broken pallets

☐ (3) 5-22. Recycle packaging

☐ (3) 5-23. Recycle concrete/asphalt rubble, rock, and brick

☐ (2) 5-24. Require subcontractors to participate in recycling efforts

☐ (3) 5-25. Recycle drywall

☐ (3) 5-26. Recycle paint

☐ (5) 5-27. Recycle landclearing and yard waste, soil and sod

☐ (4) 5-28. Recycle asphalt roofing

☐ (5) 5-29. Recycle carpet/carpet padding and upholstery foam

☐ (5) 5-30. Recycle fluorescent lights and ballasts

DESIGN AND MATERIAL SELECTION

Overall

☐ (1) 5-31. Use standard dimensions in design of structure
☐ (1) 5-32. Install materials with longer life cycles
☐ (2) 5-33. Install locally produced materials
☐ (3) 5-34. Use re-milled salvaged lumber
☐ (3) 5-35. Use wood products certified by FSC or other recognized agency as "sustainable"

Framing

☐ (1) 5-36. Use stacked floor plans
☐ (1) 5-37. Use engineered structural products
☐ (1) 5-38. For interior walls, use steel studs with minimum 50% recycled content
☐ (2) 5-39. Use structural insulated panels
☐ (2) 5-40. Use wood frame panelized construction
☐ (2) 5-41. Use cementitious foam-formed walls with flyash concrete
☐ (3) 5-42. Use finger-jointed framing material (e.g. plates and studs)
☐ (3) 5-43. Use (R-19) 2x6 intermediate framing
☐ (6) 5-44. At least 50% of dimensional lumber is certified sustainable wood (FSC or equal)
☐ (10) 5-45. At least 90% of dimensional lumber and 50% of sheathing is certified sustainable wood (FSC or equal)

Foundation

☐ (1) 5-46. Use regionally produced block
☐ (1) 5-47. Use flyash in concrete
☐ (2) 5-48. Use recycled concrete, asphalt, or glass cullet for base or fill

Sub-Floor

☐ (1) 5-49. Use recycled-content underlayment

Doors

☐ (1) 5-50. Use reconstituted or recycled-content doors
☐ (1) 5-51. No luan doors
☐ (2) 5-52. Use domestically-grown wood interior doors

Finish Floor

☐ (1-2) 5-53. If using vinyl flooring, use product with recycled content
☐ (1) 5-54. Use recycled-content carpet pad
☐ (3) 5-55. Use recycled-content or renewed carpet
☐ (5) 5-56. Use recycled-content ceramic tile
☐ (5) 5-57. Use linoleum, cork, or bamboo flooring

Interior Walls

☐ (1) 5-58. Use drywall with recycled-content gypsum
☐ (1) 5-59. Use recycled or "reworked" paint and finishes
☐ (2) 5-60. Install toilet/shower partitions with recycled content

Ceilings

☐ (1) 5-61. If installing acoustical ceiling tiles, select a recycled-content product

Exterior Walls

☐ (1) 5-62. Use recycled-content sheathing
☐ (1) 5-63. Use siding with reclaimed or recycled material
☐ (2) 5-64. Use salvaged masonry brick or block
☐ (2) 5-65. Use locally-produced stone or brick
☐ (2) 5-66. Use 50-year siding product

Windows

☐ (1) 5-67. Use wood/composite windows
☐ (1) 5-68. Use finger-jointed wood windows

Cabinetry and Trim

☐ (2) 5-69. If using hardwood trim, use domestic products
☐ (2) 5-70. Use finger-jointed trim
☐ (5) 5-71. Use tropical hardwood trim or cabinets only if FSC certified or equal as "sustainable"
☐ (3) 5-72. Use domestic hardwood trim that is FSC certified or equal
☐ (3) 5-73. Use resource-efficient countertop material in lobby/reception areas

Roof

☐ (2) 5-74. Use recycled-content roofing material
☐ (2) 5-75. Use 30-year roofing material
☐ (3) 5-76. Use 40-year roof material

Insulation

☐ (2) 5-77. Use recycled-content insulation
☐ (3) 5-78. Use environmentally friendly foam building products (formaldehyde-free, CFC-free, HCFC-free)

Other Exterior

☐ (2) 5-79. Use reclaimed or salvaged material for landscaping walls
☐ (3) 5-80. Use recycled-content plastic or wood polymer lumber for decks and porches
☐ (5) 5-81. Use least toxic pressure treatment for pressure-treated wood (no CCA)

_____ Subtotal for Section Five

SECTION SIX: PROMOTE ENVIRONMENTALLY FRIENDLY O&M

O&M PLANS, TRAINING, & EDUCATION

☐ (★) 6-1. Provide an operations & maintenance kit for each unit
☐ (2) 6-2. Prepare an operations and maintenance plan for common area facilities
☐ (2) 6-3. Prepare a landscape operations and maintenance plan
☐ (3) 6-4. Conduct training sessions for maintenance staff and/or occupants
☐ (3) 6-5. Prepare education plan for occupants

WATER PROTECTION

Outdoor Conservation

- ☐ (2) 6-6. Mulch landscape beds with 2 in. organic mulch
- ☐ (1) 6-7. Use grass type requiring less irrigation and minimal maintenance
- ☐ (3) 6-8. Use compost soil amendments to establish turf and other vegetation with less irrigation
- ☐ (3) 6-9. Limit use of turf grass to 25% of landscaped area
- ☐ (3) 6-10. Landscape with plants appropriate for site topography and soil types, emphasizing use of plants with low watering requirements
- ☐ (3) 6-11 Install high-efficiency irrigation system
- ☐ (4) 6-12. Plumb for greywater irrigation
- ☐ (5) 6-13. Install rainwater collection system (cistern) for reuse
- ☐ (10) 6-14. No turf grass
- ☐ (10) 6-15. Install irrigation system using recycled water

Indoor Conservation

- ☐ (1) 6-16. Select bathroom faucets with GPM less than code
- ☐ (1) 6-17. Select kitchen faucets with GPM less than code
- ☐ (1) 6-18. Select toilets that meet code, work with the first flush
- ☐ (4) 6-19. Install (tankless) instant hot water systems (where appropriate)
- ☐ (5) 6-20. Stub-in plumbing to use greywater water for toilet flushing
- ☐ (3) 6-21. Provide water and sewer sub-metering for each unit
- ☐ (10) 6-22. Use greywater water for toilet flushing
- ☐ (10) 6-23. Install composting toilets

Eliminate Water Pollutants

- ☐ (1) 6-24. Educate owners/tenants about fish-friendly moss control
- ☐ (4) 6-25. Provide food waste chutes and compost or worm bins instead of a food garbage disposal

ENERGY

Transportation

- ☐ (2-4) 6-26. Provide subsidized bus passes
- ☐ (2) 6-27. Provide bicycle lockers
- ☐ (2) 6-28. Provide bus shelters
- ☐ (var) 6-29. Provide community common areas

Heating/Cooling

- ☐ (1) 6-30. Provide separate switching for bathrooms fan/heat lamp and fan/light combination fixtures
- ☐ (3) 6-31. Select ENERGY STAR® heating / cooling equipment
- ☐ (2) 6-32. No gas fireplaces, use direct vent gas or propane hearth product (AFUE rating)
- ☐ (2) 6-33. No fireplaces or only high efficiency units (Rumsford or Russian fireplace, masonry heater)
- ☐ (2) 6-34. No air conditioner
- ☐ (3) 6-35. Provide electricity and/or natural gas direct metering for each unit

Water Heating

- ☐ (2) 6-36. Passive or on-demand hot water delivery system installed at farthest location from water heater
- ☐ (3) 6-37. Upgrade electric water heater efficiency from EF of .88 to .93
- ☐ (3) 6-38. Upgrade gas or propane water heater efficiency from EF of .55 to .60
- ☐ (4) 6-39. Install the water heater inside the heated space (electric, direct vent, or sealed venting only)
- ☐ (4) 6-40. Upgrade electric water heater to exhaust air heat pump water heater or de-superheater: EF 1.9
- ☐ (4) 6-41. Upgrade gas or propane water heater from EF of .55 to .83

Appliances

- ☐ (1) 6-42. Install gas clothes dryer
- ☐ (2) 6-43. Install a horizontal-axis or ENERGY STAR® washing machine
- ☐ (3) 6-44. Install an extra-efficient dishwasher (ENERGY STAR®)
- ☐ (3) 6-45. Install ENERGY STAR® refrigerator

HEALTH AND INDOOR AIR QUALITY

- ☐ (1) 6-46. Provide isolated storage for hazardous cleaning & maintenance products, separate from occupied space
- ☐ (1) 6-47. If installing water filter at sink, select one with biodegradable carbon filter
- ☐ (1) 6-48. Install showerhead filter
- ☐ (1) 6-49. Provide track-off mats and/or shoe grates at entryways

RECYCLING

- ☐ (2) 6-50. Provide recycling bins
- ☐ (4) 6-51. Provide built-in kitchen or utility room recycling center

_____ Subtotal for Section Six

EXTRA CREDIT

- ☐ (1-10) A-1. Extra credit for innovation

_____ **Total Points for Project**

Program Level Obtained:

☐ 1-Star ★ ☐ 2-Star ★★ ☐ 3-Star ★★★

By my signature, I certify that I have performed all Action Items checked above:

_____

(Multi-Family Builder Signature and Date)

2002 Revision Note. The point values on this checklist have been revised effective January 1, 2002. Because Parts I and II have *not* yet been revised, the point values as they appear in the narrative of Parts I and II may differ from the checklist. ***Use this checklist for the correct point assignments.***

Appendix A
Built Green™ 2002 Revisions

A-1 Extra Credit for Innovation — 1-10 Points

This Action Item recognizes builders for using innovation and emerging technologies, practices, and products that fulfill the intentions of the program, but are not called out in the checklist.

Builders can earn up to 10 points by submitting a short written justification for the extra credit points to the Built Green™ Executive Committee for review, approval, and award of points. Builders are encouraged to recommend point values (up to 10) for their submittals in line with the Multi-Family Program. The Executive Committee will evaluate the submittal and recommended points and will determine final point awards. For instance, an innovative educational poster for a Common Area may be valued at 2 points, while creating a full-scale low-watering, low-maintenance demonstration landscape may be valued at ten points. Other ideas include a program to donate usable building materials, establishing a food waste composting program for residents, and incorporating emerging energy efficiency technologies.

A-1 Extra Credit for Innovation (Resources)

- See Built Green™ Resource Library.

5. Energy Efficiency Mortgages and comparison chart

(A picture of the existing green lending industry, by Massachusetts Technology Collaborative)

National Programs

Program/Loan	Eligibility				Rating				Mortgage Type
	Property Type	Eligible E.E. Measures	Eligible Renewables	Upgrade time frame	Rating System	Score	Additional appraisal	Certification (EIM only)	EEM / EIM / other
Fannie Mae: Energy Efficient Mortgage	One unit, owner occupied, new or existing homes	Measures as specified in Energy Star Builder Option Package	Photovoltaics	120 days	Energy Star or approved alternative HERS system	Must receive 4 Stars for ratio adjustment or 4 Stars Plus for value adjustment	Appraiser completes Energy Appraisal Addendum (Form 70B/1004C) to increase market value by present value of energy savings	Form 701 Certificate of Completion	Purchase or refinance; EEM and EIM
Fannie Mae: My Community Energy Efficient Mortgage	One unit, owner occupied, new or existing homes	Measures as specified in Energy Star Builder Option Package	Photovoltaics	120 days	Energy Star or approved alternative HERS system	Must receive 4 Stars for ratio adjustment or 4 Stars Plus for value adjustment	Appraiser completes Energy Appraisal Addendum (Form 70B/1004C) to increase market value by present value of energy savings	Form 701 Certificate of Completion	Purchase or refinance; EEM and EIM
Freddie Mac: Energy Efficient Mortgage	1-4 units, existing energy efficient homes	Any elements included in HERS analysis	Not typically included	n/a	CHEERS Report or RESNET/NASEO accredited home energy rating system	Must receive minimum energy rating of 70 for a home built before 1999 and 80 for a home built after 1999	Addendum to Appraisal Form 70A	n/a	Purchase or refinance; EEM
Freddie Mac: Energy Improvement Mortgage	1-4 units, existing/resale homes	Improvements must result in an expected decrease in energy costs of at least 20% per year for a home built before 1999 and 10% per year for a home built after 1999	Not typically included	120 days	CHEERS Report or RESNET/NASEO accredited home energy rating system	Energy rating must increase at least: 5 points for a home built before January 1, 1999 No increase required for a home built after January 1, 1999	Addendum to Appraisal Form 70A	Form 701 Certificate of Completion	Purchase or refinance; EIM
HUD (FHA): Energy Efficient Mortgage	1- to 4-unit properties; New or existing homes	Any improvements or existing elements recommended or noted by HERS report	Would need to be recommended by HERS rating; not typically included	90 days	Must meet CABO-MEC '92 "Energy Efficient Home" (EEH) standards	n/a	None	Borrower or independent contractor certifies completion	Purchase or refinance; EEM and EIM
Veterans Affairs	1- and 2-unit properties; New or existing homes	Any improvements noted by HERS report	Would need to be recommended by HERS rating; not typically included	180 days	Must meet CABO-MEC '92 "Energy Efficient Home" (EEH) standards	n/a	None	Borrower or independent contractor certifies completion	Purchase or refinance; EEM and EIM
EFS Partnerships	Residential owner-occupied single-family and duplex homes	HVAC, water heaters, envelope, appliances, lighting. Any measure approved by Energy Star also qualifies	Some programs fund photovoltaics (Wisconsin funds both PV and wind). Other programs fund solar hot water and air/ground source heat pumps	Not specified.	Energy Star or other approved HERS rating system	APR depends on score: 640-679 points = level 1 APR reduction 680-719 points = level 2 APR reduction 720+ = level 3 APR reduction	None	If required, filed with sponsoring utility or energy service company	Purchase or refinance; EEM and EIM

National Programs (continued)

Program/Loan	Mortgage Details								Other
	Cost Limit	Loan Limit	Loan-to-Value Ratio	Debt-to-Income Ratio or APR reduction	Up-front contribution from buyer / remodeler	Additional qualifying	Loan Term	Escrow (for EIM)	Loan Sale to Secondary Market
Fannie Mae: Energy Efficient Mortgage	Adjustment to appraisal capped at 5% of the home's value for new construction. 15% cap for installed cost for retrofits	FNMA/FHLMC loan limits may not be exceeded	Final LTV (including upgrades) up to 100%	Built after Jan. 1995: 2% DIR increase for 4 Stars Built before Jan. 1995: 2% DIR increase for 3 Stars Plus Max. DIR ratio: 41%	3%	Yes: qualify for total loan amount (after adding upgrade cost)	15 or 30 years	100% with fixed-price contract; 110% if estimated, with 10% from the borrower	After closing
Fannie Mae: My Community Energy Efficient Mortgage	Adjustment to appraisal capped at 5% of the home's value for new construction. 15% cap for installed cost for retrofits	FNMA/FHLMC loan limits may not be exceeded	Final LTV (including upgrades) up to 100%	Built after Jan. 1995: 2% DIR increase for 4 Stars Built before Jan. 1995: 2% DIR increase for 3 Stars Plus Max. DIR ratio: 41%	Lesser of 1% or $500 for borrowers at 100% AMI or no income limit in FannieNeighbors areas	Yes: qualify for total loan amount (after adding upgrade cost)	15 or 30 years	100% with fixed-price contract; 110% if estimated, with 10% from the borrower	After closing
Freddie Mac: Energy Efficient Mortgage	No limit if supported by value	Cannot exceed maximum loan limits	Loan amount including energy upgrades cannot exceed 95% LTV; based on lesser of total purchase price or appraised value	Debt-to-income ratios may be increased on a case-by-case basis; rationale must be documented by appraiser	None required	Yes: qualify for total loan amount (after adding upgrade cost)	Not specified	Escrow account may equal 100% of costs for a fixed cost contract, or 110% (10% contingency) must be collected from the borrower	After closing
Freddie Mac: Energy Improvement Mortgage	Up to 10% of the base mortgage amount can be financed in the mortgage amount for cost effective energy improvements	Cannot exceed maximum loan limits	Loan amount incl. energy upgrades cannot exceed 95% LTV; ratio based on lesser of total purchase price or appraised value	Debt-to-income ratios may be increased on a case-by-case basis; rationale must be documented by appraiser	None required	Yes: qualify for total loan amount (after adding upgrade cost)	Not specified	Escrow account may equal 100% of costs for a fixed cost contract, or 110% (10% contingency) must be collected from the borrower	Upon completion of energy efficiency improvements
HUD (FHA)	Maximum mortgage, single family = $160,950 Total cost of improvements must exceed $5,000	$4,000 or 5% of the property value (up to $8,000) may be financed. Statutory loan limits may be exceeded by $8,000	Final LTV may exceed 100% if upgrades produce energy savings with a present value greater than cost	2% for "Energy Efficient Home" (EEH) or 4 Stars	None -- if upgrades produce energy savings with a present value greater than their cost	None -- Buyer qualifies only for original loan amount (prior to adding cost of upgrades)	Determined by pairing with other mortgages	Not specified	After closing
Veterans Affairs	Up to $3,000 based solely on cost, or up to $6,000 with positive cash flow	Statutory loan limits may not be exceeded	Final LTV may exceed 100% if the upgrades can produce a positive cash flow in the first year	Lower "utility costs" would result in higher "residual income" calculation	None -- if upgrades are cost-effective (i.e., result in positive cash flow)	None -- Buyer qualifies only for original loan amount (prior to adding cost of upgrades)	15 or 30 years	Not specified	After closing
EFS Partnerships	Borrowers can finance $2,500 - $20,000	Loan limits determined by participating utilities	Can finance 100% of installation costs	APR reduction based on HERS points ranges from 1.5-2%	Unsecured loan (homeowner provides no collateral)	None	Fixed rate loan terms available: 3,5,7,10 years	Not specified	After closing

State and Local Programs

Program/Loan	Eligibility				Rating				Mortgage Type
	Property Type	Eligible E.E. Measures	Eligible Renewables	Upgrade time frame	Rating System	Score	Additional appraisal	Certification (EIM only)	EEM / EIM / other
NYSERDA Energy $mart	All building types except 1-4 unit residences are eligible; a separate option for those residences is available	Heat pumps, Chiller replacements, High-efficiency lighting, High-efficiency air-conditioning equipment, Premium motors, Energy Star windows and appliances	Renewables can potentially be included as "custom" elements; requires documentation that capacity is increased while reducing use, and that payback is under 10 years	Not specified.	Improvements are calculated on a case by case basis	n/a	n/a	Certified by homeowner or contractor.	Purchase and refinancing; EEM and EIM
Sacramento Municipal	Homeowners only	Central air conditioners, heat pumps, windows	Renewables not included, but a PV buydown can be paired with the financing	Not specified.	Each element must meet SMUD's efficiency standards to be eligible for financing	n/a	n/a	n/a	Refinancing; EIM
Vermont Energy Investment Corporation: Energy Efficient Mortgage	1- and 2-unit properties, including condominiums; new and existing homes	Any element included in an Energy Star rating is eligible	Not typically included	120 days	Energy Star	Must receive 4 Stars or higher Energy Rating	Appraiser must address energy upgrades in the appraisal report	ERH-VT certifies completion	Purchase only
Vermont Energy Investment Corporation: YESS Mortgage	1- and 2-unit properties, including condominiums; existing homes only	Any element included in an Energy Star rating is eligible	Not typically included	120 days	no HERS requirement	n/a	Appraiser must complete Energy Appraisal Addendum (Form 70B/1004C) to increase market value by the present value of the estimated energy savings	ERH-VT certifies completion	Purchase only

State and Local Programs

Program/Loan	Mortgage Details								Other
	Cost Limit	Loan Limit	Loan-to-Value Ratio	Debt-to-Income Ratio or APR reduction	Up-front contribution from buyer / remodeler	Additional qualifying	Loan Term	Escrow	Loan Sale to Secondary Market
NYSERDA Energy $mart	Total project cost < $5 million. For multifamily, lesser of $5 million or $5,000 per unit	Reduced interest rate up to $500,000 over life of mortgage	Not impacted by energy improvements	The lender's interest rate is "bought down" by 450 basis points, or 4.5%. At current market rates, this generally comes out to half the conventional rate	Based on individual bank requirements; no difference from standard mortgage	None	Lesser of 5 years or total term of the loan	Not specified	After closing
Sacramento Municipal	Market rate of each individual technology	None: dependent on individual component costs	100% financing	9.25% flat interest rate	No up front contribution required	None	up to 10 years (depending on technology)	Not specified	Not applicable
Vermont Energy Investment Corporation	No limit	For windows, loans above $7,500 require additional underwriting.	Final LTV (including upgrades) can be up to 100% if the loan is guaranteed by RECD or FHA; otherwise, cannot exceed 95%	DtI ratio: 3% for 4 Star (up to 33% for housing debt, 41% for overall debt)	Relative to LTV; down payment % paid on upgrades needs to be the same as down payment % paid toward the home.	Yes: Buyer qualifies for the total loan amount (after adding upgrade cost)	30 years	Not specified	Loan cannot be purchased by VHFA until upgrades completed
Vermont Energy Investment Corporation (YESS program)	At least $2,500 in cost-effective energy improvements is required	Purchase price limits may not be exceeded	Final LTV (including upgrades) can be up to 100% if the loan is guaranteed by RD or FHA; otherwise, it cannot exceed 95%	29% for housing debt and 41% for overall debt APR reduction: Interest rate starts at 1.5% below the MOVE rate, increasing ½% per year over 3 years	None: if upgrades are cost-effective (i.e. result in positive cash-flow) and if guaranteed by RD or FHA	Yes: Buyer qualifies for the total loan amount (after adding upgrade cost) at the first year stepped rate	30 years	100% escrowed with fixed- price contract; 125% escrowed if estimated	With an acceptable guarantee, VHFA will purchase loans prior to completion

6. The LEED-NC 2.1 check list

LEED Version 2.1 Registered Project Checklist

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Project Name
City, State

Yes	?	No			
			Sustainable Sites		**14** Points
Y			Prereq 1	**Erosion & Sedimentation Control**	Required
			Credit 1	**Site Selection**	1
			Credit 2	**Development Density**	1
			Credit 3	**Brownfield Redevelopment**	1
			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
			Credit 4.3	**Alternative Transportation**, Alternative Fuel Vehicles	1
			Credit 4.4	**Alternative Transportation**, Parking Capacity and Carpooling	1
			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
			Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
			Credit 6.1	**Stormwater Management**, Rate and Quantity	1
			Credit 6.2	**Stormwater Management**, Treatment	1
			Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
			Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
			Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
			Water Efficiency		**5** Points
			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
			Credit 2	**Innovative Wastewater Technologies**	1
			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No			
			Energy & Atmosphere		**17** Points
Y			Prereq 1	**Fundamental Building Systems Commissioning**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
			Credit 1	**Optimize Energy Performance**	1 to 10
			Credit 2.1	**Renewable Energy**, 5%	1
			Credit 2.2	**Renewable Energy**, 10%	1
			Credit 2.3	**Renewable Energy**, 20%	1
			Credit 3	**Additional Commissioning**	1
			Credit 4	**Ozone Depletion**	1
			Credit 5	**Measurement & Verification**	1
			Credit 6	**Green Power**	1

Yes	?	No			
			Materials & Resources		**13** Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
			Credit 1.2	**Building Reuse**, Maintain 100% of Shell	1
			Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
			Credit 2.1	**Construction Waste Management**, Divert 50%	1
			Credit 2.2	**Construction Waste Management**, Divert 75%	1
			Credit 3.1	**Resource Reuse**, Specify 5%	1
			Credit 3.2	**Resource Reuse**, Specify 10%	1
			Credit 4.1	**Recycled Content**, Specify 5% (post-consumer + ½ post-industrial)	1
			Credit 4.2	**Recycled Content**, Specify 10% (post-consumer + ½ post-industrial)	1
			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
			Credit 6	**Rapidly Renewable Materials**	1
			Credit 7	**Certified Wood**	1

Yes	?	No			
			Indoor Environmental Quality		**15** Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
			Credit 2	**Ventilation Effectiveness**	1
			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
			Credit 4.2	**Low-Emitting Materials**, Paints	1
			Credit 4.3	**Low-Emitting Materials**, Carpet	1
			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber	1
			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
			Credit 6.1	**Controllability of Systems**, Perimeter	1
			Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Yes	?	No			
			Innovation & Design Process		**5** Points
			Credit 1.1	**Innovation in Design**: Provide Specific Title	1
			Credit 1.2	**Innovation in Design**: Provide Specific Title	1
			Credit 1.3	**Innovation in Design**: Provide Specific Title	1
			Credit 1.4	**Innovation in Design**: Provide Specific Title	1
			Credit 2	**LEED™ Accredited Professional**	1

Yes	?	No		
			Project Totals (pre-certification estimates)	**69** Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

7. The Upham's Corner Market project data

a. Upgrades Elements

(By Kimberly Vermeer, Urban Habitat Initiatives)

BUILDING ENVELOPE		
ELEMENT	ORIGINAL	UPGRADE
Exterior Walls—studs with brick façade	6" metal stud walls with fiberglass insulation	3/4" inch rigid insulation added to interior face
Windows—Metal frame doublehung to meet historic requirements	Double-pane insulated glass U-factor: .55-.56 SHGC: .67	Argon-filled U-factor: .50-.52 SHGC: No change
Roof—Membrane system on plywood sheathing	R- 30 fiberglass batt insulation in ceiling below roof	R- 30 rigid insulation installed above sheathing and under membrane
HEATING, VENTILATION, COOLING, AND HOT WATER		
ELEMENT	ORIGINAL	UPGRADE
Heating—Gas-fired boiler for hydronic system; fan distribution system in units	A single 1300 MBH gas-fired boiler; 69.5% efficiency rating	Two 700 MBH gas-fired boilers; 85% efficiency rating
Ventilation--fresh air intake conditioned, then ducted to hallways. Uptake to units via door cuts	Two heating and cooling rooftop units to condition fresh air for corridors. Standard switch-controlled bath exhausting through roof fans	Heat Recovery Ventilation system capturing continuous bath exhaust from 30 units
Cooling—chiller for hydronic system.	Carrier 100 ton capacity 9.9 EER	Carrier 70 ton capacity 9.9 EER
Domestic Hot Water—central system	2 gas-fired 512MBH boilers	2 gas-fired boilers; 85% efficiency
PULG LOADS		
ELEMENT	ORIGINAL	UPGRADE
Appliances (refrigerators and dishwashers)	Standard apartment grade	EnergyStar®
Lighting—common areas	Incandescent	Compact Fluorescent

b. Survey forms

(As example of info collection, designed by Green CDCs Initiative.)

Green Affordable Housing Survey

Green CDCs Initiative

General Instructions

Overview	This survey is intended to help document the costs and benefits of greening your project. The survey has three sections: Project Information, Capital Costs and Operating Savings, and Project Financing. The survey can be completed and sent back to us (address below), or it can be completed through a telephone interview with someone from the Green CDCs Initiative.
Section 1	The first section asks for general background information about the project.
Section 2	In the second section, we are interested in learning about several cost aspects of the project. First, we would like to know what the overall construction costs were for your project, and what the construction costs for a comparable, traditionally designed and built project would be. This will demonstrate the incremental costs of greening for the entire project. Next, we would like to gather information on the Capital Costs for the project's green features. We have organized this section of the survey into six categories of green features: Sustainable Sites, Water Conservation, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, or Innovation and Design.
	We also wish to understand the Operating Savings that the project has achieved or projects to achieve as a result of specific green features. In the Operating Savings section please provide any quantitative or qualitative information you have about the savings resulting from the greening of the project. Operating savings can be achieved by lowering utility costs, operations and maintenance costs, labor costs, materials costs, and/or through savings from reduced replacement costs due to improved material durability.
Section 3	The final section asks for information about the financing used in the project. This section has basic questions about financing sources and amounts as well as questions about the impact of greening efforts on financing sources.
Notes	We anticipate that one person may not have all the information necessary to complete this survey. We request that you contact others who may have additional information about the project so that we can have the most complete description of the project and its associated costs and benefits.
	Project documentation is requested in the Section 1: Project Information worksheet in Parts D and E. Please send this documentation and any other documentation to: **email: ; fax: ; mail:**
	Additionally, please feel free to add any relevant information, either by adding lines to the appropriate section of the existing survey or as a separate attachment.
	Many thanks for your participation in this project. Please do not hesitate to contact us with any questions.

Green CDCs Initiative

Section 1: Project Information

Please fill in the following information about the project

A. Background Information

Project Name	Uphams Corner Marketplace Redevelopment
Project Address (city, state, zip code)	610-618 Columbia Road, Dorchester, MA
Sponsor or Developer	New Atlantic Development Corporation, New Commu
Dev. Consultant (if used)	Kimberly Vermeer

Survey respondent: Name	Peter Roth, Kimberly Vermeer
Address	59 Temple Place Suite 1000, Boston, MA 02111
Phone Number	617-338-7600 x319
Email Address	peterroth@newatlantic.net, kim.vermeer@urbanhabitat
Contractor name	CWC Builders, Inc.
Architect name	ICON Architecture, Inc., Nancy Ludwig

Construction Completion Date	Dec-02
Occupancy Date	Jan-03
New construction or Rehab?	Substantial Rehab
Basement? (Y or N)	Y *
Number of Units	45
Number of Bedrooms	59
Number of Affordable Housing units (restricted to families with 80% median income or less)	44
Number of other income restricted units	
Number of market-rate units	

Note: if fewer than 20% of the project's units are affordable housing units, please do not proceed with the survey, and contact us to discuss the project.

B. Housing description

Housing Type	Number of units
Family Rental	30 Low Income Tax Credit Units
Conventional Elderly Rental	
Rental, Special Populations (including assisted living)	14 units of elderly single-room occupancy housing plus one staff apartment
Co-op	
Owner Occupied: Fee Simple	
Owner Occupied: Condominium	
Other	
TOTAL UNITS	45

Unit Type (across entire project)	Number of units
Single Family, Detached	
Single Family, Attached	
Duplex	
Multifamily	45
Townhouse	
TOTAL UNITS	45

C. Gross square feet of project

	Square Feet	Notes
Residential units	43,451	
Commercial space	16,094	
Community space (for residents or community at large)		
Common area, circulation, maintenance, systems		
Other (describe in notes section)	10,024	Parking/Loading/Storage
TOTAL	69,569	

D. Actual Project Development Costs

Please provide a copy of a **project cost certification (summary) for a public lender or regulatory agency**. **Alternately, provide** a summary of **final construction proceeds requisition** or **drawdown request** (showing cumulative draws).

If such documents are unavailable, please provide the following information.

Activity	Dollar Amount
Property acquisition	609,500
Final construction cost (include all approved and likely-to-be-approved change orders)	5,931,129
Architecture and engineering	
Environmental assessment and testing	
Development consultant(s)	
Legal	
Lender fees and costs	
Construction and pre-development loan interest	
Sponsor/Developer project management and overhead	
Other Soft Costs	1,041,321
Developer fee/profit	885,816
Capitalized Replacement Reserves	
Capitalized Operating Reserves	250,000
TOTAL	**$8,717,766**

E. Operating History

For rental projects, for every 12-month operating period since project completion and 95 percent occupancy, please provide at leas**ONE** of the following *(indicate which is being provided)*:

	Provided (Y/N)
Month 12 Budget to Actuals Operating Report (with year-to-date figures) as prepared by property manager	
Operating Expense Information as included in Project Audit	
Annual Operating Report Submitted to Lender or Regulatory Agency	
If home ownership project, is there an outside agency that tracks the operating history that has this data?	Name:

Section 2: Capital Costs and Operating Savings

In this section, please first record the Overall Project Costs and then record the Capital Costs for the project's green features. Features are listed in one of six categories: Sustainable Sites, Water Conservation, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, or Innovation and Design. Finally, record any Operating Savings resulting from the green features.

A. Overall Project Costs (excluding site acquisition and preparation)

Please provide the cost of the design of any features for the project that required additional design and engineering. Next, provide the construction costs (excluding site acquisition and preparation and the design costs) for the project and the construction costs for a comparable, traditionally designed and built project.

	Cost	Cost/square foot
Green Design		
Traditional Design		
Green Construction	$ 8,839,955.00	$ 203.45
Traditional Construction	$ 8,717,766.00	$ 200.63
Net Cost of Greening	$ 122,189.00	$ 2.81

B. Capital Costs (excluding site acquisition and remediation)

Please provide the cost for incorporating green features in the project (design, engineering, construction, excluding site acquisition), and the costs for a comparable, traditionally designed and built project. Project features are listed in one of six categories: Sustainable Sites, Water Conservation, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, or Innovation and Design.

		Traditional Capital Cost	Green Capital Cost	Upgrade cost
Sustainable Sites				
	(e.g., Building orientation; Brownfield; Infill)			
Water Efficiency				
	(e.g., Low-flow fixtures/appliances; Low-water landsc			
Energy and Atmosphere	Exterior walls insulation			$ 14,608
	Add argon gas to windows			$ 7,781
	Added design cost			$ 4,166
	Roof insulation upgrade			$ -
	Boiler, DHW upgrades, controls			$ 8,730
	Heat Recovery Ventilator			$ 44,296
	Lighting upgrade to compact fluorescents			$ 35,328
	EnergyStar Appliance			$ 7,280
	(e.g., Efficient HVAC systems & appliances; Envelope improvements beyond code)			
Materials and Resources				
	(e.g., Non-toxic materials, paints, and finishes; Certified wood)			
Indoor Environmental Quality				
	(e.g., Ventilation & moisture control; Non-toxic materials)			
Innovation and Design	(Note: List only those green features and design processes that have not been accounted for in the other categories)			
Total		$0	$0	$ 122,189

C. Operating Savings

Are there any performance or operating cost analyses the developer/sponsor has done with respect to green features? If yes, please specify below (type of analysis, for whom, etc), and provide a copy of the analysis.

If available, please provide the Operating Savings that the project has achieved or projects to achieve as a result of greening the project. Operating savings can be achieved from utility costs, operations and maintenance costs, labor costs, materials costs, and/or savings from reduced replacement costs due to improved material durability.

Operating Cost Category	Traditional Operation (units)	Traditional Operation ($/yr)	Green Operation (units)	Green Operation ($/yr)	Operating Savings ($/yr)
Electricity (kwh)		$ 10,800		$ 30,300	$ (19,500)
Gas (Therms)		$ 32,400		$ 18,000	$ 14,400
Oil (gallons)					
Water (gallons)		$ 27,000		$ 12,000	$ 15,000
Maintenance					
Other (incl. replacements)					

Section 3: Project Financing

Please provide the following information about the financing used in the project. If the project had additional financing mechanisms that do not fall into one of the categories listed below, please describe them on an additional line or a separate sheet.

A. Pre-Development and Construction

	Source (name of institution)	Amount	Type (loan, equity, grant)	Terms, if loan	Was source aware of sponsor/ developer's plans to include green features? (Y/N)
Predevelopment: funds used before start of construction	Sponsor/Developer				
TOTAL		$0			
Construction Period	Sponsor/Developer				
TOTAL		$0			

B. Home Mortgages

Please complete this section for any "For Sale" project, with owner-occupied units

				Mortgage(s) associated with a Green Lending Program?	
	Lender	Number of mortgages	Value of mortgages	Y/N	If yes, type of program
Developer-arranged mortgage financing					
Other mortgage financing (that developer is aware of)					

C. Permanent Funders

i. Name of institution or organization	ii. Amount of funding	iii. Type of funder (from key below)	iv. Type of funding (from key below)	v. Disclosure of green features by developer to funder (from key below)	vi. Funder's response to green features (from key below)	vii. Did green features affect the terms of the funding? If yes, how?	viii. Post construction monitoring of green features? (from key below)
Developer	$ 278,863		H	H			
Tax Credit Equity	$ 4,206,621						
City of Boston Economic Devel	$ 1,292,226						
DHCD/HOME Grant	$ 600,000						
NCS/McKinney	$ 240,056						
CEDAC Loan/Housing Innovati	$ 500,000						
MHFA first mortgage loan	$ 1,600,000						
TOTAL	$8,717,766						

Key:

iii. Type of funder	iv. Type of funding	v. Disclosure by developer to funder	vi. Funder response	viii. Funder monitoring
A. Bank	A. Senior mortgage	A. All green features were explicitly highlighted in presentations	A. Funding was made specifically for green development	A. None
B. Syndicator	B. Subordinate mortgage/amortizing		B. Funder was enthusiastic/positive about green features	B. First operating year
C. Government Agency	C. Investor equity	B. Some but not all green features were explicitly highlighted	C. Funder was neutral about green features	C. First 2 operating years
D. Quasi-public agency	D. Government grant			
E. Non-profit loan fund, financial intermediary/CDFI	E. Equity-like, e.g., deferred payment mortgage	C. Green features were referenced in application materials, but not highlighted	D. Funder was skeptical/negative about green features	D. Continuous following project completion
F. Foundation	F. Unsecured loan			
G. Other grant-maker	G. Grant (non-government)	D. No specific references to green materials in presentations or application materials	E. Funder was negative about green features and subjected project to unusual review	E. Occasional or episodic
H. Developer/sponsor	H. Developer's equity			

c. KeySpan Report

KeySpan QC

Customer Name: Upham's Corner Market Bldg Audit #: 5393.01 Customer 5393

Site Address: 612-618 Columbia Rd Dorchester PJX File: uphcorn3.pjx

Submittal Date: 1/8/01 QC Review By: JP QC Date: 1/9/01

	Billing History Therms	Modeled Base Case Therms	%
Last 12 Months	new	57046	#VALUE!
Ave. Summer Month		870	
Ave. Summer x 12 Months		10440	#DIV/0!
Heating		46698	
Cooling			
DHW		8012	
Cooking			
Refrigeration			
Process			
Misc.			
Laundry		2336	
Pool			

Comments:

Measure number	Base Case Therms	Scenario Therms Used	1st year Therm Savings	Annual ($) Savings	Estimated Installed Costs	Rebate Level	Rebate Offer	Net Installed Costs	Simple Payback (years)	% Savings Reduction
20	46,698	43,380	3,318	$2,750	$160,725	1	$3,318	$157,407	57.2	7.1%
951	46,698	41,939	4,759	$4,010	$36,446	H	$5,400	$31,046	7.7	10.2%
308	8,012	6,712	1,300	$1,023	$27,958	H	$3,000	$24,958	24.4	16.2%
932	46,698	44,882	1,816	$1,474	$44,296	2	$3,632	$40,664	27.6	3.9%
37	46,698	45,974	724	$615	$1,200	1.5	$600	$600	1.0	1.6%
45	46,698	43,872	2,826	$2,360	$14,608	1	$2,826	$11,782	5.0	6.1%
39	46,698	37,711	8,987	$7,531	$18,731	1	$8,987	$9,744	1.3	19.2%
25	46,698	45,961	737	$626	$1,000	1	$500	$500	0.8	1.6%
All	57,046	35,767	21,279	$18,027	$304,964	1	$21,279	$283,685	15.7	37.3%

Executive Summary

In this analysis, we compare several energy management alternatives for your facility. Cost-effective opportunities for reducing your energy bill have been identified. Below is a summary of the alternatives evaluated, including total installed cost, annual energy costs, annual savings, and simple payback periods. Each alternative is evaluated in more detail in following sections of this reports.

Recommendation	Total Installed Cost ($)	Annual Energy Costs ($)	Annual Savings ($)	Simple Payback (yrs)
Existing Scenario	--	53,919	--	--
High Performance Windows	157,407	51,169	2,750	57.2
High Efficiency Boilers - Heat	31,046	49,909	4,010	7.7
High Efficiency Boiler - Domestic Hot Water	24,958	52,896	1,023	24.4
Heat Recovery Ventilator- Corridors	40,664	52,445	1,474	27.6
Boiler Reset	600	53,304	615	1.0
Insulate Walls	11,782	51,560	2,360	5.0
Insulate Roof	9,744	46,388	7,531	1.3
Temperature Setback	500	53,293	626	0.8
All Measures	283,685	35,891	18,028	15.7

Total Installed Costs presented above are the estimated costs required to purchase and install all equipment for the energy management alternative. It does not include costs for correction of pre-existing conditions or any possible code violations.

Annual energy costs include all electric, natural gas, and other fuel-using equipment evaluated in this report. Current energy prices are used. Annual savings are the reduction in your total energy

High Performance Windows

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type – electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed

Install argon filled windows for residence areas.
Area of windows is estimated at 4382 square feet.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	53,910 kWh	724 kWh	4,534	50
Natural Gas	53,728 Therm	3,318 Therm	46,635	2,699
Total for all fuels			51,169	2,749

High Efficiency Boilers - Heat

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Install 2 high efficiency boilers each at 750mbh, or similar.
Sizing, pricing and configuration is to be confirmed.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	54,494 kWh	141 kWh	4,584	1
Natural Gas	52,287 Therm	4,759 Therm	45,325	4,010
Total for all fuels			49,909	4,011

High Efficiency Boiler - Domestic Hot Water

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Install a high efficiency boiler for domestic hot water.
Boiler to be 1000mbh with 400 gallons of storage, or similar.
Sizing, pricing and configuration to be confirmed.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	54,634 kWh	0 kWh	4,585	0
Natural Gas	55,746 Therm	1,300 Therm	48,311	1,023
Total for all fuels			52,896	1,023

Heat Recovery Ventilator- Corridors

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Install a Heat Recovery Ventilator to condition fresh air for corridors in residence area..

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	54,253 kWh	382 kWh	4,560	25
Natural Gas	55,229 Therm	1,816 Therm	47,885	1,449
Total for all fuels			52,445	1,474

Boiler Reset

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Install a boiler reset control that will modulate boiler supply temperature based on outside air temperature and have lead/lag and setback capabilities.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	54,457 kWh	177 kWh	4,574	11
Natural Gas	56,322 Therm	724 Therm	48,731	604
Total for all fuels			53,304	615

Insulate Walls

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Insulate all exterior walls with 0.75 inch rigid insulation.
Exterior wall area to be insulated is 9368 square feet.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	54,047 kWh	588 kWh	4,639	45
Natural Gas	54,220 Therm	2,826 Therm	47,020	2,314
Total for all fuels			51,560	2,359

Insulate Roof

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Install 4 inches of polyiso insulation for roof area of approximately 17,500 square feet. Area and pricing is to be confirmed.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	52,588 kWh	2,046 kWh	4,436	149
Natural Gas	48,059 Therm	8,987 Therm	41,963	7,382
Total for all fuels			46,388	7,531

Temperature Setback

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Install 4 temperature setback controls in retail areas.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	54,609 kWh	25 kWh	4,591	-6
Natural Gas	56,309 Therm	737 Therm	48,702	633
Total for all fuels			53,293	627

All Measures

The energy savings and cost impact of this energy management alternative are detailed below. They are broken out by fuel type -- electric, natural gas, oil, etc. "Typical" weather conditions and operation patterns are assumed.

Install all energy savings measures previously described.

Fuel Type	Annual Energy Use	Annual Energy Savings	Annual Energy Costs ($)	Annual Savings ($)
Electricity	51,002 kWh	3,632 kWh	4,332	253
Natural Gas	35,767 Therm	21,279 Therm	31,559	17,775
Total for all fuels			35,891	18,028

Measure	1st year Therm Savings	Annual ($) Savings	Estimated Installed Costs	Rebate Level	Rebate Offer	Net Installed Costs	Simple Payback (years)
New Windows	3,318	$2,750	$160,725	1	$3,318	$157,407	57.2
HEHE - Heat	4,759	$4,010	$36,446	H	$5,400	$31,046	7.7
HEHE - DHW	1,300	$1,023	$27,958	H	$3,000	$24,958	24.4
Heat Recovery Ventilator	1,816	$1,474	$44,296	2	$3,632	$40,664	27.6
Boiler Reset	724	$615	$1,200	1.5	$600	$600	1.0
Insulate Wall	2,826	$2,360	$14,608	1	$2,826	$11,782	5.0
Insulate Roof	8,987	$7,531	$18,731	1	$8,987	$9,744	1.3
Temperature Setback	737	$626	$1,000	1	$500	$500	0.8
All Measures	21,279	$18,027	$304,964	1	$21,279	$283,685	15.7

$0.85 / therm

Predicted gas cost w/o ESMs:
$48,500

Predicted gas cost w/ ESMs
$30,400

Actual: $48,000

Uphams Corner Market Incentive Worksheet

Measure	Annual Therm Savings	Commercial Rebate Program	C/I $ per therm	Economic Redevelopment	ED $ per therm	Customer Cost	
High Performance Windows	3318	$ 3,318.00	$ 1.00	$ 13,272.00	$ 4.00	$ 160,725.00	8%
High Efficiency Heating Equip.	4759	$ 5,400.00	$ 1.13	$ 18,223.00	$ 3.83	$ 36,446.00	50%
High Efficicncy DHW	1300	$ 3,000.00	$ 2.31	$ 5,200.00	$ 4.00	$ 27,958.00	19%
Heat Recovery Ventilator	1816	$ 3,632.00	$ 2.00	$ 7,264.00	$ 4.00	$ 44,296.00	16%
Boiler Reset	724	$ 600.00	$ 0.83	$ 600.00	$ 0.83	$ 1,200.00	50%
Wall Insulation	2826	$ 2,826.00	$ 1.00	$ 7,304.00	$ 2.58	$ 14,608.00	50%
Roof Insulation	8987	$ 8,987.00	$ 1.00	$ 9,365.00	$ 1.04	$ 18,731.00	50%
Temperature Setback	737	$ 500.00	$ 0.68	$ 500.00	$ 0.68	$ 1,000.00	50%
Sub-total	24467	$ 28,263.00	$ 1.16	$ 61,728.00	$ 2.52	$ 304,964.00	**20%**
All-Measures	21279	$ 21,279.00	$ 1.00	$ 61,728.00	$ 2.90	$ 304,964.00	20%

The goal of this project was to cover 20% of the ESM's