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Community Green: Sustainable Energy for Affordable Housing

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COMMUNITY GREEN: SUSTAINABLE ENERGY FOR AFFORDABLE HOUSING

By

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A Professional Project submitted to the Faculty of the Graduate School,
Marquette University,
in Partial Fulfillment of the Requirements for
the Degree of Master in Public Service

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ABSTRACT
COMMUNITY GREEN: SUSTAINABLE ENERGY
FOR AFFORDABLE HOUSING

Tim Hoye, B.B.A.

Marquette University, 2013

In view of the increasing concerns for escalating energy costs, healthier living, and environmental degradation, sustainable building initiatives are being pursued with both public and private support, although with significant misperceptions.

The purpose of this study is to identify homeowner perceptions of renewable energy sources and to identify the causes of apprehension towards using renewable energy technology in affordable housing. The methodology of this study uses a non-experimental, descriptive designed, random survey. Findings indicate significantly high initial costs for green building technology, such as solar panels, and serve as the primary reason for apprehension toward installing renewable energy systems in homes. However, survey results indicate high preference by homeowners for grants and incentives for green investments. Research limitations include a low sample size and delimitations of a small survey distribution area.

The void of perspective research on green affordable housing influenced the author to conduct this study with the intention to bring additional clarity to the subject. The researcher recommends continued support of public incentives for green energy education and technology especially by soliciting the involvement of nonprofit organizations. Cost effective housing, improved health conditions, and environmental awareness are survival points afforded by a transformation of rethinking towards green, sustainable living.

Keywords: environmental, sustainable, renewable energy, affordable housing, green building, solar, nonprofit

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Community Green: Sustainable Energy for Affordable Housing

The convergence of the *green movement* with affordable housing is an imperative development over the past decade to improve energy-efficiency in buildings, to provide healthy living, and to reduce negative impact on the environment. As a result, both public and private entities are increasingly pursuing green building initiatives. Although the progress is impressive, misconceptions remain about incorporating green initiatives with affordable housing projects. These misperceptions stem from the lack of available studies on public perceptions about green building initiatives and tangible results from residential renewable energy initiatives.

The common challenge of using green technology is equating initial start-up costs with long-term benefits. Another challenge is justifying the higher cost of green technology for housing programs with either private or public funds or with government subsidies. Government and local agency efforts, though persistent, have not convinced the public of the benefits of sustainable energy investment, as it relates to affordable housing development. Communities need to become better informed about the benefits of renewable energy sources through more transparency, research, and education. Integrating this technology follows the goal of providing safe, quality housing for low-to-moderate income families and all homeowners.

Purpose of Study

The purpose of this study is a) to identify homeowner perceptions about renewable energy integration in their homes, b) to identify the potential causes of apprehension toward using renewable energy technology, and c) to explore the feasibility of green technology in public funded affordable housing.

The basis of this study focuses on the reality of investing in renewable energy sources under the following circumstances: a) an affordable housing environment, b) a middle-sized

market (Milwaukee), and c) a cold-weather climate with limited sunlight. The expected outcome of this study is to provide needed transparency of actual costs and savings of green technology and to encourage further research on studies of sustainable energy and affordable housing.

Research Questions and Hypotheses

What are the public perspectives about renewable energy sources for affordable housing in neighborhoods with primarily low-to-moderate income levels? What are the potential causes of apprehension toward using renewable energy technology in affordable housing?

Hypothesis One:

H_O: There is a negative correlation between the high costs of renewable energy systems and the reluctance by homeowners to install these systems in their homes.

H_A: There is a positive correlation between the high costs of renewable energy systems and the reluctance by homeowners to install these systems in their homes.

Hypothesis Two:

H_O: Homeowners do not perceive renewable energy as a necessary element of affordable housing due to increased public concern over high-energy costs, personal health, and environmental degradation.

H_A: Homeowners do perceive renewable energy as a necessary element of affordable housing due to increased public concern over high energy costs, personal health, and environmental degradation.

The following literature review provides the definitions of key terminology and a discussion of renewable energy; green initiatives at national and state levels; and benefits, challenges, and solutions for green affordable housing.

Literature Review

Overview

The term *going green* has become a common tagline to describe the modern trend towards sustainable use of materials in consumer goods, such as clothing, technology, and food. Applying the practices of energy efficiency, using sustainable materials and natural resources for energy, has occurred for decades in both residential housing and commercial property. However, in the 21st Century, there has been an increased focus on energy efficiency and sustainable energy. When used in building construction, sustainable energy provides a renewable source of energy, reduces energy consumption and environmental impacts, and minimizes the risks to public health.

There is currently a lack of research pertaining to public perceptions about using renewable energy technologies in affordable housing. However, research from both the public and private sectors suggests that while lower energy consumption will improve the overall future costs of housing by lowering energy and water utility costs; the high cost of the implementation process, such as retrofitting older homes, continues to hinder green building. Future studies on the cost/benefit relationship of renewable energy can close the gap between misinformed homeowners and the path towards more efficient, healthy, and environmentally conscious living.

Definitions

Sustainable Energy. Sustainability is the capacity to endure. Environmental sustainability is the ability of a product to last over time without depleting natural resources for future generations. Renewable energy sources, such as sun, wind, geothermal, and biomass, produce cleaner energy versus traditional fossil fuels, such as petroleum, coal, and natural gas. Energy conservation is the use of less energy with less service. *Conservation* differs from

efficiency in that the latter strives to use less energy with the same amount of service. The avoidance of compromised energy, through conservation and efficiency, will benefit future generations.

Affordable Housing. Affordability is the ability to manage costs that fall within the limitations of the family's or individual's household income. The U.S. Department of Housing and Urban Development (HUD) indicates that affordable housing efforts are intended to bring balance to those families, whose housing expenditures exceed the generally accepted threshold of 30% of the household income. Reducing housing expenditures allows families to accommodate other expenses, such as food, clothing, consumer loans, and healthcare. Affordable housing costs have different meanings dependent on the level of family income. In Wisconsin for FY2013, Low Family Income represents 80% of Median Family Income; for Very Low Family Income: 50%; and Extremely Low Family Income: 30% (HUD, 2013, p. 1).

Green Building. The U.S. Environmental Protection Agency (EPA) (2013) defines green building as "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation, and deconstruction" (p. 1). This sustainable approach takes into consideration efficiency at every level of home building, including material origins, transportation of materials, construction methods, actual materials, and follow-up to ensure resource-efficiency.

The concept of green building originates with the environmental movement of the 1960s, including the oil crisis of 1970s, and the awareness of ozone depletion and climate change in the 1980s and 1990s (Furr, Kilbert, Mayer, & Sentman, 2009, p. 4). Ultimately, sustainable energy practices, combined with the goals of affordable housing, ensure green housing as a solution to

help curb high-energy costs, improve healthier living conditions, and protect environmental resources.

Renewable Energy

The protection of natural resources and prevention of energy waste begins with identifying the most common sources of energy for production and for consumption in the United States. In 2011, energy production of natural gas was the highest at nearly "40% followed by coal, petroleum, renewables, and nuclear."(NREL, 2013, p. 7). The highest energy consumption for the same year was "petroleum at 36%, followed by natural gas, coal, renewables, and nuclear…. Renewable energy has increased in both production and consumption since the year 2000, both by at least 3% while other energy such as petroleum has decreased in 10 years by at least 2%" (NREL, 2013, p. 7).

The slight increase in use of renewable energy is due to offering alternatives to help curb the use of environmentally harmful and less sustainable energy sources. The impact of energy consumption by buildings and construction is significant in overall resource consumption. In 2011, energy consumption by U.S. residential and commercial buildings accounted for slightly over 40% of all consumption, followed by industrial and transportation consumption (NREL, 2013, p. 13). The relentless demand for energy has made renewables a vital component of the energy consumption/production equation.

Green Affordable Housing

Green affordable housing encompasses energy efficiency and conservation along with the basic needs of housing (safety, decency, and affordability). In a study by New Ecology, emphasis is placed on the importance of including green building in the goals for affordable housing:

> Though green buildings are often promoted as reducing impacts on the environment – less natural resources and energy use, improved air quality though use of non-toxic materials, lower greenhouse gas emissions – it is important to consider green building in the context of the conventional goals for affordable housing: affordability, performance, and health. (Bradshaw, Connelly, Cook, Goldstein, & Pauly, 2005, p. 17)

In a housing market where there are increasing concerns about escalating energy prices and environmental protection, green affordable housing can be the solution.

Green Initiatives at National and State Levels

National Initiatives. Renewable energy capacity tripled between 2000 and 2009 nationwide. By 2009, "renewable energy accounted for more than 55% of all new electrical capacity installations in the United States" (NREL, 2010, pp. 3-4). As evidenced by the steady growth of renewable energy applications, developers and homeowners can anticipate advantages that accompany sustainable housing development.

The real benefits of green housing were identified by New Ecology's study of various green affordable housing projects across the country. "For residents and homeowners, the benefits of greening outweigh the costs in all but one of our case studies. The mean NPV benefit to residents is over $12,000 per unit" (Bradshaw et al., 2005, p. 166). Demonstrated benefits outweighing costs include:

> In relation to conventional projects, first cost premiums are smaller. Actual operation costs are lower than conventional buildings. Project residents and homeowners (in homeownership projects) usually experience a net benefit over a project's life while building owners and developers receive a net benefit in a majority of the cases. The

> current financial system is a barrier to green affordable housing, and there are non-financial benefits like health and quality of life. (Bradshaw et al., 2005, p. 163)

State Initiatives. California's varied climates provide an ideal example for states across the country to follow when it comes to better living through green technology. In the study performed by New Ecology, five of sixteen case studies in the United States that promote green affordable housing were locations in California. Santa Monica's *20th Street Apartments* project, one of the five case studies, focused on extending the life of a 1960s base structure and improving the affordability to residents through improvements in energy efficiency, such as adding a solar-assisted hot water heating system (Bradshaw et al., 2005, pp. 44-45). The results of the $3.5 million development for this 34 unit building are represented in their operating savings. "Based on the Syska and Hennessy energy model developed before construction, the energy- and water-efficiency improvements should save CCSM and tenants an annual total of $11,375 or $0.37 per square foot when compared with the pre-rehab structure" (Bradshaw et al., 2005, p. 46).

In recent years, Colorado has become a leader in expanding and promoting an economic transformation called the New Energy Economy. This effort includes creating green energy jobs, developing more renewable energy sources, recognizing energy efficient methods, and reducing the negative impact on the environment. Governor Bill Ritter "set out to develop oil and gas drilling rules that put greater emphasis on the protection of Colorado's signature wildlife herds, water, air, communities and landscapes. What he sought was balance between a healthy industry and a healthy environment" (Hartman, 2012, p. 99). The Colorado legislation sought to double the Renewable Energy Standard from "10 percent by 2015 to 20 percent by 2020, as well as new

utility transmission lines, and a net metering bill that credited residents for producing more energy on the grid" (Hartman, 2012, pp. 13-14).

Colorado's experience represents a model to create economic growth, but with a green twist. Governor Ritter proclaimed, "We are quickly making a name for ourselves as a state that's open for business in what will be one of the most important industries of the 21st century" (Hartman, 2012, pp. 16-17). This state's green initiative is changing the way people think about their future.

Unlike California and Colorado, there is a lack of research on green affordable housing in Wisconsin. However, a significant study was initiated in Madison to determine the impact of electrical utility load with varied components of distributed solar photovoltaic technology and to evaluate the economics of implementing solar energy across the state. The results indicate that "In Wisconsin, solar photovoltaics can contribute no more than 20% of the total electrical energy demand in the state based on a 60% flexibility factor, no short-term electrical storage, and a demand profile similar to the one experienced in calendar year 2002" (Myers, Klein, & Reindl, 2010, p. ii). Further findings in this study indicate, "The cost-to-benefit ratio for solar PV in Wisconsin is 4.5. By comparison, the calculated cost to benefit ratio of solar PV in California was between 3 and 4 according to a 2008 paper published by the University of California Energy Institute" (Myers, et al., 2010, p. 193).

NREL studies indicate overall renewable energy installation and production for the Midwest states. Table 1 displays a segment of a Midwest renewable energies table that compared 12 states. Wisconsin had the sixth highest total number of installed renewables and ranked third in most installed photovoltaic solar panels after Ohio and Illinois (NREL, 2013, p. 34).

Table 1

Renewable Electricity Installed Capacity (MW) (2011)

	Wind	PV*	CSP**	Geothermal	Biomass	Hydropower	Total Renewables	Per Capita RE Watts/Person
Ohio	112	31.6	0	0	163	128	435	38
Illinois	2,742	16.2	0	0	142	40	2,940	228
Wisconsin	631	12.9	0	0	356	518	1,518	266

Source: NREL, 2013
* Photovoltaic - Does not include off-grid installations
** Concentrated Solar Panels

National and state initiatives serve as the catalysts for adopting renewable energy, energy conservation, and green affordable housing throughout the United States. The benefits and challenges of green affordable housing are discussed in the next section.

Benefits of Green Affordable Housing

Although project equipment costs cause many homeowners to pause, the long-term benefits of installing green technology in affordable housing projects can surpass the initial start-up hurdles. Overtime, green technology will provide sustained financial, health, and environmental benefits to the developers and homeowners.

Reduced costs. Green building can offer a significant cost reduction both in construction by developers and during actual use by owners. Johnson Controls, a Wisconsin-based company specializing in building efficiency, found in a 2007 survey of company officials that "52 percent of respondents said reducing costs was the primary motivation in implementing energy efficient systems as opposed to environmental reasoning that garnered just 13 percent" (Furr et al., 2009, p. 106). Five years later, Johnson Controls conducted a similar survey, which analyzed drivers of energy efficiency by major industrial global regions including Europe, India, China, US/Canada, Australia, and Brazil. "While the motivations for energy efficiency varied according to region,

the unanimous driver for all regions was energy cost savings" (Johnson Controls, 2012, p. 6). Other noted motivational factors included government incentives/rebates and the increased energy security that comes with renewable technology.

Direct cost reduction for homeowners include savings in maintenance costs normally associated with traditional means of heating, cooling, and electrical in homes and businesses. Lower insurance premiums also allow cost savings for homes with green technology. In particular, LEED certified buildings containing certain energy-saving products might be eligible for insurance savings that reward developers, owners, and rental tenants alike. Cost reduction is not the only incentive for rental units. Market data has shown that real estate with green initiatives has the potential to increase rental income, because potential tenants observe value-added aspects to green buildings, while owners are likely to see reduced turnover in unit occupancy. Furr et al. (2009) cited another survey by Jones Lang LaSalle and CoreNet Global that found 52 percent of tenants "were willing to pay a 15 percent premium and an additional 25 percent were willing to pay a 5 to 10 percent premium" (p. 109). Although these numbers are termed by Furr et al. as anecdotal evidence, the data indicate a more positive perception of buildings with green technology versus traditional means of heating, cooling, and electrical.

Health improvements. While overall financial health of a building may result from renewable energy sources, human health concerns are also a consideration for green construction. Healthier living starts with the actual construction process in which developers use more sustainable building materials that may be less harmful to the environment and humans. While in-home use of traditional technology and materials may seem acceptable to most inhabitants, renewable energy sources reduce carbon dioxide emissions and threats to carbon monoxide infiltration that could be caused by traditional heating units. Other design techniques,

such as natural lighting and solar-sourced lighting, can increase employee productivity as much as 7% due to better indoor quality (Furr et al., 2009, p. 110). Over a span of 10, 20, or 30 years, the health benefits of green technology in affordable housing can be quite significant (Furr et al., 2009).

Environmental conservation. Healthy, green practices also translate to better environmental health. Owner-occupants of homes can do their part in conservation by installing Energy Star® products, a trademark of the U.S. Environmental Protection Agency, that have energy standards designed to use less energy in appliances, lighting, and other consumer goods. Owner-occupants of sustainable green homes can take steps to both produce and conserve energy through additional insulation, improved windows, efficient doors, etc. Conservation is not limited to energy; fresh water conservation and storm water retention can be achieved through the EPA's *WaterSense* standards in lower-flow toilets, faucets, showerheads, pipelines, rain barrels, and modification of residential yard design.

Sustainable energy initiatives can serve to create environmental conservation as a by-product. Developers address environmental awareness through green building using two methods. The first is optimal location. Developers and urban planners can locate projects closer to public transit outlets. For lower-income families, in particular, mortgages and transportation costs (i.e., varied-level gas prices) are a significant financial burden. Reduction in energy use and carbon emissions by vehicles has been an ongoing effort by the EPA, manufacturers, and various industries. The second strategy to maintain environmental conservation is building projects within existing green systems. This method attracts potential owners and renters while maintaining satisfaction of the current residents.

Positive public perception. Public perception of construction with renewable energy sources places these buildings in higher demand than projects without green technology. While energy efficiency, health concerns, and environmental conservation are the main factors of effective green buildings, public perception may only remain positive as long as there are incentives in start-up and maintenance costs. The Johnson Controls (2012) report showed that among both developed and emerging nations, "Tax credits/incentives or rebates or implementing EE measures" were the most impactful and favored policies for improving energy efficiency in buildings (p. 7). Other perceptions include recognized importance of policies towards better financing, stricter building codes, and implementing green appraisal standards, along with other policies. Implementing these types of policies for green construction and maintenance help avoid some of the barriers posed by implementing green buildings and sustainable housing.

Challenges of Green Affordable Housing

As funding opportunities increase for developers and homeowners, financial barriers toward green affordable housing continue to exist. High start-up costs and long payback for solar and wind technology, due to limited manufacturing in the U.S., remain sources of concern. Due to a lack of residential users and less general knowledge of green technology, low awareness poses a significant challenge to taking *green risks* by homeowners. This misunderstanding also transfers to actual beneficiary discrepancy. Who will reap the benefits of green technology? While green affordable housing maintains numerous positive benefits, the realization of benefits from sustainable implementations may only be realized in the long-term. Estimates of the long-term value of sustainable energy are based on net present value and future cost/benefit analyses; currently, the long-term value is undetermined.

Cost issues. At the forefront of concern, green construction has high, up-front costs. There is no doubt that some soft costs account for only a small portion of green installation; however, developers and homeowners can spend thousands of dollars for the hard costs, such as solar panels, monitoring systems, and support equipment. Depending upon the level of desired home energy production, consultation, equipment, and maintenance costs could reach levels unaffordable by most homeowners. These owners may even view solar energy as a luxury item. The costs of renovation to older homes for renewable energy can reach the actual market price of the home.

As related to affordable housing, costs are often more complicated, because there are various stakeholders—developers, owners, operators, residents, renters—who have an important role in buying and maintaining homes of all sizes. While HUD and local government assistance is available for these parties, there remains a great deal of confusion about the accessibility of these resources. Birch and Wachter (2008) comments on issues in green affordable housing by stating, "Generally, there is a direct correlation in affordable housing between higher costs and either fewer affordable units or lesser affordability—a tradeoff most affordable housing developers and policy makers are unwilling to make" (p. 116). Multi-unit housing creates even more complications.

Funding confusion. Financing sources for green housing and affordable housing in general are varied and may even be unknown to some stakeholders. State housing agencies, local governments, and HUD all provide funding that can be broken down into tax credits from the IRS, bond issuance, CDBG, voucher programs, nonprofit intermediaries, and LIHTC for renters (Global Green USA, 2007).

Negative perception. There is a perceived risk associated with any new process or unproven element. Just as there are positive perceptions of green buildings, there is also skepticism and, perhaps, nervousness by such entities as nonprofits that often can be very risk averse. Depending upon the experience of developers with green innovation, there also may be concern that extra cost and planning could delay construction.

Sustainability is an issue, because developers cannot always incorporate green solutions in a cost-effective manner. If the appropriate funding is not available or not eligible for a given project, constructing a home to be sustainable through renewable technology may push the project over budget. Bradshaw et al. (2005) refer to the life cycle of sustainable affordable housing and its mismatched financing system:

> First, green affordable housing is difficult to develop because it often requires slightly higher up-front costs, while low initial capital costs are the critical factor in funding allocations. Second, in market-rate green housing, the long-term benefits of greening (i.e., operating savings) may be reflected in a higher sales price, allowing the developer to recoup any incremental costs of greening. (p. 22)

Physical barriers. Rehabilitation and retrofitting of older homes is a more complex and costly process. While some renewable energy system maintenance is consistent between new and older homes, the process of adding energy efficiency (i.e., new electrical) and energy conservation (e.g., added insulation) can be a time consuming and expensive part of the refurbishment. Location of green affordable housing is also a physical challenge. While developers may desire to build in a targeted area that is convenient to public transit, sustainable sites are difficult to find in more densely populated areas. In urban areas, where affordable

housing needs greening the most, available area for transport, construction, and lot space are limited.

Lack of well-documented research. Renewable energy implementation for affordable housing or public housing is a relatively new movement. Limited data is available for incremental costs and cost savings due to lack of documentation and availability. Third-party permission regulations or overall lack of access prevents the use of private residence records and bills for cost comparisons. Opportunities to have more research and analyses for finding affordable housing solutions will increase as this new technology grows.

Meeting the Challenges of Green Affordable Housing

The greening of affordable housing is a process, and results are not immediate. However, the data shows that when presented with challenges in making housing affordable, there are solutions that will help to alleviate the major concerns for developers and homeowners.

Cost sharing. The Center for American Progress suggests that any savings from renewable energy implementation may be distributed evenly among the participating parties:

> One reasonable approach to this situation—where the cost of the work and burden to the owner to perform is fairly modest—is to give each party a one-third share of the benefit. That is, one-third of the savings flows to the owner in the form of green dividend distributions. Another one-third should go first to replenish the reserve for replacements, and then subsequently accrue to the benefit of HUD (and the federal budget) in the form of a downward subsidy adjustment equal to one-third of the savings. The final one-third should flow through to tenants in the form of lower tenant utility payments where applicable or lower rents. (Abromowitz, 2008, p. 21)

However, an evenly-split distribution "may result in HUD, and ultimately the public, reaping too much financial benefit from individual housing but failing to account for the larger public benefit of reduced energy usage" (Abromowitz, 2008, p. 21).

High cost and rehabilitation. To ease the cost issue, Birch and Wachter (2008) suggest taking advantage of the utility allowance, which is essentially a rent reduction when the family pays the utilities directly. "Owners have the opportunity to capture additional cash flow and reinvest it in the property, pass it through to tenants, or both" (Birch & Wachter, 2008, p. 118). Additionally, careful cost/benefit planning and exploring all methods of financial assistance are essential to easing high start-up and operating costs.

Location. Zoning policies must be examined and challenged in order for developers to make any significant headway in the development of green affordable housing.

Apprehension. "More resources are needed to provide education, training, and technical assistance" (Birch & Wachter, 2008, p. 118) for homeowners, developers, contractors, architects, engineers, and property managers. Likewise, these parties must also be willing to learn and be proactive in their greening.

Research. Time will provide more data related to housing and perceptions about renewable energy for homes. Technological advancement has allowed for rapid expansion of greener homes, and continued use will provide more affordable technology for homeowners.

Changes in political policy and financial institution practices.

If banks were willing, based on property appraisals and other data, to provide lower-cost loans or more flexible underwriting of green residential development based on their greater durability and superior performance compared to conventional properties, it

would likely have powerful effects throughout the affordable housing industry. (Birch & Wachter, 2008, p. 120)

Policies and cities must evolve. "Housing programs, zoning policies, and building codes impede the development of healthier, more energy efficient affordable homes for low-income people" (Birch & Wachter, 2008, p. 121). Some policy suggestions include a) reconsider cost caps imposed by affordable housing programs, b) change zoning in order for communities to be more heterogeneous and more accessible to public transit and parks, and (c) continue to revise building codes for even healthier living.

Methodology

Overview

This section describes the survey methodology used to gather data on public perceptions regarding renewable energy and affordable housing. Topics include research design, survey tool, sample population, and study variables. The design of this quantitative study measures the perceptions of homeowners on renewable energy integration in their homes and explores the feasibility of green technology in affordable housing programs.

One of the primary beneficiaries of this study is the community development organization, Layton Boulevard West Neighbors (LBWN), based in Milwaukee, Wisconsin. LBWN is a nonprofit 501(c)(3) organization that focuses on community revitalization by promoting neighborhood leadership, economic development, and affordable housing solutions. The survey was conducted with the citywide population in mind; however, the intended focus of the survey was on the immediate population that benefits from the community outreach of LBWN.

Research Design & Procedures

Design. This study was intended to be observational in nature without any manipulation with regard to the situation, location, or experience of the survey participants. The research design is non-experimental and descriptive for the purposes of describing and attempting an explanation of the current phenomenon of increased interest in renewable energy for both public and private residential properties.

Descriptive Study. Two factors allow this study to be descriptive. The first is the nature of the questions and the results. The Findings section presents tabular, graphical, and numerical descriptive statistics that are used to make inferences from the gathered data. The second factor is that this study is designed to be an introductory phase to the idea of using renewable energy in affordable housing. Overall, the phenomenon of renewable energy sources is still in relatively early stages; there is a lack of data, especially from local residences.

Sampling

Population and samples. The residents of the immediate neighborhood population were the focus of the study. The City of Milwaukee is a middle-sized market on a national scale with a population estimate (2011) of 598,000 (U.S. Census Bureau, 2013). The survey's target population is located on Milwaukee's south side—three neighborhoods located near the Menomonee Valley called Silver City, Burnham Park, and Layton Park. Population in these three neighborhoods combines to approximately 21, 218 residents (Clausen, 2011). This diverse area of the city is cited and compared in Table 2.

Table 2

Population - Subsample, Target, City, & State

Ethnicity	Survey Subsample*	Target Population**	City of Milwaukee***	Wisconsin***
Asian	2%	4%	3%	2%
Black or African American	2%	5%	40%	6%
Hispanic or Latino	38%	66%	17%	6%
Native American	0%	1%	1%	1%
White	48%	22%	37%	83%
Two or More Races	10%	2%	3%	2%

* Source: Survey Tool Questionnaire (2013)
** Source: T. Clausen (2011)
*** Source: U.S. Census Bureau (2013)

The general population is City of Milwaukee. The target population or sampling frame comprised of two groups of contacts made accessible by LBWN's mailing list of all professional and neighborhood contacts. The professional contacts list is represented as $N_1 = 2,153$. Professional contacts are primarily located in the City of Milwaukee. The neighborhood contact list is represented as $N_2 = 610$. The combined study population is N = 2,763 (2,153 + 610) or $N = N_1 + N_2$.

Sample method. This survey used a probability random sampling method. Specifically, a stratified (or proportional) random sample was performed in order to represent the overall population in Milwaukee and the smaller group, in this case, the immediate three neighborhoods covered by the reach of LBWN. As noted previously, the two strata are represented as N_1 and N_2 where in each stratum, a simple random sample was selected and noted as f = n/N.

Sampling frame. The sampling frame comprised a selected number of 500 contacts from the professional list and 200 contacts from the neighborhood list. The professional sample is represented as $n_1 = 500$. The neighborhood sample is represented as $n_2 = 200$. The combined

sample size was n = (500 + 200) or $n = n_1 + n_2$. The sampling fraction is equal to 25.3% or f = n/N or .253 = 700/2763.

Subsample. The respondents who answered the survey completely comprised the subsample. The total number of completed surveys was 52. The total number of stored surveys was 55, in which three were incomplete. In the Findings section of this study, the Frequency Tables account for the Adjusted Relative Frequency that eliminates the non-respondents from this survey.

Survey Tool, Materials, and Data Collection

Random Selection Tool. The final sampling frame was conducted as a random selection process through Microsoft Excel's random sample function F_x = RAND(). This computer generated random selection "returns an evenly distributed random real number greater than or equal to 0 and less than 1. A new random real number is returned every time the worksheet is calculated" (Microsoft Office, 2013). From the target population, the 700 email contacts were randomly selected electronically using the RAND function.

Communications tool. The sample frame was sent an email, consent letter, and link to the online *Opinio* survey. (See Appendix A, Bilingual Letter of Request for Participation and Appendix B, Research Consent Letter.) The researcher created the communication tool in an online software application by Constant Contact, Inc. This tool allowed the researcher to select the study population (or available contact list), add the sample frame, and send a formatted communication email to potential respondents. The tool also calculated response rate information, such as open percentage and reject or bounce rate. The results of these communications appear in Table 3.

Table 3

Actual Sample and Response Rate

Email Distribution*	Day One	Day Six***
Actual Emails Sent	654**	654
Email Opens	169	140
% Opens	28.8	23.9

* Source: Constant Contact, Inc.
** Bounce back rate of emails sent was est. 8% of 700 total emails in the sample.
*** Reminder was sent to recipients of the 7-day open survey.

Survey Tool. The survey tool is a self-constructed questionnaire, presented in an electronic survey and is email-based (see Appendix C, Survey Questionnaire). The measurement is based primarily on the interval, Likert scale. A variation is used—an even point scale—in which the forced choice method removed the neutral or undecided position. The survey took place over a stated period of one week, giving the sample frame seven days to open the survey notice message, access the survey, and complete the questionnaire.

The electronic survey was created in the web application Opinio, a survey application by independent software developer ObjectPlanet, Inc. The Marquette University Information and Technology Services provided the application software. Opinio was also able to accommodate a second survey that was bilingual; Spanish was included to accommodate the Hispanic or Latino population, which is a significant demographic group in the LBWN outreach community.

Time-in-research. This study is considered a cross-sectional study as it occurred at one point in time. The survey's activation time through Opinio was open for exactly one month; however, all 52 completed responses were received within the requested one-week timespan.

Variables in Study

Variables in this study are relatively difficult to ascertain, because this was a non-experimental study. For example, no personal interviews were conducted to determine the spending habits of homeowners. Some independent variables were interjected in several of the questions to determine a cause/effect response. For example, some questions asked respondents to decide, theoretically, what their response would be to installing renewable energy technology based upon a variable, such as an initial investment credit, grant, or future financial benefit. The outcomes would be uncertain since the suggested benefits are theoretical.

Variables in this study were mainly applicable to the demographic questions. The variable of ethnicity, for example, contained six attributes in which the goal was to be exhaustive and simulate the attributes seen in the U.S. Census reports. To avoid any mutual exclusivity, the choice of two or more races was included for ethnicity. While a survey regarding energy efficiency, conservation, and use could easily contain a wide array of values, this survey intended to reduce the number of variables with the view to soliciting succinct, direct answers to questions about theoretical scenarios of renewable energy technology use.

Findings

Overview

The intended purpose of this survey sought to describe the various perceptions of renewable energy by homeowners; thus, the majority of questions were of descriptive nature. Some questions were more of a relational nature; for example, would a homeowner implement renewable energy based upon the variable of future financial savings and the amount of time an investment in photovoltaic solar panels would eventually pay for them.

Results, Descriptive Statistics, and Analysis

The following data present the descriptive statistics for the survey, including the absolute frequencies of each question and associated relative frequencies. These tabular and graphical summaries were derived and calculated through the Opinio online support survey software and made possible by the Marquette University Information and Technology Services.

Question 1. I am currently using renewable energy in my home (solar, wind, geothermal, etc.).

Q1 general analysis. The overwhelming majority of homeowners do not currently use renewable energy in their homes. The adjusted relative frequency indicated that over 92% of the respondents disagreed with the statement, as seen in Table 4.

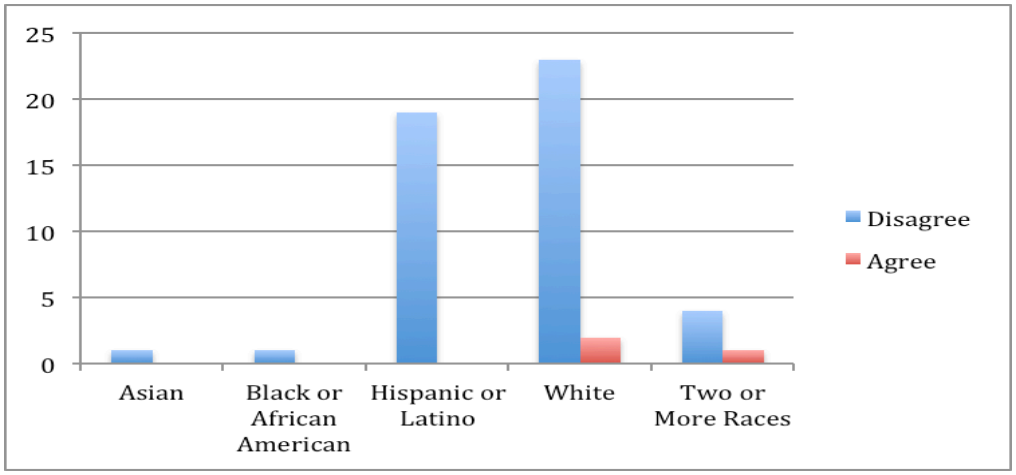
Table 4

Homeowners Who Currently Use Renewable Energy

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
Disagree	48	87.27%	92.31%
Agree	4	7.27%	7.69%
Sum:	52	94.55%	100.00%
Not answered:	3	5.45%	-
Total answered: 52			

Q1 demographic comparison. The demographics of the respondents ranged from Asian, Black or African American, Hispanic or Latino, White, and Two or More Races. Respondents using renewable energy were concentrated in the Hispanic or Latino and White categories (see Figure 1).

Figure 1. Demographic Analysis of Homeowners' Current Renewable Energy Use



Question 2. I am planning to install renewable energy in my home within the next 5-10 years.

Q2 general analysis. The plan to install renewable energy technology requires careful planning on the part of the developer or homeowner. The period for implementing a system was chosen here as a decision to be made in the short term of 5 to10 years. Most respondents disagreed with installing renewables in the short term by almost 56% (see Table 5).

Table 5

Future Installation of Renewable Energy

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
1 Strongly Disagree	6	10.91%	11.54%
2 Disagree	23	41.82%	44.23%
3 Agree	18	32.73%	34.62%
4 Strongly Agree	5	9.09%	9.62%
Sum:	52	94.55%	100.00%
Not answered:	3	5.45%	-
Total answered: 52			

Q2 demographic comparison. Of the 29 respondents who either disagreed or strongly disagreed with this statement, 69% were 45 years of age or older.

Question 3. I prefer to use energy efficient products in my home such as fluorescent light bulbs, a programmable thermostat, etc.

Q3 general analysis. Examples of more established green technologies that are highly accessible in the consumer market include compact fluorescent light bulbs, programmable thermostats, and Energy Star® rated appliances. There was an overwhelming favor toward using energy efficient products. Almost 85% of the respondents either agreed or strongly agreed to prefer to use these products in their home (see Table 6).

Table 6

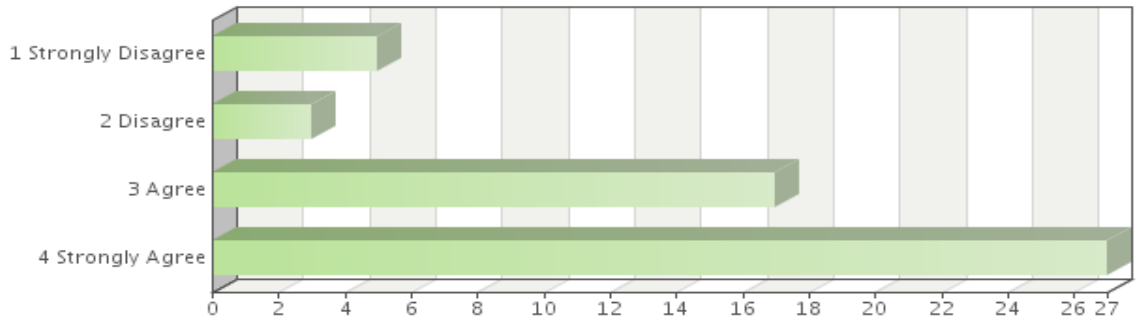
Preference of Energy Efficient Products

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
1 Strongly Disagree	4	7.27%	7.55%
2 Disagree	4	7.27%	7.55%
3 Agree	16	29.09%	30.19%
4 Strongly Agree	29	52.73%	54.72%
Sum:	53	96.36%	100.00%
Not answered:	2	3.64%	-
Total answered: 53			

Question 4. Renewable energy sources such as solar or wind power will save money for homeowners in the future.

***Q4 general analysis*.** This question incorporated wind as another renewable energy source. It suggested that wind as well as solar could be a source that would save homeowner money and energy in the future. Over 84% of the respondents agreed that these renewable energy sources would save money in the future as illustrated in Figure 2.

Figure 2. Renewable Energy Savings Perception



Q4 demographic comparison. Of the 44 respondents who agreed or strongly agreed to this statement, 23 or about 52% stated their age as 45 years or older.

Question 5.

I would be willing to pay 15%-30% more for a home with renewable energy than a home without renewable energy.

Q5 general analysis. This question asked respondents about what their spending habits would be when encountered with a choice between a home with renewable energy and one without the technology. Almost 55% of the respondents either agreed or strongly agreed that they would pay 15 to 30% more for a renewable energy equipped home—a realistic cost to install and maintain renewable technology such as photovoltaic solar panels (see Table 7).

Q5 demographic comparison. Of the 29 respondents who agreed with this statement, about 21% reported a household income of $10,000 to $29,999, and about 17% of these respondents reported $100,000 to $149,000. About the same percentage of respondents, with a $10,000 to $29,999 household income, also disagreed to paying more for a home with renewables.

Table 7

Willingness to Pay More

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
1 Strongly Disagree	6	10.91%	11.32%
2 Disagree	18	32.73%	33.96%
3 Agree	19	34.55%	35.85%
4 Strongly Agree	10	18.18%	18.87%
Sum:	53	96.36%	100.00%
Not answered:	2	3.64%	-
Total answered: 53			

Question 6. I would be willing to pay $15,000-$30,000 to install solar energy if it means I will save money in the future.

Q6 general analysis. This survey question is similar to that of question 5, because it suggests a specific price range a developer or homeowner is willing to spend on renewable technology, however it incorporates a variable that an undetermined financial savings will be available in the future. While 48% of respondents were in disagreement, 52% agreed that future savings could persuade them to pay a higher premium for renewable energy (see Table 8).

Table 8

Willingness to Pay to Install Solar Energy

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
1 Strongly Disagree	5	9.09%	9.62%
2 Disagree	20	36.36%	38.46%
3 Agree	22	40%	42.31%
4 Strongly Agree	5	9.09%	9.62%
Sum:	52	94.55%	100.00%
Not answered:	3	5.45%	-
Total answered: 52			

Q6 demographic comparison. Of the respondents who disagreed with paying to install solar energy even if it meant future cost savings, 16% reported a household income of $10,000 to $29,000. However, of the respondents who agreed to this statement, twice the number of respondents (32%) in this income bracket agreed to install solar technology.

Question 7. I would install solar panels in my home even if it takes 5-10 years for the investment to pay off.

Q7 general analysis. This question was more consequential in nature and assumed that the cost of installing solar panels may take up to 10 years to pay off completely, after which time the panels would begin to pay for themselves. Less than 60% of respondents agreed that they would install this renewable technology; 25 of the respondents agreed with this statement, given the theoretical timeframe to recoup the cost of the photovoltaic system (see Table 9).

Table 9

Future Investment

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
1 Strongly Disagree	5	9.09%	9.62%
2 Disagree	16	29.09%	30.77%
3 Agree	25	45.45%	48.08%
4 Strongly Agree	6	10.91%	11.54%
Sum:	52	94.55%	100.00%
Not answered:	3	5.45%	-
Total answered: 52			

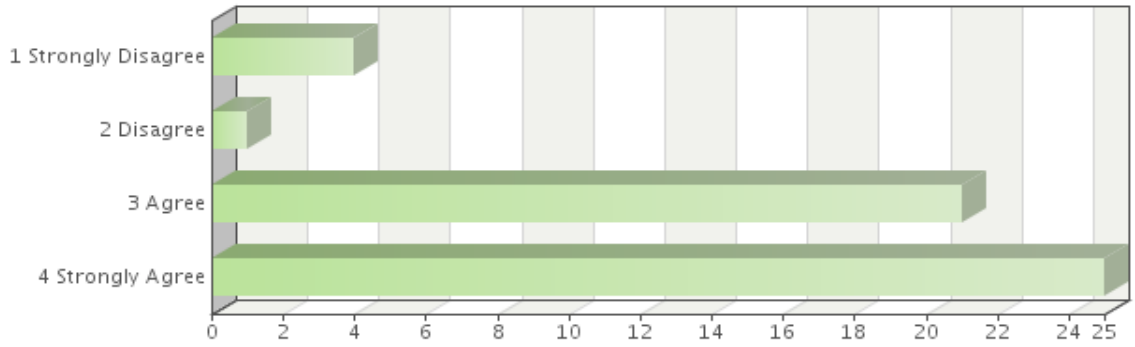
Q7 demographic comparison. Of the respondents who agreed that they would invest in solar energy even if the payoff was not for 5 to10 years, almost 94% reported an age of 25 years or older with a near even split between age groups 25 to 44 and 45 to 64 years.

Question 8. I support tax credits/grants/rebates for private residents who install renewable energy sources in their homes.

Q8 general analysis. This question solicited the perspective of the respondents towards using credits or grants towards renewables. In this case, the funding would benefit private residents. There was an overwhelming agreement towards tax credits and rebates, as seen in Figure 3, in which slightly over 90% of respondents agreed with this financial benefit.

Q8 demographic comparison. Of the respondents (10%) who did not agree with this benefit for private homeowners, two of five reported a household income of $10,000 to $29,999.

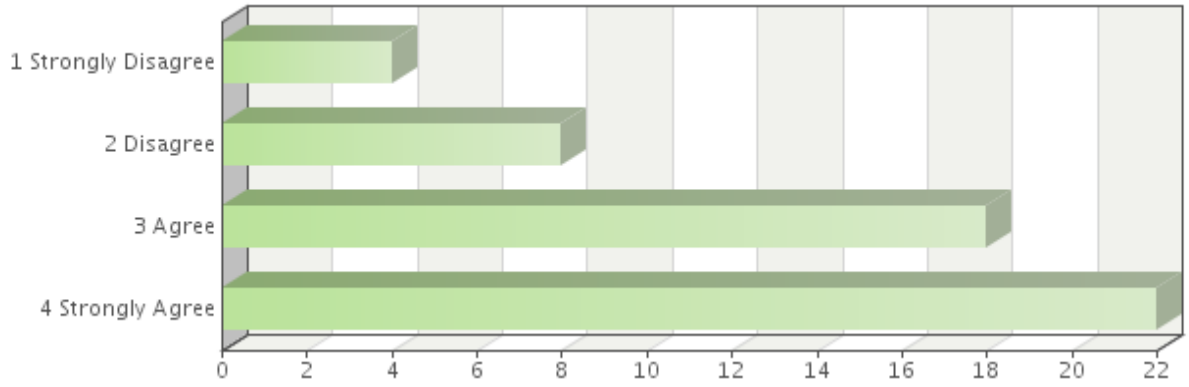
Figure 3. Support for Tax Credits/Grants Rebates for Private Residents



Question 9. Subsidies/grants for renewable energy sources are appropriate for public housing programs.

Q9 general analysis. This question differs from Question 8, because it asks respondents to respond to the use of subsidies or grants for public housing. Although not as overwhelming as for private residences, the majority of respondents favored subsidies/grants for public housing programs. Twenty-two respondents strongly agreed and eighteen agreed to the use of financial assistance for renewables as shown in Figure 4. About 23% did not agree with this use of public funds for affordable housing.

Figure 4. Support for Subsidies/Grants for Public Housing

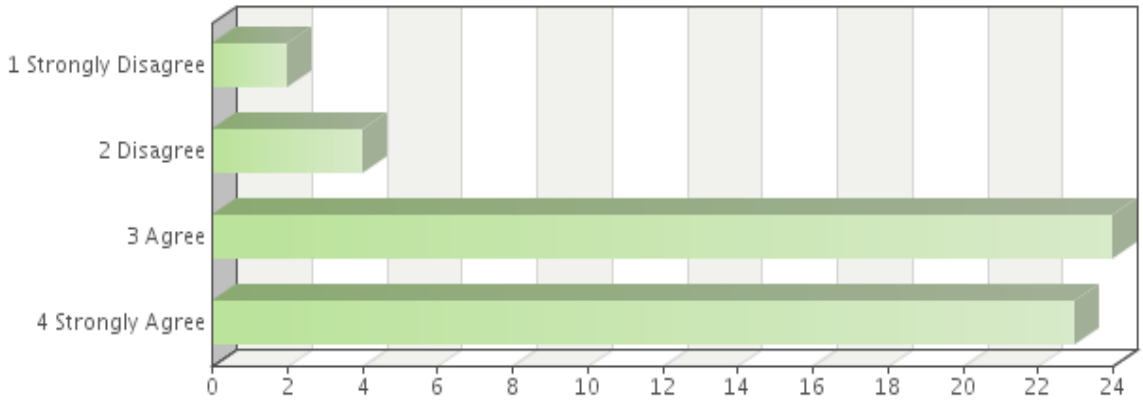


Q9 demographic comparison. Of the respondents who did not agree with this statement, 30% reported a household income of $10,000 to $29,999. Those with a household income of $70,000 to $149,999 disagreed at a frequency of about 17%.

Question 10. Solar and wind are reliable sources of energy.

Q10 general analysis. This question assumed that the current rate of information is available to the public in order to decide if renewable technology is reliable. An overwhelming response of over 88% either agreed or strongly agreed solar and wind technologies are reliable energy sources as observed in Figure 5.

Figure 5. Reliability of Solar and Wind



Question 11. Renewable energy products such as solar panels or wind turbines are physically appealing in the neighborhood.

Q11 general analysis. The question of aesthetics is a factor in renewable technology implementation, especially regarding wind turbines. As shown in Table 10, 75% of the respondents agreed and strongly agreed solar or wind products would be physically appealing in their neighborhood.

Table 10

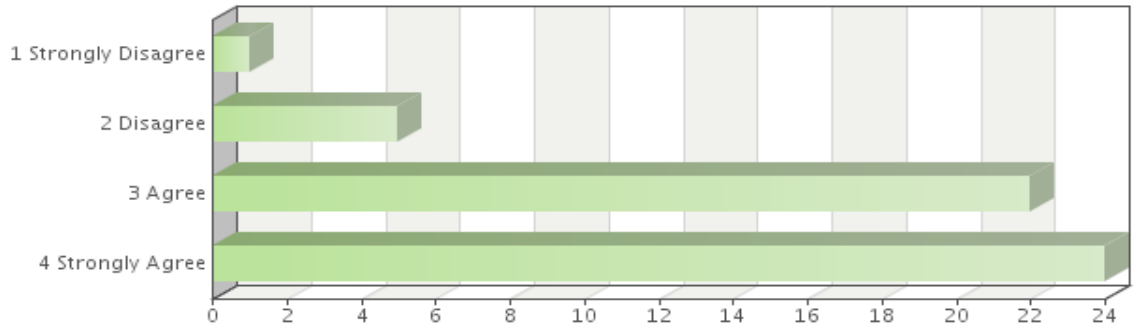
Physical Appeal of Renewable Energy Products

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
1 Strongly Disagree	5	9.09%	9.43%
2 Disagree	8	14.55%	15.09%
3 Agree	24	43.64%	45.28%
4 Strongly Agree	16	29.09%	30.19%
Sum:	53	96.36%	100.00%
Not answered:	2	3.64%	-
Total answered: 53			

Question 12. I would install solar panels in my home if it means that my monthly utility bills would be half the cost or lower.

Q12 general analysis. This question suggested a direct cause and effect relationship between renewable energy installation and the variable cost of a homeowner's utility bill. An overwhelming 88% of respondents agreed that they would install solar panels if their monthly utility bill would be lowered by at least one half (see Figure 6).

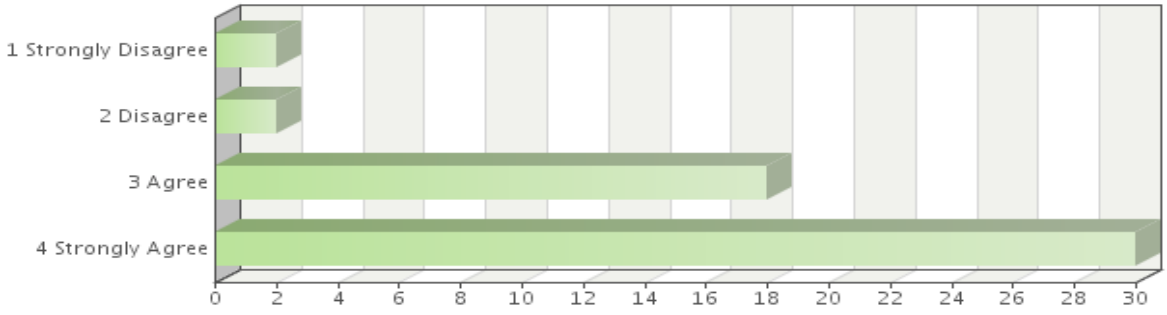
Figure 6. Installation of Solar Panels Based on Lower Utility Bills



Question 13. I would install solar panels on my home if tax credits, rebates or grants were available.

Q13 general analysis. This question suggested to respondents that benefits, rebates, and grants are available for those planning to install renewable energy technology in their homes. Over 82% would make the switch to renewable energy if financial assistance were available and accessible to homeowners (see Figure 7).

Figure 7. Installation Based Upon Available Financial Benefits



Question 14. Renewable energy systems will be an inevitable source of heating and electricity for all homes in the future.

Q14 general analysis. This question asked respondents about the future of renewable energy systems for home use. Again, an overwhelming percentage of the respondents saw

renewable energy as an inevitable source of energy in the future. Forty-five respondents out of fifty-two agreed or strongly agreed to this statement (see Table 11).

Table 11

Future Perception of Renewable Energy

Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
1 Strongly Disagree	1	1.82%	1.92%
2 Disagree	6	10.91%	11.54%
3 Agree	19	34.55%	36.54%
4 Strongly Agree	26	47.27%	50.00%
Sum:	52	94.55%	100.00%
Not answered:	3	5.45%	-
Total answered: 52			

Question 15. Renewable energy sources, such as solar, wind and geothermal, are considered a luxury for homeowners.

Q15 general analysis. This question suggested to respondents that renewable technology might be perceived as a luxury to homeowners. While 36 respondents agreed to this statement, 17 did not agree. Almost 68% of respondents agreed that renewable energy is still a luxury (see Table 12).

Table 12

Renewable Energy as a Luxury

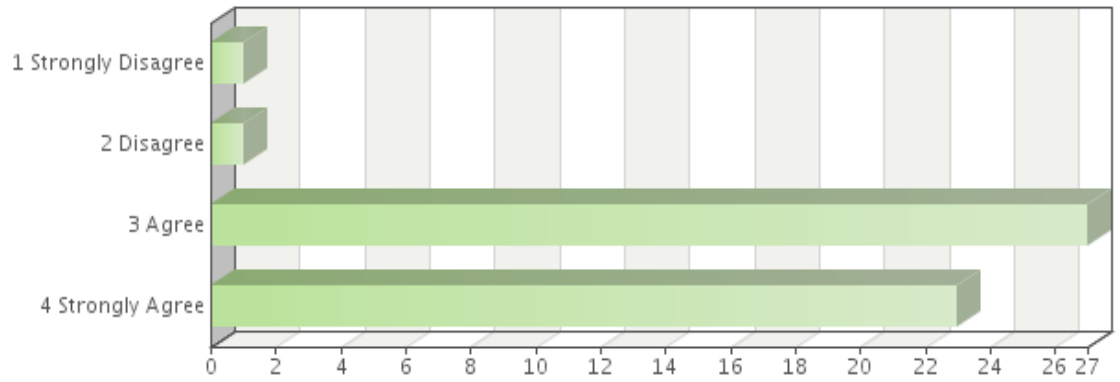
Choices	Absolute frequency	Relative frequency	Adjusted relative frequency
2 Disagree	17	30.91%	32.08%
3 Agree	22	40.00%	41.51%
4 Strongly Agree	14	25.45%	26.42%
Sum:	53	96.36%	100.00%
Not answered:	2	3.64%	-
Total answered: 53			

Q15 demographic comparison. Of the respondents who agreed with this statement, 53% reported a household income of $10,000 to $49,999; while 8% reported an income of $100,000 to $149,000.

Question 24. Water conservation and storm water management are important to me.

Q24 general analysis. The final question of the survey is the only question pertaining to water conservation as opposed to energy efficiency or production. An overwhelming number of 50 out of 52 respondents, who answered this question, agreed that water conservation and storm water management are important to them. The Frequency Table indicated an adjusted relative frequency that over 96% of respondents agreed with the statement. This overwhelming response is represented in Figure 8.

Figure 8. Importance of Water Conservation and Storm Management

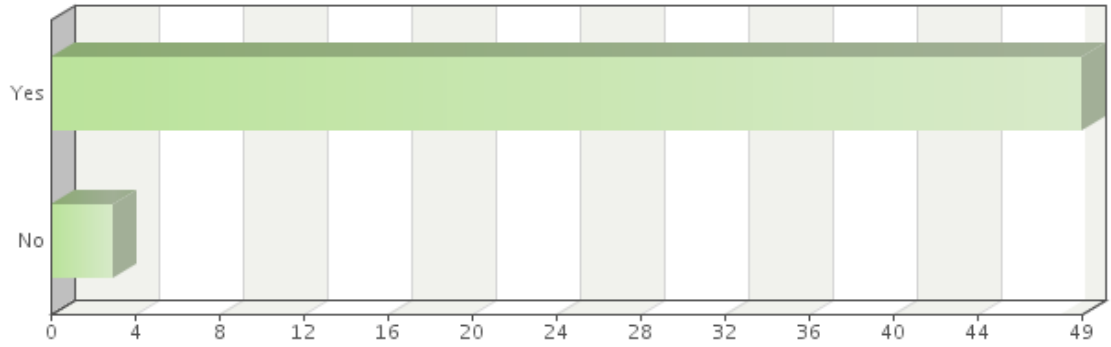


Demographic Data

Question 16. Are you the Head of Household (Homeowner)?

Descriptive analysis. Forty-nine of fifty-two respondents were homeowners or head of household as shown in Figure 9.

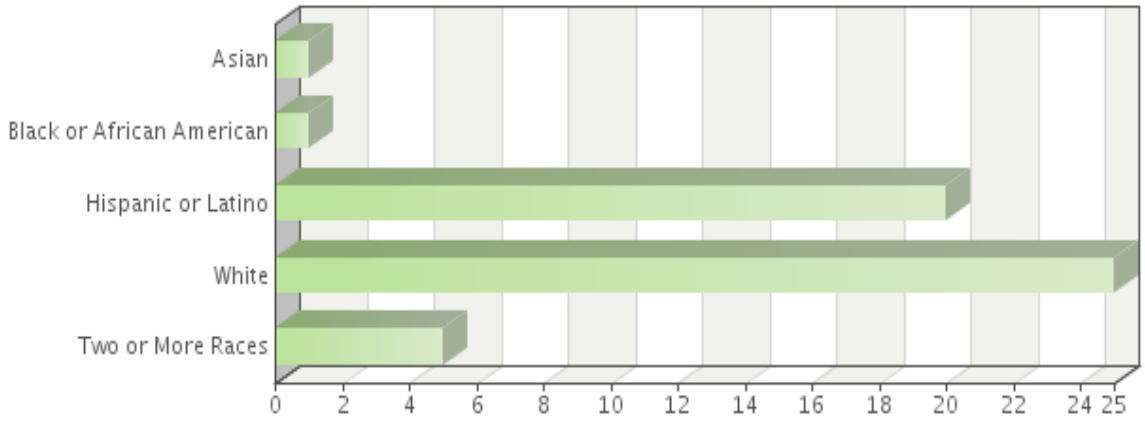
Figure 9. Head of Household



Question 17. Ethnic Background?

Descriptive analysis. The cultural make-up of the survey respondents reflects the target population in which the majority of residents are either Hispanic (Latino) or White. In this survey, more respondents identified themselves as White. The target neighborhoods for LBWN indicate a 66% Hispanic population while this survey received responses from about 38% who indicated Hispanic or Latino, as illustrated in Figure 10.

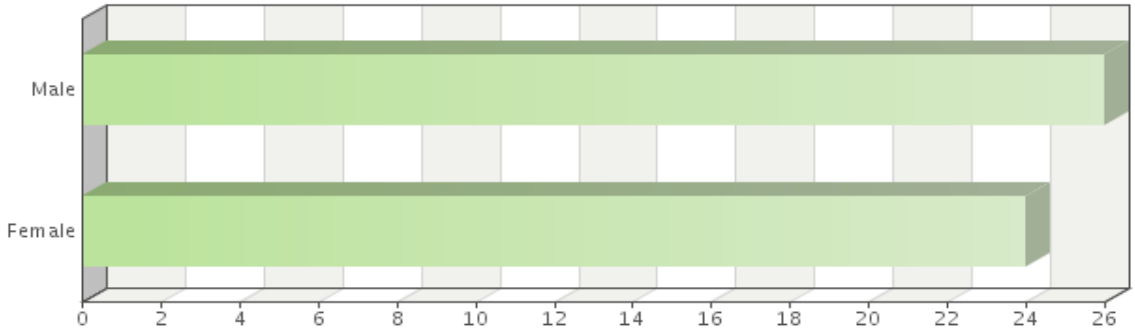
Figure 10. Ethnic Background



Question 18. Gender?

Descriptive analysis. The gender composition of this study is almost evenly split with 26 male respondents and 24 female respondents. Five respondents did not answer this question. The gender make-up is shown in Figure 11.

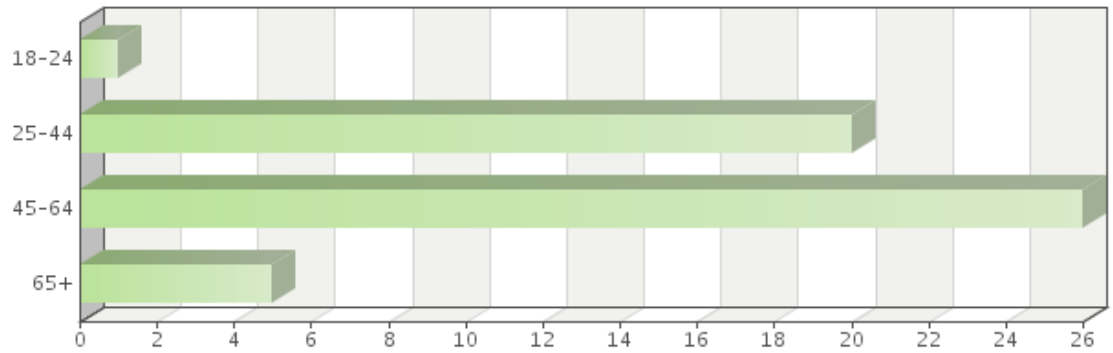
Figure 11. Gender



Question 19. Age Group?

Descriptive analysis. The age group with the most responses was comprised of respondents who indicated their ages as between 45 and 64 years (see Figure 12). Twenty respondents were between the ages of 25 and 44.

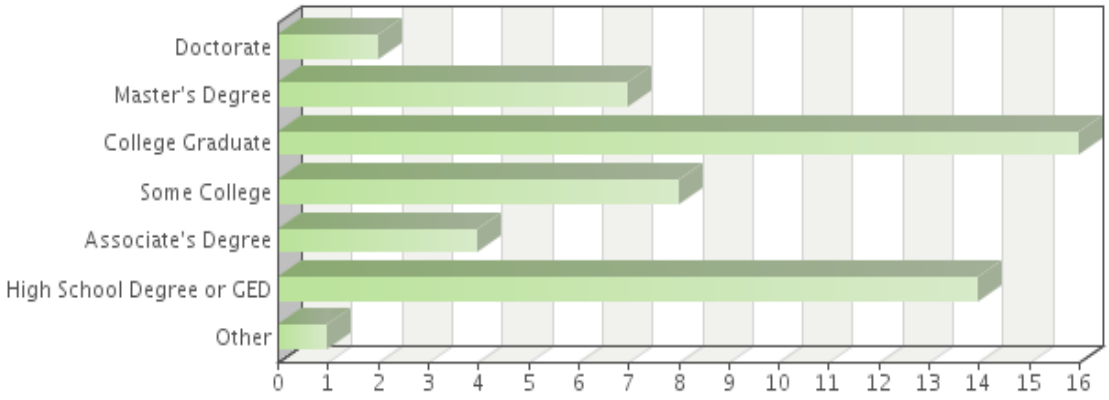
Figure 12. Age Group



Question 20. Education?

Descriptive analysis. There was a range of educational backgrounds of the respondents. About 30% indicated they were college graduates. Fourteen respondents indicated they had at least a high school degree or GED, and about 17% of the respondents held a higher education degree (see Figure 13).

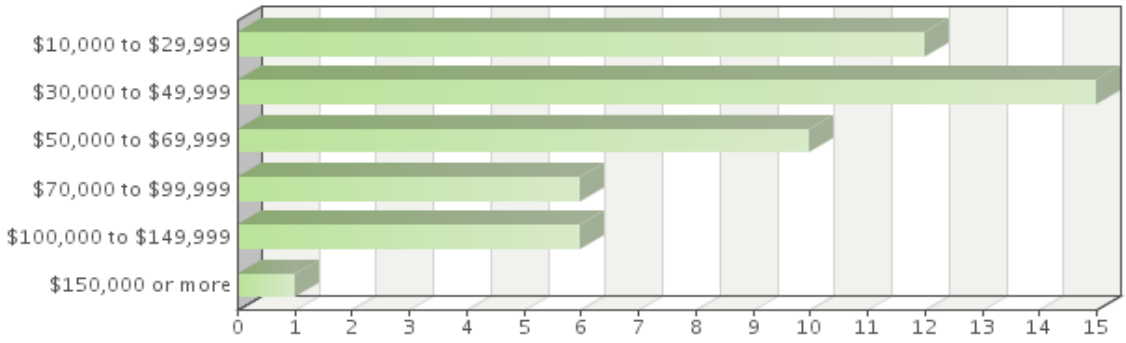
Figure 13. Education



Question 21. What is your total household income?

Demographic comparison. Fifty-four percent of those responding to the number of home occupants indicated total household income of $10,000 to $49,999. 30% of respondents indicated a total household income of $30,000 to $49,999, which is the median income range for this survey. For a household that reported four occupants, the median household income range was $70,000 to $99,999 (see Figure 14).

Figure 14. Household Income



Question 22. How many people live in your household, including yourself? (Please count children and adults. Include all members whether or not they are related to you.)

Descriptive analysis. The least number of people in the household for a respondent was one, and the greatest number of people in a household was eight. Table 13 indicates the number of people in a household and the percentage out of the total number of respondents. The average number of people in each household was three people (2.88).

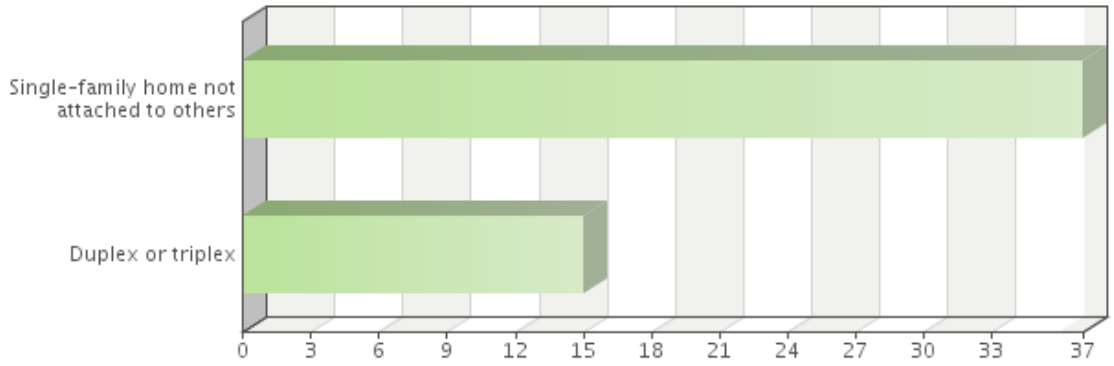
Table 13. Number of Household Occupants

Answers	Absolute frequency	Relative frequency
1	11	21.15%
2	15	28.85%
3	10	19.23%
4	9	17.31%
5	3	5.77%
6	2	3.85%
7	0	0.00%
8	2	3.85%
Sum:	52	100.00%
Total answered: 52		

Question 23. What type of house do you live in?

Descriptive analysis. Homeowners indicated that about 71% lived in single-family homes while about 29% lived in a duplex or triplex. Over two times as many respondents indicated that they lived in a single-family home as compared to a duplex or triplex (see Figure 15). No respondents indicated they lived in an apartment or a townhome.

Figure 15. Type of House



Response to Research Questions

This study was performed to answer two questions: What are homeowner perceptions about renewable energy sources? What are the potential causes of apprehension towards using renewable energy technology in affordable housing? The results of this study indicate that homeowners perceive high initial costs as the primary factor when considering renewable energy technologies for their homes. In order to offset these costs, homeowners support public incentives such as grants and credits for both installation and long-term maintenance of green technologies. While there is apprehension to install renewable energy technology in 5 to 10 years, the majority of homeowners recognize that renewable energy sources such as solar, wind and geothermal are reliable sources of energy for the future. As related to affordable housing, the

majority of respondents indicated that subsidies or grants for renewable energy sources are appropriate for public housing programs.

Implications of Findings

This study sought to test the following hypotheses:

Hypothesis One:

H_O: There is a negative correlation between the high costs of renewable energy systems and the reluctance by homeowners to install these systems in their homes.

H_A: There is a positive correlation between the high costs of renewable energy systems and the reluctance by homeowners to install these systems in their homes.

The data from the survey support the alternative hypothesis (H_A), in which the majority of homeowners find high, initial costs as a hindrance to installing renewable energy technology in their homes.

Hypothesis Two:

H_O: Homeowners do not perceive renewable energy as a necessary element of affordable housing due to increased public concern over high-energy costs, personal health, and environmental degradation.

H_A: Homeowners do perceive renewable energy as a necessary element of affordable housing due to increased public concern over high energy costs, personal health, and environmental degradation.

The data regarding sustainable housing concerns over energy cost, health, and the environment support the alternative hypotheses (H_A), in which homeowners perceive renewable energy as a necessary element of affordable housing. While most respondents agreed that renewable energy is currently a luxury for homeowners, the majority indicated that they would

install renewable energy in their homes if there would be future financial benefits and savings. The study results indicate an overall support for renewable technologies as a viable source for energy in private residences and public housing.

Renewable energy technology is not widely used private homes and in public housing. This survey identified only about 8% of homeowners who stated they use a form of renewable energy, such as solar power. On a national scale, there are numerous sources tracking renewable energy use, but the actual number of residents using green technology is uncertain. The cost of utilities for families, especially those who are at a low-to-moderate income level, can be upwards of 25% of their income, after their home payment (Global Green USA, 2007, p. 6). The survey conducted supports the current research, which indicates that financial concern for cost is the primary concern for homeowners regarding renewable energy. Despite these concerns, enthusiasm is very prevalent in this study regarding future renewables potential and the fundamental understanding of the importance of green energy in residential homes.

There is a strong favoritism towards grants, tax deductions, and energy credits in return for renewable technology installations. These financial benefits highly influence decisions made by developers and homeowners alike to invest in green technology. Some benefit examples include tax credits from the Treasury Department and voucher programs from HUD or the Department of Energy (DOE).

The high concern over increasing energy costs, personal health risks, and the environmental impact are also significant influences for increased energy efficiency and conservation. The survey results demonstrate that renewable energy is regarded as an essential element for future production and consumption. Homeowners and developers indicate that renewable energy is a necessary element of affordable housing.

The concern for sustainability in affordable living, health, and the environment has also influenced homeowners in their everyday living habits regarding energy efficiency and conservation. Most respondents have not installed renewable technology, such as photovoltaic solar panels. However, respondents strongly preferred accessible, consumer products, such as compact fluorescent bulbs, programmable thermostats, and energy efficient appliances. There is a correlation between public concern over energy costs, personal health, and environmental degradation and homeowners taking measures toward energy efficiency and conservation.

There are some demographic implications. The income levels of the respondents showed little influence on attitudes towards green technology, energy efficiency, and conservation. Moderate-income earners as well as higher income earners equally supported green home technology. This survey indicated that the Hispanic or Latino population, followed by White, more heavily populates the focus area of LBWN's outreach neighborhoods. In comparison to the City of Milwaukee, there is a higher majority of White and Black populations as opposed to the LBWN target areas. The survey indicated a favorable response rate for renewable energy in affordable housing and positive perceptions toward energy efficiency priorities in residences. A larger sample may be able to provide further inferences for a more representative population in Milwaukee, Wisconsin and even on a national scale.

Research Limitations and Recommendations

Research Limitations

The limitations of this study include low sample size**,** survey communication intervals, and a lack of a sample frame comparative. External limitations include a lack of current, local studies pertaining to actual residential energy use and relationships between energy efficiency and local, affordable housing.

Low sample size. This survey does not go without such limitation as aforementioned. The foremost limitation is sample size. Because the sample was small, research results may lack generalizability. A larger sample might better replicate the demographic make-up of the city of Milwaukee. LBWN's outreach listing included over 2,000 contacts; however, only 500 contacts were randomly selected. The sample frame was limited to the LBWN outreach listing.

Low communication rate. One limitation regarding the survey tool was that the survey was open for a short period of one week. Although the survey was technically open for one month, the researcher believed that a limited period would garner at least a minimum of 50 respondents, who would respond immediately to the communication for solicitation of survey participants. The result of a shorter open period for the survey proved successful, especially on the days when the communications were released. Most responses were received either the first day of communication or the sixth day of communication—when the reminder email was released. Although the survey time was open for an additional three weeks, the working organization, LBWN, believed that excessive emails would become a nuisance and flood the communication lines for organizational contacts and neighbors. The research assumes that additional survey reminders may have gained additional responses, but the researcher also respects the organizational policy for communication procedures.

Lack of sample frame comparative. Another limitation to this study is a lack of comparative statistics between the two N sample frames—between the neighborhood sample and the LBWN outreach sample. After completing the random selective process via computerized random selection application, both populations of 500 and 200 were combined and sent communications as a group. The Opinio survey application was designed with partial anonymity to give the respondent an opportunity to retake the survey in case of technical error. This design

protected the identities of the respondents from the survey tool to safeguard the respondents' privacy while ensuring that each respondent had the opportunity to complete a single survey. As a result, each respondent completed just one survey.

Lack of current, local studies. A limitation to the literature review was lack of current studies. Local studies on renewable energy were limited and primarily came from private research. One notable study came from Madison, Wisconsin entitled, *Assessment of High Penetration of Photovoltaics on Peak Demand and Annual Energy Use* (Myers et al., 2010). This statewide study focuses primarily on large-scale implementation of photovoltaic panels as opposed to strict, consumer residential use. Current research in progress is Wisconsin's Focus on Energy research initiative entitled *Energy Efficiency and Affordable Housing*.

Recommendations for Future Research

Recommendations for researchers. The author recommends a comparative analysis between populations. In this study, there were two parallel random samples from each of the target populations. The recommendation is to analyze attitudes of the respondents and compare any general difference or similarities. Another recommendation for researchers is to execute additional perception surveys on renewable energy in low-to-moderate income neighborhoods. Expand the survey pool to adjacent and other neighborhoods. Researchers are also encouraged to conduct further research in both quantitative and qualitative measures with a larger city, state, or national sample to gain additional perspectives about renewable energy use in the home.

Recommendation for policymakers. As this survey has indicated, the responses were highly favorable for incentives and benefits of renewable energy installations. Existing policies to promote green building construction must continue. Increased incentives are recommended, especially for public housing, grant-funded construction, and multi-unit construction. Perhaps the

most important recommendation is to follow HUD's *Energy Strategy—Summary of Actions (2006) (see Appendix D)*. "In August, 2006, as directed by Congress pursuant to Section 154 of the Energy Policy Act of 2005, HUD submitted an expanded 25-point energy strategy for HUD's inventory of public and assisted housing, *Promoting Energy Efficiency at HUD at a Time of Change" (HUD, 2008, p. 12).* The energy strategy pursued actions, such as furthering partnerships with DOE and EPA, increasing rewards incentives, providing more education and training, and supporting technology research.

Recommendations for Community Development Corporations (CDCs). The researcher recommends a renewed and concerted effort to pursue education points on green technology and to promote all available funding resources for homeowners. Renewable energy and policy education is not limited to the CDC's outreach population, but includes the internal education of operators and CDC staff as well. Another recommendation is to have CDCs outline available funding programs and grant assistance through social and online communications for both developers and homeowners.

Recommendations for homeowners. The researcher recommends that homeowners should analyze their current energy use and investigate all possible resources of renewable energy credits and incentives, especially those that are available for low-to-moderate income families. The author further recommends residential energy audits and self-analysis of energy consumption, conservation, and future energy production. Results of this study and those performed for green housing initiatives across the country demonstrate a renewed effort to consider long-term financial benefits and overall well-being for green energy use.

Concluding Remarks

Going green is a method of survival, not simply a trend. Sustainability, as it relates to housing, focuses on three main components: cost, health, and the environment. Sustainable green housing encapsulates the preservation of affordability in which renewable energy ensures affordability for housing as long as there are accessible financial incentives for up-front implementation and long-term maintenance.

The ability to build, produce, and consume more efficiently goes beyond financial benefits, which was cited as the main driver for green projects. Therefore, a green economy must also focus on long-term sustainability with green building for multiple future generations.

The global environment can only be protected by a new perception and method of habitual thinking about sustainable lifestyles. The way that humans live, consume, and produce must evolve from the current status quo. Thus, mainstream sustainable living relies on the joint efforts of the homeowner, policymakers, nonprofit organizations, and the entire community to focus on green.

Perceptions about improved quality of life begin with truth in information, resourcefulness, and common sense policy. This change can begin by providing affordable and sustainable access to an intrinsic human need … shelter.

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Appendix A: Bilingual Letter of Request for Participation

COMMUNITY GREEN:
Sustainable Energy for Affordable Housing

Dear Homeowner,

We appreciate your input regarding how to make housing more affordable!

LBWN, in conjunction with Marquette University, is conducting a study to examine neighbors' perspectives on renewable energy sources (such as solar panels) for affordable housing. As a homeowner, your opinion about renewable energy is important to us to determine the public perspective on making housing more affordable and energy efficient in the future. Your responses will be **ANONYMOUS** and will not be associated with your name or residence.

If possible, please complete this survey by January 29th. Thank you!

Please click here to take the survey in ENGLISH

LA COMUNIDAD VERDE:
Energía Sostenible para la Vivienda Asequible

Estimado propietario de vivienda,

¡Apreciamos su información respecto a la forma de hacer la vivienda más asequible!!

LBWN, en conjunto con la Universidad de Marquette, está realizando un estudio para examinar las perspectivas de los vecinos sobre las fuentes de energía renovables (como los paneles solares) para viviendas asequibles. Como dueño de casa, su opinión sobre la

Appendix A: Bilingual Letter of Request for Participation (Continued)

*energía renovable es importante para nosotros para determinar el punto de vista del público en hacer la vivienda más asequible y eficiente de la energía en el futuro. Sus respuestas serán **anónimas** y no se asociará con su nombre o domicilio.*

Si es posible, por favor complete la encuesta el 29 de enero. ¡Gracias!

Haga click aquí para la encuensta en ESPAÑOL

THANK YOU from Layton Boulevard West Neighbors!

Best Regards,
Tim Hoye

Turnkey Renovation Program
Layton Boulevard West Neighbors

Student - Master of Public Service
College of Professional Studies
Marquette University

1545 S. Layton Boulevard
Milwaukee, Wisconsin 53215
Layton Boulevard West Neighbors
414-383-9038

Appendix B: Research Consent Letter

COMMUNITY GREEN: SUSTAINABLE ENERGY FOR AFFORDABLE HOUSING
LAYTON BOULEVARD WEST NEIGHBORS, INC. AND MARQUETTE UNIVERSITY
RESEARCH CONSENT TO PARTICIPATE

Dear Homeowner,

The purpose of this study is to examine the feasibility of renewable energy sources such as solar panels for affordable housing. Your opinion about renewable energy as a homeowner is important to us to determine the public perspective on making housing more affordable and energy efficient in the future. The study involves completing the following survey (estimated time 5-10 minutes).

Please know that your responses will be ANONYMOUS and will not be associated with your name or residence. By participating in this study, you are giving permission to the researcher to use your survey responses in research publications and presentations. If you have any questions about this project please contact Tim Hoye at tim@lbwn.org or (414) 383-9038 ext. 2518.

Thank you very much for your participation.

Best regards,

Tim Hoye
Layton Boulevard West Neighbors, Inc.
Marquette University - College of Professional Studies

Appendix C: Survey Questionnaire

Community Green: Sustainable Energy for Affordable Housing

Q1: I am currently using renewable energy in my home (solar, wind, geothermal, etc.)

◯ Disagree ◯ Agree

Q2: I am planning to install renewable energy in my home within the next 5-10 years.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q3: I prefer to use energy efficient products in my home such as fluorescent light bulbs, a programmable thermostat, etc.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q4: Renewable energy sources such as solar or wind power will save money for homeowners in the future.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q5: I would be willing to pay 15%-30% more for a home with renewable energy than a home without renewable energy.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q6: I would be willing to pay $15,000-$30,000 to install solar energy if it means I will save money in the future.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q7: I would install solar panels in my home even if it takes 5-10 years for the investment to pay off.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q8: I support tax credits/grants/rebates for private residents who install renewable energy sources in their homes.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q9: Subsidies/grants for renewable energy sources are appropriate for public housing programs.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Appendix C: Survey Questionnaire (continued)

Q10: Solar and wind are reliable sources of energy.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q11: Renewable energy products such as solar panels or wind turbines are physically appealing in the neighborhood.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q12: I would install solar panels in my home if it means that my monthly utility bills would be half the cost or lower.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q13: I would install solar panels on my home if tax credits, rebates or grants were available.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q14: Renewable energy systems will be an inevitable source of heating and electricity for all homes in the future

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q15: Renewable energy sources such as solar, wind and geothermal are considered a luxury for homeowners.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Q16: Are you the Head of Household (Homeowner)?

◯ Yes ◯ No

Q17: Ethnic Background?

◯ American Indian
◯ Asian
◯ Black or African American
◯ Hispanic or Latino
◯ Native Hawaiian or Other Pacific Islander
◯ White
◯ Two or More Races

Appendix C: Survey Questionnaire (continued)

Q18: Gender?

◯ Male ◯ Female

Q19: Age Group?

◯ 18-24 ◯ 25-44 ◯ 45-64 ◯ 65+

Q20: Education?

◯ Doctorate ◯ Master's Degree ◯ College Graduate
◯ Some College ◯ Associate's Degree ◯ High School Degree or GED
◯ Less than High School ◯ Other

Q21: What is your total household income?

◯ Less than $10,000 ◯ $10,000 to $29,999 ◯ $30,000 to $49,999 ◯ $50,000 to $69,999
◯ $70,000 to $99,999 ◯ $100,000 to $149,999 ◯ $150,000 or more

Q22: How many people live in your household, including yourself?
(Please count children and adults. Include all members whether or not they are related to you.)

Number of people in household: ☐

Q23: What type of house do you live in?

◯ Single-family home not attached to others ◯ Townhouse or row house
◯ Duplex or triplex ◯ Apartment (in building with 4+ units)
◯ Other

Q24: Water conservation and storm water management are important to me.

◯ 1 Strongly Disagree ◯ 2 Disagree ◯ 3 Agree ◯ 4 Strongly Agree

Appendix D: HUD's Energy Strategy—Summary of Actions (2006)

Departmentwide

1.1 Provide incentives for energy efficiency in housing financed through HUD's competitive grant programs.
1.2 Include energy efficient performance measures in HUD's Annual Performance Plan (APP) and Management Plan.
1.3 Promote the use of Energy Star® products and standards through HUD's new Partnership for Home Energy Efficiency with DOE and EPA.
1.4 Provide residents or organizations with training or information on energy efficiency for building or rehabilitating affordable housing.
1.5 Establish residential energy partnerships with cities, counties, states, and other local partners.

Community Planning and Development

2.1 Encourage energy efficiency in HOME- and CDBG-funded new construction and housing rehabilitation projects.
2.2 Identify opportunities and assist with feasibility analysis for Combined Heat and Power in public or assisted housing.

Public and Indian Housing

3.1 Base appliance and product purchases in public housing on Energy Star® standards, unless the purchases are not cost effective.
3.2 Build HOPE VI developments to a high level of energy efficiency.
3.3 Improve tracking and monitoring of energy efficiency in public housing.
3.4 Streamline energy performance contracting in public housing.
3.5 Promote energy conservation in federally assisted housing on Indian tribal lands.

Housing—Single Family

4.1 Feature the Energy Efficient Mortgage as a priority loan product.
4.2 Provide training on how FHA single-family programs can be used effectively to promote energy efficiency.
4.3 Continue improved tracking and evaluate performance of Energy Efficient Mortgages.

Housing—Multifamily

5.1 Promote energy efficiency in multifamily-assisted housing and multifamily programs.
5.2 Continue HUD-DOE multifamily weatherization partnerships.
5.3 Encourage use of Energy Star® new home standards in the design, construction and refinancing of Section 202 and 811 projects.
5.4 Develop incentives for energy efficiency through FHA multifamily insurance programs.
5.5 Explore asset management strategies and guidance for energy efficiency in HUD-subsidized multifamily properties.

Appendix D: HUD's Energy Strategy—Summary of Actions (2006) (continued)

5.6 Support energy efficiency training for multifamily managers and maintenance staff.

Housing—Manufactured Homes

6.1 Implement energy efficiency recommendations of the Consensus Committee in HUD-code homes.

Field Policy and Management

8.1 Partner with local energy efficiency groups, HUD program offices, and other agencies to educate HUD customers about ways to reduce energy costs.

Policy Development and Research

8.1 Conduct energy-related policy analysis and research to support Departmental energy efficiency actions.

Office of Healthy Homes and Lead Hazard Control

9.1 Develop computerized assessment tool for integrated energy and environmental retrofits.