OPERATIONALIZING SUSTAINABLE RESIDENTIAL DEVELOPMENT IN GHANA: CONSUMER ATTITUDES TOWARD WILLINGNESS-TO-PAY FOR SUSTAINABLE ALTERNATIVES

Simon Ofori Ametepey[1] and Clinton Aigbavboa[2]
[1]*Koforidua Training Centre, Ministry of Roads & Highways, Koforidua, Ghana*
[2]*Department of Construction Management & Quantity Surveying, University of Johannesburg, Doornfontein Campus, Johannesburg, South Africa*
E-mail: [1]oforipmp@gmail.com and [2]caigbavboa@uj.ac.za

ABSTRACT
For centuries humankind's built environment and quality of life has been closely predicated on the diversity and availability of natural resources. However, it has become evident that the ecological bounds that have provided a seemingly infinite stream of resources are showing signs of global degradation. As a result, a new focus has been placed on the concept of sustainable development. For sustainable alternatives to materialize in a free-market, it must be driven by market-based solutions and not solely by government regulation. Hence, this research sought to determine the extent to which current markets exist for sustainable alternatives and consumer response to the cost-benefit of sustainable alternatives in Ghana. A Market Survey Assessments methodology was adopted to determine the extent to which capital costs and life-cycle return on investment (ROI) affect consumer willingness to pay for sustainable alternatives. Questionnaire was adopted to assess consumer attitudes toward cost and non-cost related issues pertaining to sustainable residential construction. The population of study for this research consists of owner occupied single family housing units in high-growth residential regions of Accra consisting of areas of East Legon, and Trassaco Valley. *Cross-tabulation and correlation analysis* were then used to describe, correlate and draw inference from the survey response data. The results revealed that consumers were found to prioritize level of willingness-to-pay according to total return-on-investment, meaning willingness-to-pay changed proportional to changes in total return as that the vast majority of consumers chose high capital cost, high return alternatives. Results also indicated that the savings-to-investment (SIR) ratio was not as significant a consideration, meaning that if consumers viewed the purchase of a sustainable alternative as an "opportunity" cost, they should have chosen low cost, low return alternatives, which had the highest SIR, and invested the balance of their available resources elsewhere. As a result, the most fundamental discovery is that although incremental changes in capital costs, SIR and capital cost recovery are contributing factors, the variable most influencing consumer willingness-to-pay was clearly rate-of return and subsequent ROI.

Keywords: Capital costs, Ghana, Life cycle, Return-on-investment, Sustainable residential development,

BACKGROUND

For centuries humankind's built environment and quality of life has been closely predicated on the diversity and availability of natural resources. However, it has become evident that the ecological bounds that have provided a seemingly infinite stream of resources are showing signs of global degradation. As a result, a new focus has been placed on the concept of sustainable development. Although many definitions of sustainability exist, all essentially recognize the importance of providing for the needs of the present without compromising our ability to serve the needs of the future. The paradigm of sustainability seeks a symbiotic relationship between humankind and the environment, where human socio-economic endeavors and the natural world engage in a mutually beneficial relationship that enhances the vitality of each.

A division of Sustainable Development called Sustainable Construction defines the general goals and principles that the construction industry should follow to operate with a high level of environmental awareness and sensitivity (Grosskopf, 1998). As the construction industry senses the need to be more responsible and minimize negative environmental impacts, projects such as the Recycled House in Denmark, ReCraft 90 in Montana, Florida House in Sarasota, Florida, and the Green Builder Program in Austin, mark the beginning of a new era placing sustainability into the forefront of the built environment (Kibert & Brad, 1995).

Sustainable construction can be described as a means of profiting from the “interest” or regenerative capacity of the environment and not its interest-bearing capital stocks (Grosskopf, 1998). Operationalizing this concept in residential development requires practices that reduce the use of non-renewable resources, the generation of waste and the overuse of energy and water resources, during both the development process and throughout the building life-cycle. Ghanaian industries creating and supporting the built environment contribute enormously to the annual GNP and remain a leading indicator of the nation’s economic well-being. Yet to be sustainable, an industry that derives nearly all its material wealth from natural resources and employs a lot of people must now complement traditional development criteria with a new set of principles that address the ecological impacts of human activities.

In Ghana, where the population is nearly 25 million, resource depletion is expected to reach a crisis level unless sustainable patterns become reality. To materialize in a free-market economy however, it is postulated that sustainable development in Ghana must be driven by market-based solutions and not solely by government regulation. Yet to determine the extent to which current markets exist for sustainable alternatives, the consumer response to the cost-benefit of sustainable alternatives must be assessed.

LITERATURE REVIEW

As resource consumption increases in a supply-and-demand world, the cost of resources will limit, even eliminate the use of a scarce resource. Substitution will result until the demand for the scarce resource balances the ability of the environment to renew it. As an example, global deforestation for building materials, agriculture, and urban development will inevitably accelerate the cost of wood products until cost-effective substitutions are made. If no viable substitutions are found, restricted agriculture and development will result. As a “ripple effect,” the increased cost of basic food and shelter will theoretically promote sustainable forestry, recycling and population control. What this expansionist view does not account for however, is the degradation to the web of interdependent ecosystems. To practice deforestation until market forces dictate sustainable resource substitution does not assess the true externalized cost of extinction, watershed pollution, or global climatic change as a result of habitat destruction, soil erosion or the inability of a declining number of forest biomes to assimilate waste byproducts and emissions.

Instead of a “comfortable” transformation to sustainable development, the ecological worldview would assert probable ecosystem collapse and extreme human hardship if it were left solely to capital market forces to dictate sustainable practice. Competitive market economies will themselves collapse unless they can reflect environmental realities. The eco-economist believes that the economic system must begin a shift from an adversary in the environmental debate to a proponent of sound environmental practice. Internalizing externalities, or assessing the cost-benefit of a product from its cradle to grave life-cycle, is the first step in a processes that will reward firms and consumers for producing and purchasing sustainable goods that do not contribute to environmental degradation once outside the manufacturer's hands (Grosskopf, 1998). The Harvard Business School found that nations with the most rigorous environmental standards often lead in exports of affected products, offering proof that on a macro-economic scale, environmental protection does not restrict, but rather promotes economic competitiveness (Chiras, 1993).

Can continued economic growth be reconciled with sustainable development? Many would argue that as a result of the damage they believe is attributed to the economic system, no further growth is desirable. Most contend that unlimited growth is unsustainable for any organic system, and that for all natural systems there is a size at which efficiency is optimized (Grosskopf, 1998). The counterpoint to this argument is that for the foreseeable future, economic growth may be necessary during sustainable market transformation. Reality suggests that attempts to secure the objectives of sustainability are futile in a world ravaged by poverty. The Earth's population is expected to double by 2025, with 90% of this increase occurring in the developing world (Chiras, 1993). Currently, one-billion people live in poverty globally. Alleviating this problem will require economic growth using market-based solutions that reflect environmental realities.
While there is strong consensus at the conceptual level about sustainable development, there are few formal models that outline the conditions for environmentally steady and sustainable growth in a decentralized market economy (Coi, 1994). Current measures of overall income and output of a nation, GNP, provide a highly imperfect indication of a nation's well-being. Aggregate measures of progress such as the Human Development Index (HDI) of the UN do not account for resource inequality and poverty and thus often conceal more than they reveal. By integrating environmental concerns into the core accounting process using both physical and monetary units, the true long-term productive capacity of a nation can be derived (Steer & Ernst, 1993). By integrating economic decisions with environmental and social impacts, development decisions can be improved, resources can be better allocated, and sustainable economic investment can be optimized (Munasinghe, 1994).

Current economic systems are based on circular-flow exchange values, not on the linear entropic through-put of matter and energy. Subsequently, current supply and demand economic systems do not relate the use of the environment to the resource based economy, nor does it internalize the full cost of resource consumption and waste generation, resulting in inaccurate pricing of natural resources (Grosskopf, 1998). Benefits accrue to private interests as society pays for the externalized costs of mounting ecological debt. Although in theory market forces can attain optimal resource allocation, they cannot attain optimal scale within an economic system whose primary emphasis remains reducing capital investments, regardless of life-cycle impacts and costs. Growth beyond optimal scale or "carrying capacity" of the environment is an eventual negative for the economic system because increasingly costly resources are consumed to exploit fewer, more distant, dilute natural stocks (Daly, No date). Consequently, life-cycle cost assessments and a resultant optimal scale cannot materialize in market economies without ecological criteria.

Supply and demand economies account for current resource scarcity. During the formative years of market-based economic theory, the environment was considered an infinite source of materials and an endless sink for wastes. "Free" goods such as energy, materials, water and air were appropriated with little or no exchange value. As through-puts became increasingly scarce, conventional exchange values could not account for generations of externalized pollution and resource depletion. Unlike micro-economics, macro-economics does not account for optimal scale as no life-cycle cost-benefit structures currently exist for the economy as a whole (Grosskopf, 1998). Without a “true cost” function for the economic system, growth pushes beyond the optimum in the form of pervasive, detrimental externalities such as ozone depletion, destruction of old growth biomes and critical habitats, global warming, acid rain and watershed pollution.

Although quantitative growth is limited, development, or steady-state qualitative improvement independent of quantitative growth, is not. Transforming a quantitative growth dependent market economy to a qualitative development market economy occurs when sustainable principles and criteria become operationalized through life-cycle costing of resources (Grosskopf, 1998). The result is the use of market forces to penalize resource inefficiencies and reward eco-efficiency, thereby allowing the economy to gradually become more reflective of the natural system from which all material wealth is ultimately derived. Integrating environmental criteria into the market economy is therefore considered a necessary condition for a market-based transformation process.

Environmental degradation and resource depletion transcends global economics, urban growth rates, and resource demands, leaving some form of impact, both replenishable and permanent, an unavoidable consequence of human activity (Grosskopf, 1998). The question then is not why degradation exists, but why it takes forms and magnitudes inconsistent with many of society’s environmental goals and objectives.

Increasingly scarce resources are utilized in low-return, non-sustainable applications. Renewable resources, or those that can be replenished at a given rate, are being treated as extractive resources, which suggests that these resources are being mined rather than managed for sustainable yields. Other resources are placed into single uses when multiple uses would generate a larger net benefit. Resources are not being effectively recycled, and of those that are, the net embodied energy and capital investment required is often greater than those products that are conventionally produced.

Sustainable development as a “systems” response to global environmental degradation seeks a symbiotic relationship between economic prosperity and sustainable resource harvesting by linking the products of economic development to market-driven sustainable processes (Grosskopf, 1998). Establishing sustainable criteria consistent with natural systems ecology and pricing resources according to their life-cycle efficiencies will result in an economy that rewards environmental stewardship and penalizes inefficient, destructive practices that would in time undermine both the health of the economy and the environment from which all material wealth is ultimately derived (ibid).

Residential development based on life-cycle costing begins to operationalize sustainability by providing market-based incentives for investment in higher performance alternatives that reduce resource use over the building life-cycle. The life-cycle ROI in fact, is due almost exclusively to the added resource efficiency of the building, where units of resources conserved are reimbursed for units of exchange value, providing further evidence of the potential integration between economic and environmental metrics.

SURVEY METHODOLOGY

A Market Survey Assessments methodology was adopted to determine the extent to which capital costs and life-cycle return on investment (ROI) affect consumer willingness to pay for sustainable alternatives. The assumption is made that sustainable residential construction, a first-level dependent variable (DV1) is affected by market-consumer response, a first-level independent variable (IV1) and first-level extraneous variables (EV1) such as regulatory and institutional influences. This assumption was not the primary focus of the research and was not directly tested. The effects that capital and life-cycle costs, second level independent variables (IV2) have on market-consumer response to sustainable construction was the focus of this research and was tested while controlling for second-level, non-cost related extraneous variables such as early adoption, perception and aesthetics.

The population of study for this research consists of owner occupied single family housing units in high-growth residential regions of Accra consisting of areas of East Legon and Trassaco Valley. For Market Survey Assessments, the areas of East Legon and Trassaco Valley were defined in this study as Gye Nyame and Sankofa Communities. Since the population for this study is not well defined, purposive sampling was adopted to select the sample for the study. In all 148 owner-occupants in this population participated in the study.

Market Survey Assessments are intended to provide a cross-section (sample) of a representative portion of high growth residential regions in Accra at a single point in time. The primary research question, to what extent will capital costs and life-cycle return on investment (ROI) affect consumer willingness-to-pay for sustainable energy and water alternatives? is a very complex, intangible construct that cannot be answered directly. Since the research question is an opinion and not a tangible or "directly observable" entity, it must be inferred from responses to several interrelated questions correlated toward answering this research question. The study adopted questionnaire to collect the data.

Once the target population and sampling parameters above were defined, the development of the survey instrument was initiated. The instrument was divided into several "themes" that concentrated on answering the research questions. A lot effort was made in the design of the survey instrument, including question wording, transition between "theme" sections, and measurement of responses. The goal was to design an instrument that addressed the research objectives yet was clear to all respondents so that all respondents understood the meaning of the questions in the same way. As a result, questions of a similar nature were grouped together. Since the nature of the research questions are complex and opinion oriented, item selection and Likert type formats were implemented. For most interval scale data, the five-point Likert type scale was used which includes a "neutral" response. For nominal scale demographic questions, such as age, and income, respondents were given a range of values encompassing all relevant responses. The instrument developed for Market Survey Assessments was assessed for both content and construct-related validity and was reassessed following a pilot study. Since the purpose of this research is to broadly identify significant differences, describe relationships, and draw inferences among variables, the degree of reliability needed in a measure of descriptive correlational data was established using a coefficient alpha (∝) level of 0.10 for the instrument.

Descriptive statistics for the survey involved frequencies, distributions and percentages as well as measures of central tendency and cross-tabulations. As one of the most important components of statistical analysis for Market Survey Assessments, correlational procedures were used to determine the extent to which a change in one variable is associated with change in another variable for the purposes of prediction, instrument consistency (reliability) and describing relationships. The intent of Market Survey Assessments is to collect cost and non-cost preference data on owner-occupants in single-family housing in high-growth regions of Accra.

RESULTS AND DISCUSSION

To assess the relationship between capital costs and life-cycle ROI, respondents were asked to choose between low, moderate and high capital cost, high return alternatives. Data showed that consumers were most "willing-to-pay" for high cost, high return alternatives (57%) compared to moderate (23%) or low capital cost, low return (20%) alternatives (Figure 1).

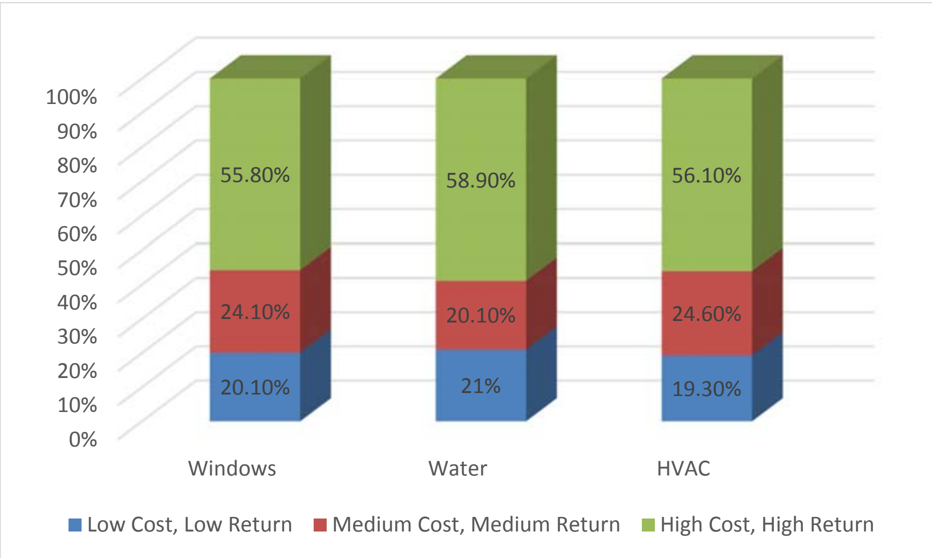

Figure 1: Distribution of consumer willingness-to-pay for low, moderate and high cost, high return sustainable window, water resource and HVAC alternatives.

The range of capital costs and ROI for low, moderate and high cost, high return window, water resource and HVAC alternatives was GHC500-GHC1200, GHC2500-GHC5000; GHC750-GHC2,000, GHC4500-GHC8,520; and GHC1500-GHC5,000, GHC9,495-GHC13,745 respectively. Window, water resource and HVAC alternatives were intended to provide the respondent "tangible" alternatives they could relate to yet equally measure their consideration of capital costs and life-cycle ROI in willingness-to-pay.

The percentage of willingness-to-pay as shown on the y-axis of Figure 2, is defined as the number of respondents selecting a given alternative over other sustainable alternatives provided, and is not the typical definition, willingness-to-pay for a sustainable alternative over a conventional alternative.

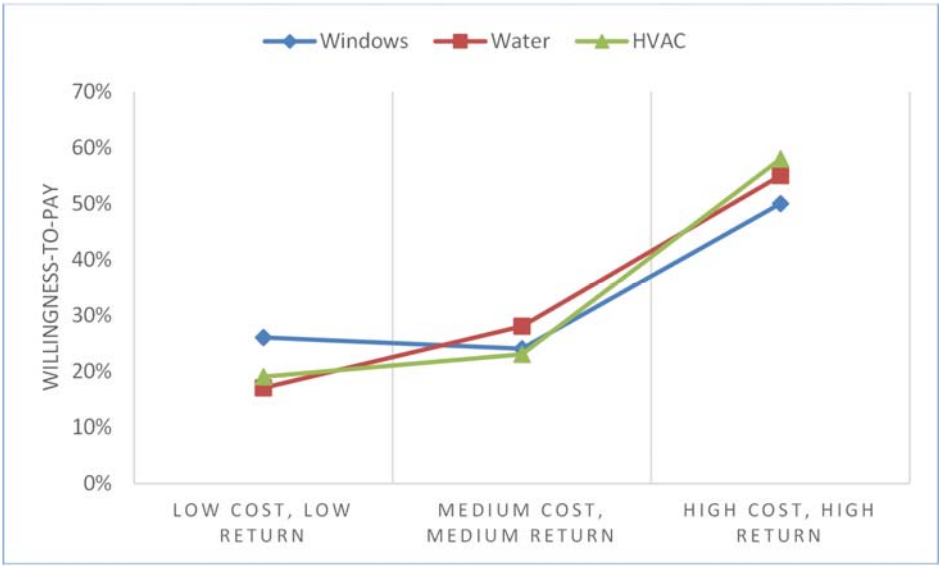

Figure 2: Analysis of consumer willingness-to-pay for low, moderate and high cost, high return sustainable window, water resource and HVAC alternatives. Differences between low, moderate and high cost, high return groups "significant" ($\rho < 0.01, 0.03, 0.01$). Correlation among window, water resource, and HVAC groups "high" ($r = 0.70$-0.85).

Once collective willingness-to-pay averages had been determined from the population as a whole, cross-tabulations were used to determine if significant differences existed between population and individual consumer demographics. The first of these demographic analysis suggested that gender had little influence on the consumer's choice between low, moderate and high capital cost, high return alternatives. As table 1 shows, male and female respondents selected sustainable window, water resource and HVAC alternatives similarly.

Table 1: Gender Distribution of willingness-to-pay for sustainable alternatives

Gender	Low Cost, Low Return	Moderate Cost, Moderate Return	High Cost, High Return
Male	22%	26%	52%
Female	24%	27%	49%

Collective gender averages were consistent with collective population averages as shown in Table 1. However, consumer response to low, moderate and high cost, high return window and water resource alternatives showed nearly identical trends whereas response to HVAC alternatives showed a significantly greater willingness-to-pay for moderate alternatives than moderate alternatives in either window or water resource groups, indicating the possible emergence of an affordability "ceiling" for added capital cost, regardless of future returns.

The added capital cost increase of low (12 SEER), moderate (14 SEER) and high cost, high return (16+ SEER) HVAC alternatives is GHC1,200, GHC2,000, and GHC4,500. The life-cycle ROI of low, moderate and high cost, high return HVAC alternatives is GHC5,450, GHC8,225, and GHC11,185 respectively. Even though the SEER 16 alternative achieved a greater total return over its useful life, respondents were nearly as likely to select the moderate 14 SEER alternative due to either its lower capital cost or faster capital cost recovery. Again however, the differences between gender was statistically insignificant and largely reflective of overall population totals.

Analysis of consumer age revealed that willingness-to-pay for high cost, high return alternatives increased from as low as 34% to as high as 60% as consumers approached middle age (45-54) and steadily decreased thereafter to 48% by age 65 (Table 2). Consumer interest in low cost, low return window, water resource and HVAC alternatives remained relatively unchanged between age groups, averaging between 20% and 30%. Willingness-to-pay for moderate cost alternatives was found to be inversely proportional to high cost, high return alternatives. For all age groups however, interest in high cost, high return alternatives remained distinctly above both low and moderate cost, moderate return alternatives, except for consumers 25-35 years of age. This age group demonstrated a significant willingness-to-pay for moderate alternatives over high cost, high return alternatives (HVAC, $\rho = 0.08$).

Table 2: Age Distribution of willingness to-pay for sustainable alternatives

Age	Low Cost, Low Return	Moderate Cost, Moderate Return	High Cost, High Return
25-34	31%	35%	34%
35-44	20%	28%	52%
45-54	18%	22%	60%
55-64	25%	26%	49%
65+	24%	28%	48%

Analysis of consumer occupation (Table 3) indicates that all occupations were generally reflective of the population, choosing first high cost, high return alternatives followed by moderate and low cost, low return alternatives in descending order.

Table 3: Occupational Distribution of willingness-to pay for sustainable alternatives

Occupation	Low Cost, Low Return	Moderate Cost, Moderate Return	High Cost, Low Return
Professional	28%	29%	43%
Service	24%	27%	49%

Admin	26%	28%	46%
Retired	25%	26%	49%
Builder	24%	28%	48%

An analysis of income (Table 3) revealed no statistically significant differences between levels of economic means, although consumer willingness-to-pay gradually favored high cost, high return window, water resource and HVAC alternatives as income increased.

Table 3: Occupational Distribution of willingness-to pay for sustainable alternatives

Income	**Low Cost, Low Return**	**Moderate Cost, Moderate Return**	**High Cost, High Return**
<GHC50K	25%	27%	48%
GHC60K-GHC99K	22%	27%	51%
GHC100K-GHC149K	21%	25%	54%
GHC150K-GHC199K	16%	26%	58%
GHC200K+	14%	24%	62%

Data suggests that costs are the single greatest factor in the consumer's willingness-to-pay decision for sustainable alternatives, and given a choice, consumers were generally inclined to select high cost, high return-on-investment alternatives. However, the moderate cost, moderate return HVAC alternative (34.1%) approached and, in some demographic sub-groups, exceeded willingness-to- pay for the high cost, high return HVAC alternative, indicating the emergence of a possible affordability "ceiling" since the capital cost of the high cost, high return HVAC alternative was greater than that of any other alternative. Factors such as margin of affordability (MOA), minimal attractive rate of return (MARR), and maximum return on investment (ROImax), were predicted to account for some variance in consumer willingness-to-pay. Yet, further analysis was needed to determine the effects, if any, of these underlying ROI cost structures on the consumer's decision to select sustainable energy and water resource alternatives.

As the maximum investment that can be afforded by the consumer for a given return, margin of affordability is simply the willingness-to-pay for an increase in capital costs. To determine the margin of affordability, the changes in willingness-to-pay were evaluated as a function of changes in capital costs. Surprisingly, willingness-to-pay was positively correlated to increase in capital costs, meaning willingness-to-pay increased as capital costs increased (r = 0.90). The consumer's willingness-to-pay for higher capital cost likely stems from corresponding increases in total returns over the product life-cycle. Yet further analysis suggests that the "ratio" of changes in capital costs between alternatives do affect willingness-to-pay. To determine the "ratio" change in willingness-to-pay relative to a change in capital costs, the capital cost increase between low and moderate cost, moderate return alternatives were compared to the difference between that of moderate and high cost, high return window, water resource and HVAC alternatives.

Minimal Attractive Rate of Return (MARR), although expressed in many forms, MARR can be as a desired period of capital cost recovery. Capital cost recovery is the second and from a statistical vantage point, the most significant MARR variable affecting consumer willingness-to-pay. Similar to capital costs, willingness-to-pay was positively correlated to increase in capital cost recovery, meaning willingness-to-pay increased as the time necessary to recover the capital cost investment increased ($r = 0.79$). The consumer's willingness-to-pay for extended recovery periods most likely results from corresponding increases in total returns over the product life-cycle. Again however, further analysis suggests that the magnitude of marginal changes in capital cost recovery between alternatives do affect willingness-to-pay.

Total Return-on-Investment, although the ratio and marginal differences in capital cost and capital cost recovery between "low-moderate" and "moderate-high" window, water resource and HVAC alternatives *may* have underlying influences on willingness-to-pay, maximum return-on-investment over the product life-cycle was found to be the most influential independent variable. Results find that willingness-to-pay for each alternative is positively correlated to the actual Ghana cedi amount of maximum return-on-investment ($r = 0.90$).

The fundamental objective of this research is to determine the viability of sustainable residential development through market-based economic structures, meaning reduced energy and water resource, resource consumption and subsequent reduced environmental impact should become a competitive advantage over inefficient use of resources. However, many adverse effects of inefficient resource use will continue to be *externalized*, or left unaccounted for in market-based decision processes for the foreseeable future. The effects that "hard" capital and life-cycle costs have on willingness-to-pay have been surveyed and extensively analyzed. It is now necessary to assess the consumer's willingness-to-pay for "soft" cost benefits, or societal benefits that are derived from reducing negative, externalized effects of resource exploitation.

Results from Figure 3 indicate that willingness-to-pay for "soft cost" benefits excluding hard cost ROI vary widely from 33.8% to 61.1%, presumably as a result of either differences in familiarity with the advanced alternatives presented by the survey instrument or the level of "soft" cost benefits consumers perceive to be provided by the respective alternatives. Regardless, consumers within the sample population appear to have a slightly higher likelihood of selecting sustainable alternatives that do not demonstrate a positive ROI but protect the human health and the health of the environment than those that are unlikely to invest in sustainable alternatives for soft cost benefit alone. When comparing those approximate 40% of consumers that were unwilling to pay for soft cost benefits, more than 80% chose either a low, moderate or high cost, high return window, water resource or HVAC alternative. This means that fewer than 10% of respondents were unwilling to invest in either the hard or soft cost benefits of energy and water resource alternatives.

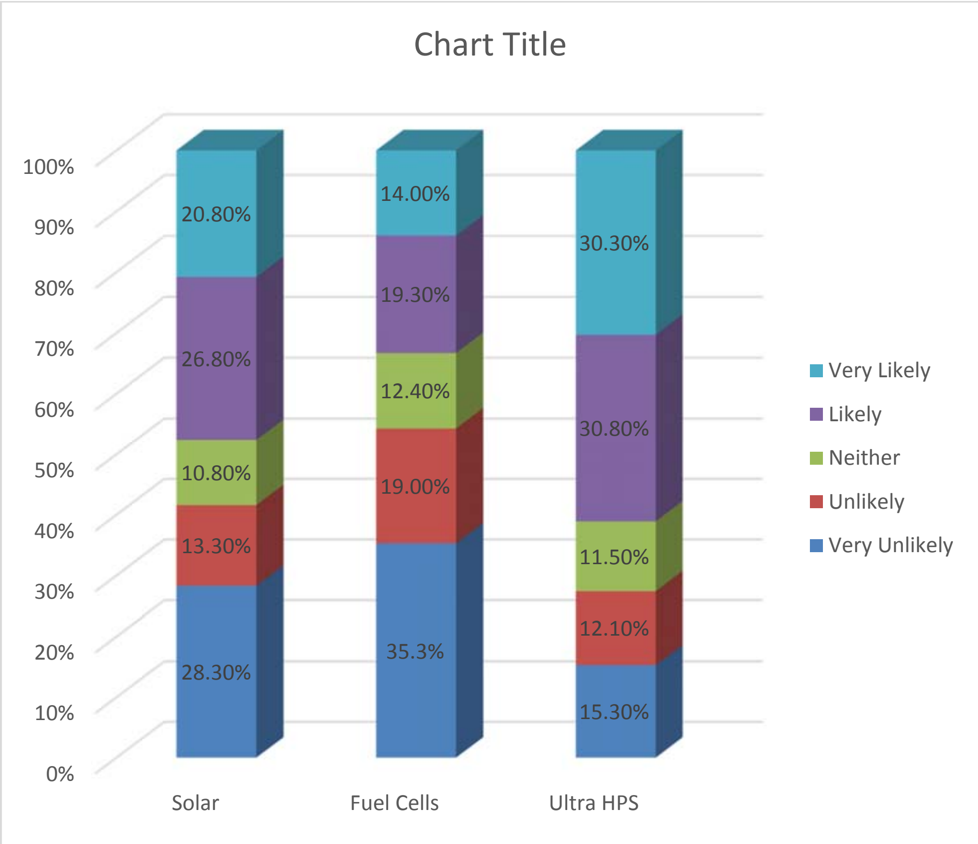

Figure 3: Frequency distribution of consumer willingness-to-pay for "soft cost" benefits excluding tangible ROI between 33.8% and 61.1% select "futuristic" sustainable alternatives regardless of hard-cost payback.

Data from the analysis shows that consumer willingness-to-pay for sustainable alternatives regardless of monetary "payback" remained very consistent among consumer ages and levels of income. Notable exceptions were found willingness-to-pay for natural gas fuel cells and ultra-efficient air-conditioning systems. Consumers with lower incomes GHC60K-GHC99K, $\rho = 0.09$) were less likely to invest in the soft cost benefits of residential scale fuel cells, which catalytically reform simple hydrocarbon fuels such as natural gas and propane to hydrogen for near emissions-free electrical power and waste heat for domestic hot water. Overall, more than 60% of consumers were likely to invest in ultra-high efficiency HVAC systems such as 18+ SEER dual variable speed compressor technologies, that due to emerging demand, remain very costly and may not provide the "payback" possible with more mature, commercially available12-16 SEER systems. Notable exceptions are consumers age 55-65 and those having incomes less than GHC60K, who were significantly less likely to invest in 18+ SEER soft cost benefits alone.

CONCLUSION

Although clear trends have emerged between consumer willingness-to-pay and a) cost and non-cost issues, b) capital costs and life-cycle return, and c) demographics, consumer behavior remains a complex social phenomena that cannot be explained by a single critical factor, making attempts to determine causality with any degree of certainty very difficult without considerably more in-depth analysis. However, with this key limitation of research noted, *Market Survey Assessments* have successfully provided the foundation to 1) correlate the affects of capital and life-cycle costs on consumer willingness-to-pay when other behavioral domains and consumer demographics are known, and 2) identify statistically significant differences in willingness-to-pay from norms and averages based on specific consumer profiles.

In summary, consumers prioritized level of willingness-to-pay according to total return-on-investment, meaning willingness-to-pay changed proportional to changes in total return as that the vast majority of consumers chose high capital cost, high return alternatives. The results also indicated that savings-to-investment (SIR) ratio was not as significant a consideration, meaning that if consumers viewed the purchase of a sustainable alternative as an "opportunity" cost, they should have chosen low cost, low return alternatives, which had the highest SIR, and invested the balance of their available resources elsewhere. As a result, the most fundamental discovery is that although incremental changes in capital costs, SIR and CCR are contributing factors, the variable most influencing consumer willingness-to-pay was clearly rate-of-return and subsequent ROImax. Since, consumers demonstrated no apparent inclination to view investment in sustainable energy and water resource alternatives as an "opportunity" cost, discounting life-cycle returns to account for lost opportunity returns was eliminated.

The findings of this research will aid industry professionals to have the information necessary to provide competitive alternatives to conventional building practices, allowing market forces to become the primary driver for the integration of sustainability into residential development.

References

Chiras, D. D. (1993). ed. Voices for the Earth. Boulder: Johnson Books, 1993.

Coi, Y. (1994). A Green GNP Model and Sustainable Growth. Journal of Economic Studies. Vol 21, p. 37-45.

Daly, H. E. (No Date). Sustainable Development: From Concept and Theory Towards Operational Principal. Population and Development Review.

Grosskopf, K.R. (1998). A Methodology for Operationalizing Sustainable Residential Development. Phd Thesis, University of Florida.

Kibert, C. and Brad G. (1995). ABACOA: Sustainable Construction Code - Residential. The John D. and Catherine T. MacAuthur Foundation. Gainesville.

Munasinghe, M. (1994). The Economist's Approach to Sustainable Development. Vol. 30 p. 16-19.

Steer, A. and Ernst L. (1993). Measuring Environmentally Sustainable Development. Finance & Development. Vol. 30 p. 20-23.