International Journal of Applied Environmental Sciences
ISSN 0973-6077 Volume 12, Number 5 (2017), pp. 937-951

http://www.ripublication.com

The Importance of Green Technologies and Energy Efficiency for Environmental Protection

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Abstract

It is essential that an appropriate model of green building be used by the administrators and professionals. The global problems of environmental degradation have forced the society to rethink about the way of development and evolve the concept of sustainable development. Indeed, the new environmentally friendly technologies are fundamental to attain sustainable development. Various green initiatives are being taken to maintain and improve the quality of environment that might flourish on the new resource efficient and sustainable thinking society of the future. There is hope for international action in the application of science and technology to environmental concerns a hope born of the urgency of current environmental problems, of the new-found recognition of mutual environmental interests and of the fundamental role of science and technology in general and green technologies, in particular, in assessing and responding to environmental threats. This study aims to investigate the prima facie conjecture that there are problems to an evaluation on development of green building and energy efficiency in developed country with regard to the effectiveness of green building. These problems may explain why the main players are less responsive to the implementation and practice of the green building and energy efficiency .The data were collected via a questionnaire survey and analysed with the help of SPSS. This study recommends the need for selection of green technologies, some of the feasible green technologies and challenges and alternatives in sustainable development. In conclusion, it can be inferred that the green building is still at its infancy stage and as such serious attention is needed among the players in the development of green building and energy efficiency in developed countries.

Keywords: Green Technology, Energy Efficiency, Sustainable Development, Environment Protection

1.0 INTRODUCTION

Economic development is closely linked with the energy development. Most of the world's commercial energy supplies are provided by fossil fuels, with the associated emissions causing global environmental problems [28]. It is feared that not only these levels of energy production and use from current energy sources are difficult to achieve but also unsustainable. Therefore, energy use efficiency needs to be increased to moderate the growth of energy while the contribution from clean energy sources needs to be increased to reduce adverse environmental impacts of energy usage [3].

Green energy offers a promising alternative to traditional energy sources. The fact that renewable energy accounts for only a modest proportion in meeting the world's (commercial) energy demand means that there is a missing link in their potential and their implementation - the barriers in their implementation [6]. These barriers (either financial or non financial) need to be identified and addressed in order to design innovative policy approaches for the international and domestic financing or renewable energy technologies[4]. Renewable energy can play an important role in helping to meet basic energy needs through the use of modern technologies Green technologies [1]. The Rio Declaration adopted at United Nations conference on Environment and Development in Rio emphasizes entitlement of healthy and productive human life in harmony with integration of environment protection in the development process. The Earth Summit at Rio adopted Agenda 21 on June 14, 1992, which proposes various actions to be implemented from now and into the 21st century to accelerate sustainable development [2].

The green technology policy to provide direction and motivation to continuously enjoy good quality and a healthy environment should be based on four pillars [10]:

- Energy: Seek to attain energy independence and promote efficient utilization.
- Environment: Conserve and minimize the impact on the environment.
- Economy: Enhance the national economic development through the use of technology.
- Social: Improve the quality of life for all.

1.1 Green Technology

Green technology (GT) is a broad term and a field of new innovative ways to make environmental friendly changes in daily life. It is created and used in a way that conserves natural resources and the environment. It is meant as an alternative source of technology that reduces fossil fuels and demonstrates less damage to the human, animal, and plant health, as well as damage to the world [20]. The use of green technology is supposed to reduce the amount of waste and pollution that are created during production and consumption. It is also referred to as environmental technology and clean technology [18].

Although it is difficult to precisely define the areas that are covered by green technology, it can safely be said that “GT is the development and application of products, equipment and systems used to conserve the natural environment and resources, which minimizes and reduces the negative impact of human activities." This technology should meet the needs of society in ways that can continue indefinitely into the future without damaging or depleting natural resources [5]. In short, GT is defined as the technology that meets present needs without compromising the ability of future generations to meet their own needs.

1.2 Sustainable Development

The World Commission on the Environment and Development also known as the Brundtland Commission, in their report, “Our Common Future” introduced and defined the term sustainable development as the process in which the exploitation of natural resources, the allocation of investments, and the process of technological development and organizational change are in harmony with each other for both current and future generations. Based on this context, “sustainability” is considered as a path forward that allows humanity to meet current environmental and human health, economic, and societal needs without compromising the progress and success of future generations [29].

Some of the definitions of sustainable development illustrating the variety of foci are:

- Development that meets the needs of the present without compromising the ability of future generations? To meet their own needs “The World Commission on Environment and Development, Our Common Future [30].
- “Improves the quality of human life while living within the carrying capacity of supporting ecosystems," International Union for the Conservation of Nature and Natural Resources (lUCN), World Conservation Union, United Nations Environment Programme (UNEP), and worldwide fund for Nature (WWF), Caring for the Earth [30].

1.3 Criteria for Selection of Green Technologies

The Green technology is the knowledge for conserving natural environment and resources and reducing human involvement. It can operate in diversified areas such as bio-fuel, eco-forestry, renewable energy, and solid waste management [17]. However, it is neither viable nor required to adopt all the available technologies at one time without considering country-specific strengths and weaknesses. The selection of tools and techniques as an appropriate technology is an important element in helping communities to decide what their future should be like. In other words, appropriate technology's search for those technologies that have beneficial effects on income distribution, human development, environmental quality, and the distribution of political power [14].

In general, the seven criteria have been proposed to judge the appropriateness of technology by Robert (1998) in his paper entitled, "Design Criteria for Sustainable Development in Appropriate Technology: Technology as if People Matter" [24].

A) System Independence: It is the ability of the technological device to stand alone for doing the required job. Whether the technology will require relatively more capital or labour will be analysed to check system independence of the technology [21].

B) Image of Modernity: People should perceive themselves as modern by adopting the technology. The message is people's realization that technological device can elevate the user's social status as well as need a basic human need. Image of modernity requires that the social status of people who adopt it either increases or remains unchanged.

C) Individual Technology vs. Collective Technology: It is the criteria to look into the societal/cultural standards in which the technology operates. In other words, it is the careful assessment of the technology that is based on group approach and becomes more systems dependent. A society geared towards individual or single family unit will need more systems independent technology. Collective technologies are more easily adopted as collective action reduces a transaction cost [12].

D) Cost of Technology: Affordability of the technology is an important indicator for their wider use since cost is the major factor in encouraging or discouraging the application of appropriate technology in developing economies.

E) Risk Factor: It is an important factor to find out how smoothly technology works in the local production system and system that explains to what degree is the technology system dependent or system independent. This indicates the need for understanding two types of risk- both the internal and external risk. Although analysis of risk is necessary before applying new technology, it is almost impossible to remove all risks.

F) Evolutionary Capacity of Technology: If the chosen device is static, it will relatively reflect the short-lived solutions to a much larger problem. The technology, which supports the continuation of development by enhancing capability to expand, can be expected to compete at the regional, national and international level.

G) Single-Purpose and Multi-Purpose Technology: In contrast to single purpose technology, multipurpose technologies are the ones that furnish a variety of applications (e.g. a tiller who can be used for tilling the land, powering water pump, and drying rice) [24].

1.4 Feasible Green Technologies

Some of the selected renewable-energy technologies are:

A) Solar Photovoltaic: Solar photovoltaic technology converts sunlight into electricity using semi conductor modules. Used generally for meeting lighting requirements, they can also be used for pumping water, refrigeration, communication, and charging batteries. Solar photovoltaic has application as the green agricultural energy source for pumping water, street lighting in villages, lighting in rural houses and pest management [4]. Since the technology efficiently produces low-cost, high-power photovoltaic cells, this new generation of solar energy can be one of the most affordable and efficient energy sources in the future.

B) Wind Energy: Wind energy is in a boom cycle. Its importance is increasing in the sense that comparatively with other sources; the wind energy produces fewer air pollutants or greenhouse gases. Wind turbine for electricity or mechanical power generation is a proven technology [25]. Available in 75% of the world, wind turbines of sizes ranging from 900 W to 50 kW can be applied off-grid for pumping and treating drinking water, irrigation, telecommunications, homes, schools, clinics and for supplementing larger power stations [4]. Wind turbines used in pumping water for irrigation can increase agricultural growth without carbon emission.

C) Bio-fuel: Bio-fuel as bio-ethanol and bio diesel has the potential to assume an important portfolio in the future energy platter. Caution is mandatory in evaluating bio-fuel as green agricultural technology. Food security concerns and risks to environment and bio diversity are parameters that necessarily need to be accessed while analyzing sustainability linkage of agriculture and bio-fuel. Furthermore, conversion of the wasteland to farmland with some crop options can be viewed as positive impacts.

D) Biogas: Bio gas is the product of anaerobic digestion of organic matters by methanogenic bacteria. Bio gas qualifies on the merits that this technology utilizes organic agricultural waste and converts it to fuel and fertilizer. Direct impacts of bio gas are fuel-wood, agriculture residue, livestock manure, and kerosene savings. Increases in soil fertility and crop production have also been observed. Bio gas also solves the problem of indoor air pollution and improves household or communal sanitation. India's bio gas potential is estimated to be 12 million bio gas plants. Nepal carries the potential of 1.9 million bio gas plants. In Malaysia Palm Oil Mill, Effluent (POME) can generate 177 MW [11] and China can generate 4 billion cubic meters of bio gas [6].

E) Micro & Small Hydropower: National convention of renewable hydropower varies across nations. Hydropower plants ranging from maximum capacity of 500 kW in Nepal to 25 MW in India are conceived renewable. Generally used in rural electrification, hydropower plants can take an equally important role in facilitating irrigation and value addition at source of agricultural products.

F) Biomass: Agriculture residues and wastes are converted to electric and thermal energy through processes like combustion, gasification, and cogeneration. Biomass technologies compliment mainstream crop production and reduce or completely replace consumption of traditional fuel. Experiences of some of the countries portray biomass to be effective means of increasing agricultural revenue and conserving exhaustible resources.

G) Solar Thermal, Improved Water Mill, and Geothermal Energy: These clean technologies are found to contribute in adding value to agriculture products. Food processing, animal husbandry, dairy, and aquaculture are identified sectors for application of solar water heating and researches on solar drying of agro products, including paddy, coffee beans, tobacco, groundnuts, banana, bamboo, rubber, etc. have been carried out in Malaysia [11].

1.5 Recommendations

The recommendations are grouped into three action areas:

I. Generating new sources of revenues to fund green technologies
II. Intensifying dialogue on existing national green policies
III. Spurring new international co-operation on green technologies.

I. Generate new sources of revenues to fund green technologies: Green technologies not yet price competitive with fossil-fuel technologies. Governments must help in cutting-edge clean technologies and create the framework conditions that enable renewable-energy companies to bring their products to the market. Hence, a key task of any government must be to generate new sources of private and public revenues. Where possible, governments should try to generate incentives for additional private investment in clean-technology research and projects; when private markets fail, public spending must play a role.

The key recommendations to generate new sources of revenues are:

1. Expand the share of green financing of public financial institutions. Public financial institutions, such as the European Investment Bank (EIB) or the World Bank, should make the financing of renewable energy projects a priority and provides at least 20% of new loans for energy efficiency and renewable energy [17].

2. Establish new international sources of climate funding. A portion of national emission allowances (AAUs) should be auctioned under the UNFCCC system or taxes on air tickets, etc. to fund international initiatives. These systems should be established in a way that combines internationally binding financing obligations for countries while maintaining the final budgetary responsibility of countries and parliaments to ensure political viability.

3. Issue government-backed “green bonds” to make use of socially responsible investments. Public finance institutions and governments should start to jointly develop a market for “green bonds." These bonds are issued by public finance institutions (such as KfW) and backed by governments to attract retail investors at reduced interest rates [24]. A strong incentive for consumers to buy green bonds would be to make their yields/coupon payments tax-free [20].

II. Intensify dialogue on existing national green policies

Individual countries could profit from other countries' experiences. Best practices should be copied while wrong paths do not need to be taken. At the centre of the discussion should be the following topics:

1. Extend public procurement of clean technology. Large-scale government purchases and deployments of green technologies will reduce the public sector's carbon footprint and spur private investment.

2. Lead the way by cutting taxes on green products and send a strong message all-around to countries. Once the public budget allows for such a measure, more tax deduction incentives for green services and products should be given [23].

III. Spur new international co-operation on green technologies

In the light of the various International communique, the following steps should be taken to create a more effective framework for international clean-technology cooperation:

1. Create a Clean tech Investment Forum: The online forum would serve as a one-stop hub with an efficient search system connecting public money, private investors, and clean tech business/entrepreneurs at one's fingertips.

2. Harmonize green technology standards, codes and contractual principles: Supranational harmonization of standards is important in enabling the uptake of eco innovation and clean technologies and facilitating their dissemination in global markets. In many cases, regulations and standards are more effective than direct government funding.

3. Create a best-practices expert panel on green technologies: An international panel of stakeholders and experts should define, and advise on, best. In its effort to define the elements of successful policy frameworks for encouraging green technology, the panel needs to take into account regional, geographic and socioeconomic differences among countries and sub-regions.

4. Improve the knowledge sharing ability of multi-industry multi-technology clean tech research centers: No centralization of research should be pursued rather a bundling of expertise from leading universities and institutes in order to enhance cooperation between regional research centers.

5. Define legitimate forms of public "green" aid and reduce environmentally harmful subsidies: Uniform definitions of what constitutes legitimate green objectives for state aid will help avoid judicial challenges. To ensure that public spending achieve climate goals without running afoul of state-aid rules and trading agreements, various countries should take the initiative [22].

6. Open and sustain the markets for green technologies through better trade policy: To facilitate the expansion of the cleanest technologies, trade barriers for proven clean technologies should be lifted, including discontinuing direct or hidden subsidies to manufacturers [25].

2.0 RESEARCH METHODOLOGY

In this research, quantitative analysis is used to analyze the data. This study analyzes data which include descriptive statistics, goodness of measures, reliability analysis, validity analysis, hypothesis testing and mediation effects testing. It investigates relationships between Awareness of Environment, Technology, Social Element, Legislation and Green Building Performance. The data collection resources (tools) are classified into two groups of primary and secondary sources or information. In the case of secondary resources, articles, books, researches, studies and the theses conducted in this field (collected from libraries and internet websites) have been used. Also, the primary information has been collected using the field research method (questionnaire).

A draft of the questionnaire is evaluated by ten academic professors in the areas of GBI and Green Building in Malaysian building Industry. These processes enable a researcher to develop a questionnaire with high content validity. according to our respondents who are a group of experts,where all the ambiguities in the questionnaire were made clear and items have been designed and reviewed. A structured questionnaire is according to a 5-point (Likert-type) scale ranging from 1 to 5 namely Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree and Strongly Agree. Because, the Likert scale makes available more information about the respondents' degree of contribution, it can make available deeper implications of the perception to be surveyed. Table 1 shows the reliability coefficient of the questionnaire. It shows that the Cronbach's alpha of the questionnaire is 0.8235 which means the reliability of the present research questionnaire is acceptable. (Cronbach, 1951).

Table 1: Reliability Statistics

Cronbach's Alpha	N of Items
0.8235	39

Sampling technique in this research is stratified sampling, where, the researcher divides the population into separate groups, called strata. Then, a probability sample (often a simple random sample) is drawn from each group. The sample size of research can be determined according to Morgan's Table. In this research population size is N=800 and According to Morgan’s Table the sample size should be n=260 but could were collected 266 (33.25%). The target population of this research consisted of managers and non-managerial staff and professional members of green building index (GBI).

2.1 Analysis and Interpretation

This part discusses the objectives of the research, namely the effects of GBI in Malaysian Building Companies. In data analysis part, the collected data and summarized information, are studied, categorized and tested using the descriptive and inferential statistical techniques in order to achieve the research objectives, answer its questions/hypotheses and its problems as well as the detailed process of how it works will be explained.

2.2 Mahalanobis Distance

Mahalanobis distances provide a powerful method of measuring how similar some set of conditions is to an ideal set of conditions, and can be very useful for identifying which regions in a landscape are most similar to some "ideal" landscape. Moreover, Mahalanobis distances are based on both the mean and variance of the predictor variables, plus the covariance matrix of all the variables, and therefore take advantage of the covariance among variables. The region of constant Mahalanobis distance around the mean forms an ellipse in 2D space (i.e. when only 2 variables are measured), or an ellipsoid or hyperellipsoid when more variables are used (refer to Table 2).

Table 2: Residuals Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.0000	4.6667	4.4211	.16039	266
Std. Predicted Value	-2.625	1.531	.000	1.000	266
Standard Error of Predicted Value	.000	.000	.000	.000	266
Adjusted Predicted Value	.	.	.	.	0
Residual	.00000	.00000	.00000	.00000	266
Std. Residual	.000	.000	.000	.000	266
Stud. Residual	.	.	.	.	0
Deleted Residual	.	.	.	.	0
Stud. Deleted Residual	.	.	.	.	0
Mahal. Distance	23.095	25.504	24.906	1.043	266
Cook's Distance	.	.	.	.	0
Centered Leverage Value	.087	.096	.094	.004	266

a Dependent Variable: dv

The tests results show that minimum is for Mahalanobis distance (23.095) and maximum for Mahalanobis distance is (25.504). It means that, our data value is between min and max range.

2.3 Skewness and Kurtosis Test Results

Skewness and Kurtosis it can be used to test the normality of a given data set. Since the statistics is between (-2, 2) means that the distribution of the sample is normal.

The amount of skewness for all variables respectively is -0.590, -0.391, -0.277, -0.592 and -1.365. Its shows these variables were normal and symmetric distribution.

The amount of kurtosis for all variables respectively are -0.040, -0.657, -0.644, -0.467 and 1.872.Its shows that variables distribution is normal (refer to Table 3).

Table 3: Descriptive Statistics to Skewness and Kurtosis

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
DV	266	-.590	.149	-.040	.298
IV1	266	-.391	.149	-.657	.298
IV2	266	-.277	.149	-.644	.298
IV3	266	-.592	.149	-.467	.298
IV4	266	-1.365	.149	1.872	.298
Valid N (listwise)	266				

2.4 The Regression Test among Independent Variables (Awareness of Environment, Technology, Social Element, Legislation) and Dependent Variable (Green Building Performance)

Multiple linear regression (MLR) is a method used to model the linear relationship between a dependent variable and one or more independent variables. The dependent variable is sometimes also called the predictand, and the independent variables the predictors. MRA to identify the significant factors that affect of green building performance on Malaysian green building.**.** Analysis of Variance (ANOVA) shows that factors identified by this analysis together significantly related to the dependent variable. This means that the factors identified in this analysis are significantly related to the green building performance (refer to Table 4). If there is a change in the factors, there will be change in the green building performance.

Below Table shows the individual factors relationship with the dependent variable of the regression model. It shows that all impact factors such as, awareness of environment (2.035); technology (2.744), social element (2.774) and legislation (5.599) are significantly related to the green building performance.

Table 4: The Regression Test among IVs and DV

IV	DV (Green Building Performance)								
	Coefficients[a]				Annova[b]		Model Summary		
	B	Beta	t	Sig	F	Sig	R	R^2	Durbin Watson
Constant	3.697	-	6.336	0.000	11.23	0.000	0.383[a]	0.147	2.285
Awareness of Environment	0.181	0.124	2.035	0.043					
Technology	0.310	0.171	2.774	0.006					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.383[a]	.147	.134	.37464	2.285

a. Predictors: (Constant), legislation, social building, awareness of environment , technology

b. Dependent Variable: D

As observed in the above table, since the obtained sig in ANOVA table is smaller than 0.05 (0.00<0.05), the whole regression has the required statistical validity. In the next stage, the effects of independent variable on the dependent variable are assessed. The Beta coefficient and significance value (sig) of the variables imply that all of the independent variables have statistical validity, because the significance value of these variables are smaller than the significant level 0.05.

♦- Unstandardized Model

$Y= 3.698 + (0.181\ x_1) + (0.310\ x_2) + (0.223 x_3) + (0.469\ x_4)$

♦- Standardized Model

$Y= (0.124\ x_1) + (0.171\ x_2) + (0.161\ x_3) + (0.350\ x_4)$

Y= Dependent Variable (green building performance)

x1=Independent Variable1 x2=Independent Variable2

x3= Independent Variable 3 x4= Independent Variable 4

2.5 Pearson's Correlation Coefficient

The Pearson Product-Moment Correlation Coefficient is a measure of the linear correlation (dependence) between two variables X and Y, giving a value between +1 and −1 inclusive, where 1 is total positive correlation, 0 is no correlation, and −1 is total negative correlation. It is widely used in the sciences as a measure of the degree of linear dependence between two variables. It was developed by Karl Pearson from a related idea introduced by Francis Galton in the 1880s. Early work on the distribution of the sample correlation coefficient was carried out by Anil Kumar Gain and R. A. Fisher from the University of Cambridge. Pearson's correlation coefficient is defined between two random variables equal to their variance divided by the standard deviation (refer to Table 5).

Table 5: Correlation Pearson Coefficient Test between Variables (c1, c2, c3, c4 and c5).

Independent Variables (IV)	Dependent Variable (DV) (Green Building Performance)	
Awareness of Environment	Pearson Correlation	0.227 **
	Sig. (2-tailed)	0.000
Technology	Pearson Correlation	0.137*
	Sig. (2-tailed)	0.03
Social Element	Pearson Correlation	0.271**
	Sig. (2-tailed)	0.000
Legislation	Pearson Correlation	0.399
	Sig. (2-tailed)	0.000

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Statistical Hypotheses:

Null Hypothesis (H0): There is no significant positive relationship between c1 and c2, c3, c4 and c5.

Hypothesis A: There is significant positive relationship between c1 and c2, c3, c4 and c5.

Test results: Considering that the significance levels are smaller than 0.05, the null hypothesis is rejected and therefore hypothesis A is accepted .There is significant positive relationship between Dependent Variable and Independent Variables.

3.0 CONCLUSION

The environmental protection, resource conservation and addressing other socio-economic aspects for sustainable development are essential. The green initiatives adopted for resource conservation, and environmental protection shall help sustain higher economic growth rate necessary to fulfill basic needs with some acceptable quality of life in the future. According to Brundtland Commission (1983), sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development that is respectful of the social equity and environmental healthiness may occur only when it gets stronger international awareness and large-scale changes into tendencies in production and consumption patterns. Recognizing the debilitating and even devastating – impact of climate change, countries all over the world should pledge to reduce their contribution to the climate by cutting down carbon dioxide emissions. To move toward sustainable development, policymakers should consider not only domestic economic concerns, but also the major scientific and technological challenges affecting all countries.

4.0 ACKNOWLEDGEMENT

The authors wish to express their gratitude to Universiti Sains Malaysia who had funded the study through their research grant scheme (account number 304/PPBGN/6313151) without which the publication of this work would not be possible

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