

Tools Proposed to Better Manage the CO₂ Emissions in Organizations: Learning & Insight

Terence Douet*

Vinamra Jain**

This study addresses an important and relatively new topic by investigating the CO₂ constraints that businesses will face with the future worldwide CO₂ regulation and will focus on the barriers that prevent the employees within a company to better manage it. After a description of the current and possible future CO₂ emissions constraints and regulation, it will be deeply study the main barriers that prevent today the employee engagement in the CO₂ reduction policy. Then, a possible solution that engages individually all workers of a business in the reduction of their CO₂ emissions will be tested.

INTRODUCTION

Firms worldwide, responding to the threat of government legislation or to concerns raised by their own consumers or shareholders, are undertaking initiatives to reduce their carbon footprint. (Benjaafar, B. Yanzhi, L. Mark, D. (2010)). Carbon Footprint is now a buzzword widely used across the media (Wiedmann, T. and Minx, J. (2008)) and companies started to create tool to manage it properly.

We can find in the scientific literature various description of tools that enable supply chain manager to evaluate and control the CO₂ emissions of their activity. These tools can be the improvement of classical supply chain models by associate carbon footprint parameters (Benjaafar, B. Yanzhi, L. Mark, D. (2010)), or the creation of new tools like the Bottom - up life cycle goods based on Process Analysis (PA) or the Up - Bottom approach with Input-Output (EIO) (Tukker, A. and Jansen, B. (2006)).

However, in this literature review, no tools engaged the whole company workers in the reduction of their CO₂ emissions and where only addressed to the

decision makers. Also, whereas it is critical, observations prove that the engagement of employees in the reduction of their CO₂ emission is poor today. What factors does explain this poor engagement and what tool is it possible to implement to engage more efficiently the employees?

The first part of this dissertation will consist in a picture of all the legal and consumer pressure a French business has to face front of the CO₂ reduction issues. The second part will focus on the barriers that prevent employees to decrease their CO₂ emissions at the office. The third part, which is the intelligent fruit of the two previous one, will present a solution for businesses which integrate the legal and worker environment for engaging all employees in their CO₂ reduction.

CO₂ EMISSIONS : A NEW CHALLENGE FOR CORPORATIONS

A) The creation of a global governance regime to limit the global warming

The United Nations Framework Convention on Climate Change (UNFCCC) process aimsto manage the climate as a public good that is available for all humans through a global governance regime. (Zou, J. Fu, Sha. (2015)). This new governance will probably define quotas of CO₂ per countries that will be then subdivided per industries and companies. In a close future so, companies will have to directly deal with their CO₂ emission to avoid taxes or penalties.

*ESC Rennes School of Business, Rennes, Bretagne, France

** Assistant Professor, Amity Business School, Amity University Uttar Pradesh, India (Corresponding Author)

B) How companies deal with CO₂ emission reductions?

According to a survey done on 31 US major companies, take actions about climate related strategy became important among companies for 1. Increase profit (Energy efficiency, Operational improvement, cost saving) 2. Influence government regulation 3. Enhance corporate reputation (Hoffman, A. (2016)). Develop climate strategy also became critical about financing. 93% of investors think about climate change risk in their investment decisions and it has been proved that firms with superior CSR performance enjoy a subsequent reduction in the cost of capital equity (Dhaliwal, D. Zhen Li, O. Tsang, A. 2010) and subsequent ease to hire talents (Brekke, K. Nyborg, K. (2007)). Companies try to transform the global warming threat as a competitive advantage (Porter, E. Kramer Mark, R. (2006)).

C) The current barriers that prevent employees to decrease their CO₂ Emissions

Employees are emitting CO₂ during their working time and in the realization of their missions. These emissions can be categorized in the Scope 3 that are defined as other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities. Scope 3 emissions represents in average 50% of a company carbon footprint.

Because these emissions are directly controlled by employees of a company it is crucial to better engage them in the reduction of the carbon footprint. However today, a lot of studies show that employees face many barriers that prevent them to adopt a pro-environmental behavior.

a. Introduction

Why do people act environmentally and what are the barriers to pro-environmental behavior? Numerous theoretical frameworks have been developed to explain the gap between the possession of environmental knowledge and environmental awareness, and displaying pro-environmental behavior. To summarize,

the factors that have been found to have some influence, positive or negative, on pro-environmental behavior are demographic factors, external factors (e.g. institutional, economic, social and cultural) and internal factors (e.g. motivation, pro-environmental knowledge, awareness, values, attitudes, emotion, locus of control, responsibilities and priorities). (Kollmuss, A. Agyeman, J. (2002))

b. Why environmental knowledge does not lead directly to pro-environmental behavior? The Rajecki model

By 'pro-environmental behavior' we simply mean behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world (e.g. minimize resource and energy consumption, use of non-toxic substances, reduce waste production). Rajecki (1982) defined four causes that prevent an individual to adapt his behavior to his new environmental knowledge.

- Direct versus indirect experience: Direct experiences have a stronger influence on people's behavior than indirect experiences. In other words, indirect experiences, such as learning about an environmental problem in school as opposed to directly experiencing it (e.g. seeing the dead fish in the river) will lead to weaker correlation between attitude and behavior.
- Normative influences: Social norms [3], cultural traditions, and family customs influence and shape people's attitudes, e.g. if the dominant culture propagates a lifestyle that is unsustainable, pro-environmental behavior is less likely to occur and the gap between attitude and action will widen.
- Temporal discrepancy: Inconsistency in results occur when data collection for attitudes and data collection for the action lie far apart (e.g. after Chernobyl, an overwhelming majority of Swiss people were opposed to nuclear energy; yet a memorandum two years later that put a 10-year halt to building

any new nuclear reactors in Switzerland was approved by only a very narrow margin). Temporal discrepancy refers to the fact that people's attitudes change overtime.

- Attitude-behavior measurement: Often the measured attitudes are much broader in scope (e.g. Do you care about the environment?) than the measured actions (e.g. Do you recycle?). This leads to large discrepancies in results (Newhouse, 1991).
- c. Why environmental knowledge does not lead directly to pro-environmental behavior? The Hines model
In 1986, Hines, Hungerford and Tomera published their Model of Responsible Environmental Behavior which was based on Ajzen and Fishbein's theory of planned behavior (Hines et al., 1986-87; Hungerford & Volk 1990; Sia et al. (1985-86). They did a meta-analysis of 128 pro-environmental behavior research studies and found the following variables associated with responsible pro-environmental behavior:
 - Knowledge of issues: The person has to be familiar with the environmental problem and its causes.
 - Knowledge of action strategies: The person has to know how he or she has to act to lower his or her impact on the environmental problem.
 - Locus of control: This represents an individual's perception of whether he or she has the ability to bring about change through his or her own behavior. People with a strong internal locus of control believe that their actions can bring about change. People with an external locus of control, on the other hand, feel that their actions are insignificant, and feel that change can only be brought about by powerful others.
 - Attitudes: People with strong pro-environmental attitudes were found to be more likely to engage in pro-environmental behavior, yet the relationship between attitudes and

actions proved to be weak.

- Verbal commitment: The communicated willingness to take action also gave some indication about the person's willingness to engage in pro-environmental behavior.
- Individual sense of responsibility: People with a greater sense of personal responsibility are more likely to have engaged in environmentally responsible behavior.
- d. Why environmental knowledge does not lead directly to pro-environmental behavior? The Fietkau model
Fietkau and Kessel (1981) use sociological as well as psychological factors to explain pro-environmental behavior or the lack of it. Their model comprises variables that influence either directly or indirectly pro-environmental behavior. These variables are independent from each other and can be influenced and changed.
 - Possibilities to act ecologically [4] (Verhaltensangebote). These are external, infrastructural and economic factors that enable or hinder people to act ecologically.
 - Behavioral incentives (Handlungsanreize). These are more internal factors that can reinforce and support ecological behavior (e.g. social desirability, quality of life, monetary savings).
 - Perceived feedback about ecological behavior (wahrgenommene Konsequenzen). A person has to receive a positive reinforcement to continue a certain ecological behavior. This feedback can be intrinsic (e.g. satisfaction of 'doing the right thing'), or extrinsic (e.g. social: not littering or recycling are socially desirable actions; and economic: receiving money for collected bottles).
 - Knowledge (Wissen). In Fietkau's model, knowledge does not directly influence behavior but acts as a modifier of attitudes and values.

A SOLUTION OF WEB PLATFORM THAT COULD ENGAGE ALL WORKERS IN THE REDUCTION OF THEIR CO2 EMISSION

A) Introduction

This last part is the intelligent fruit of the two previous chapter of this paper. After the analysis of the new CO2 constraints for businesses and the description of barriers that prevent employees to engage themselves in the reduction of their carbon footprint we will propose here a web platform that help employees to act environmentally for the interest of themselves and for the interest of the business.

B. Method

The user experience of the web platform can be divided in three steps.

- The creation of a personal carbon footprint: The employee realizes a 15 minutes survey about his environmental behavior on his working time. The questions will focus on the transportation, purchasing and the utilization of electronic devices. At the end of the survey the employees can have access to the detail of his consumption. Ex: Martyna Lara; 800 kilo CO2/ year in transportation, 400 kilo CO2/year in purchasing and 20 kilo CO2/year in electronic devices. This type of survey already exists for the whole life of an individual (WWF carbon-footprint), however it is needed to be adapt this survey to focus on the working time.
- Selection of environmental actions: According to the previous answer of the employee, the web platform proposes an adapted set of actions to undertake. The employee decides to undertake this action or not and can directly see the impact of this change on his carbon footprint. Ex: Martyna decides to come by public transportation and not by car avoid 200 kilo CO2/year in transportation.
- Comparison of results with other employees and discussions: The employees can compare their results and the progressions of their carbon footprint with other workers. The best competitors have financial rewards.

C. Why these platforms fight the employees' barriers to act environmentally?

The next part is the list of the barriers that are broken by the web platform.

- Knowledge of action strategy and pro-environmental knowledge: The web platform deep dive the sources of consumption and it allows the employee to priorities his actions. It also provides knowledge through the environmental actions it proposes.
- Behavioral incentive: The behavioral incentive is double. First social (people can compare their results with yours) and second financial, the best reductions have a financial reward.
- Temporal discrepancy: A competition between employees is created and the workers are engaged during all the year. Also, the constant advancement of the reduction of their carbon footprint allows them to see the progression of their results in the time.
- Direct experience: The employee gives information about his own life and feel directly implicated in this CO2 emissions reduction. He can concretely see the impact of his actions
- Locus of control: The propositions of action presented by the web platform proof to the employee that easy action can be undertaken to decrease his CO2 emissions.
- Normative influence: The fulfillment of the survey and the engagement in the program will be mandatory and asked by the managers. The company could control the advancement of employees in the reduction of their carbon footprint.

D. Limits of the platform

The platform has two limits. The first one is the lack of control about the validity of actions undertaken by employees. The only source of control comes from the colleagues that can see if the action undertaken by the other employees. A solution need to be found to control it. The second one is the large approximations that are done by the survey.

CONCLUSION

We get here an interesting proposal to engage all workers in the reduction of their carbon footprint. The next step would be to develop the application and to test it in a company to observe if it concretely leads to more environmental actions.

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Environmental Accounting and Reporting – A principled analysis in Indian scenario

Sudhir Kumar Shukla*

Amit Kumar Pandey**

Shivam Shukla***

In recent years, environmental pollution has become a severe issue and the stakeholders are considerably uneasy about the issue which has paved way for the ever increasing concern about the implementation of environmental accounting. The field of environmental accounting has made a gigantic stride in the past two decades, moving from a rather secret practice to the one tested in many countries with a well established framework in a few of them. As far the case of India is concerned it is not mandatory for the corporate entities to reveal the environmental related cost and benefits sans certain industries. Therefore, in India such disclosures are of voluntary nature and are pioneered by corporate social responsibility norms which are mandatory. The prime intention of the study is to unearth the roots and the inclinations of the growth of environmental accounting. In addition, environmental accounting will also be discussed in terms of its contingency to supplement the traditional accounting system in practice. Despite the shortfalls and problems described in this paper, however, there is growing interest in modifying national income accounting system in order to promote sightedness of the bridge between economy and environment. In this paper an attempt has been made to deliberate upon the theoretical foundations of environmental accounting and reporting practices with special reference to Indian companies. Environmental accounting and awareness require more importance as it is the need of the hour.

Keywords: Environmental Accounting and Reporting, SWOT analysis, Corporate Social Responsibility, Listed Companies, Annual Reports, Green Accounts, sustainability reports.

INTRODUCTION

Just because concern regarding environmental safety has become a global purport, managers have become bound to focus their attention on manufacturing biodegradable products that can be recycled again. Also there is an increasing need to have greater control over air pollution, to curtail as much as possible the energy consumption, and exploit natural resources in a prudent way. Managers have to take into notice costs and harm for not complying with the laws concerning the environment. Therefore, they seek information from finance and accounting department, information concerning revenues and expenses. Information pertaining to economy and accounting has to be complicated, objective, and relevant and should be provided perpetually in such a way that it permits speedy and accurate decision making with a low cost incurrence. The developmental activities undertaken by the ongoing civilization generates

immense quantity of wastage with potential ingredients. The disposal of such wastes contributes towards the environmental pollution. Today, the magnitude of environmental pollution is at a distressing level in many parts of the globe. Well-known environmental tragedies like Minamata mercury poisoning in Japan (1956), Bhopal gas tragedy (1984), Chernobyl nuclear-power plant disaster in Ukraine (1986) reaffirmed the significance of environmental protection in the minds of masses.

ENVIRONMENTAL ACCOUNTING DEFINED

Environmental accounting is the practice involving incorporation of principles of environmental management and conservation into reporting practices and cost/benefit analysis. Environmental accounting allows a business to foresee the influence of ecologically sustainable practices in every activity right from their supply chain to facility enhancement. It allows accountants to report on the economic effect of those decisions on stakeholders so as to allow for proactive decision making about processes which simultaneously meet environmental regulations while adding on to the bottom line of the corporate enterprise.

Thus, Environmental Accounting involves the identification, measurement and allocation of

environmental costs, and the unification of these costs into business and encompasses the way of communicating such information to the stakeholders of the organisation. In this sense, it is a comprehensive approach to assure improved corporate governance that includes transparency in its societal activities. Finally, Environmental Reporting can be defined as an umbrella term that describes the various means through which companies disclose information on their current and future environmental activities.

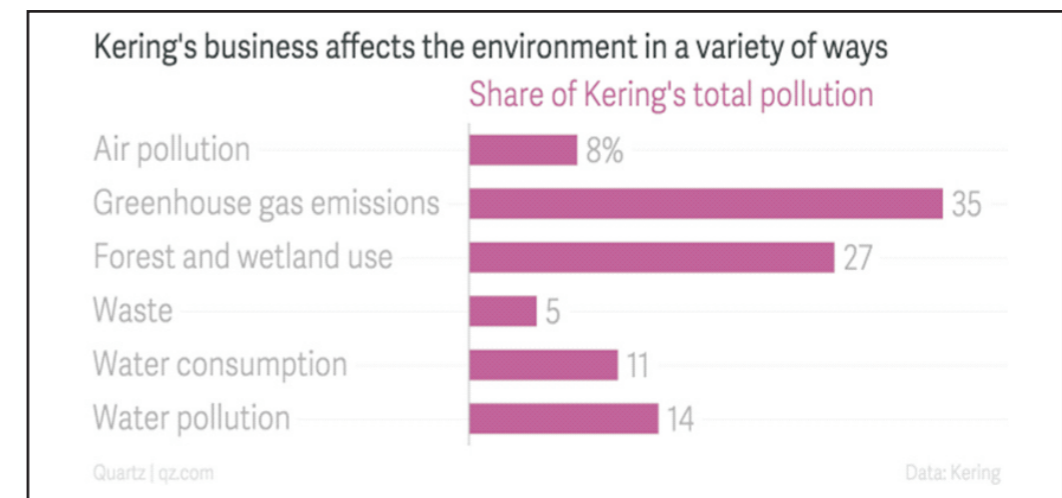
Objectives of the study

- To understand the concept of environmental Accounting;
- To analyze the Environmental accounting and reporting framework
- To identify the issues in environmental reporting in India
- To suggest some measures to overcome the problems in environmental accounting.

Environmental accounting and reporting framework

| | Monetary Units | Physical Units |
|----------|---|---|
| Internal | Monetary Environmental Accounting (MEA) | Physical Environmental Accounting (PEA) |
| External | Monetary External Environmental Accounting and Reporting & Monetary Environmental Regulatory Accounting and Reporting | Physical External Environmental Accounting and Reporting & Physical Environmental Regulatory Accounting and Reporting |

How do businesses affect environment



Source: <http://qz.com/408313/fancier-clothes-arent-that-much-better-for-the-environment-than-fast-fashion/>

The SWOT analysis of the organization on environmental accounting

| Strengths | Weaknesses |
|--|---|
| <ul style="list-style-type: none"> • the economic entities are keenly interested in getting involved in activities concerning the environment; • it is a current field which has a special dynamics of its own; • the selective accumulation of waste and prevention of pollution could create financial resources for the economic entities; • there is a strong competition in the cleanliness (sanitation) services market. | <ul style="list-style-type: none"> • the managers in India do not understand the importance of environmental accounting yet; • there are untrained or semi trained personnel in this field of environmental accounting; • the personnel for the financial - accounting department do not possess enough information about environmental accounting and also lack awareness on how the aspects connected to the environment reflect in the environmental accounting and what impact they have upon the economic entity and environmental politics; • there is not a specific system concerning the environmental accounting which is to be applied at economic entity's level; • the technologies that are used to recycle and to take value from waste or to prevent pollution are obsolete. |

* Professor & Head, Department of Commerce, M.G. Kashi Vidyapith, Varanasi (U.P.) - 221002

** Assistant Professor (Marketing & Sales), Amity Business School, Amity University, Noida (U.P.)

*** Research Scholar (UGC - JRF), Faculty of Commerce, Banaras Hindu University (U.P.) - 221005

| Opportunities | Threats |
|---|---|
| <ul style="list-style-type: none"> the entire legislation of the Government of India concerning the environmental can be applied also at the level of economic entities and particularly for all of them irrespective of their sector of operation; the perspective of the need of a greater number of workers in the environmental accounting in a very coming future – recycling, capitalization, and remediation; the possibilities to bring new and advanced technologies and equipments; the possibility to attract foreign direct investment in the field | <ul style="list-style-type: none"> there are several difficulties in introducing an information system which is time efficient and cost effective; There is need of a significant budget in order to apply environmental accounting and the benefits are not obtained immediately, which attracts a resistance of the economic entity; the correspondent legislation is normally absent and if at all present then very little and treated tangentially. |

Environmental accounting Issues in India and their suggested solutions

| Environmental Accounting Issues | Proposed Solutions |
|---|---|
| Definition of environmental cost and expenses | Environmental costs that do not lead to future expected benefits |
| Environmental costs recognition and measurement issues | Materiality, Measurability and Certainty |
| Capital or revenue allocation problem | Capitalize if it is intended to prevent or reduce future environmental damage or to conserve resources |
| Capitalization of environmental costs incurred subsequent to the acquisition of a capital asset | Capitalize either (i) if the costs result in an increase in expected future income benefits or (ii) if the costs are considered to be a cost of expected future benefits from the assets. |
| Accounting for future environmental expenditure | Where an entity has a legal obligation to incur future costs, the cost involved represents an environmental liability. |
| Accounting for the impairment | Reduce the carrying amount of assets rather than introduce a liability |
| Environmental accounting policy disclosures | All significant accounting policies relating to financial statement items to be disclosed |

Source: GAAP based solutions for some environmental accounting related issue (The Cost and Management, May-June 1998)

Conclusion

Corporate reporting is a key and important vehicle for the corporate bodies to communicate with the external world. With the rise in complexities of the business world the role of information has been gradually and steadily increasing for making correct and pointed economic decision. It is also a recognised fact that due to increase in level of environmental awareness of stakeholder, environmental reporting has now become a part of financial reporting in India. Most of the Indian companies use to report environmental initiative in their annual report. But now majority of listed companies in India are into the process of publishing Sustainability Reports which clearly and adequately encompass the impact of the activities of business corporations on their immediate environment and the community on whose resources they prosper. However, such reporting is mere descriptive and nothing substantial is disclosed about its financial implications and

accounting policy of environmental cost. It is not practically neither possible nor feasible to measure all environmental liabilities and assets in monetary unit. As a result it is not possible to amalgamate all environmental information with existing accounting system at micro level. However, it can be inferred that the internal cost of environment to a firm which have material effect on financial results of the business can be suitably integrated with existing accounting information. For externalities it is possible to have some other quantitative measurement and disclosure. Moreover, due to annihilation of clear guidelines on the part of accounting regulatory bodies, like accounting standard board, Ministry of Corporate affairs etc. on the issue like environmental cost, environment assets and liabilities, recognition and measurement of such cost, assets and liabilities and its disclosure requirement, it is not developed as it is expected by stakeholder. The recent initiative of Ministry of Corporate Affairs (MCA), Government of India, i.e. the National Voluntary Guidelines on Social

Environmental and Economic Responsibility of the business 2011 is also in infant stage. Thus it can be safely assumed that, though environment reporting has been developed in the corporate reporting practices in India, it is found to be lacking in its approach regarding comparability and verifiability, the basic feature of accounting information. So it is expected that in the near future the government and other accounting regulatory bodies will play a greater and more active role in the development of environmental accounting and reporting by making it reliable and relevant to users.

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Consumers' Perception of Responsibility for Climate Change

Rahul Gupta**

The call for move to a lower-carbon economy is pressing strategic challenge widely accredited by policymakers. Poignant to a lower-carbon economy requires measures, including hi-tech innovation, stringent regulation, investments, financial incentives, organisational change, and education. Climate change is also linked to the consumption of private households their choices and behaviours for products. Like all environmental markets, the global 'carbon market' is a creation of regulations. In this paper we have tried to find out consumers perception of responsibility for factors responsible for climate change, and the relation between their behaviour towards their uses of products responsible for climate change and weather their some demographic profile influence their behaviour towards these factors.

Key Words: Climate change, Consumers, Environmental behaviour

INTRODUCTION

Scientific consensus is that economic growth has placed an indefensible burden on the environment. Over-consumption, use and the creation of pollution and waste are degrading the 'ecosystem services', and disturbing survival and well-being (WRI, 2005). The most pressing environmental challenge is to preventing and responds to disruptive climate change; which significantly impacts the global economy. Review by the Nicholas Stern (2006) states that unless 1% of GDP is invested in responding to the climate challenge its consequence could shrink economy by 20% by year 2035. The call for move to a lower-carbon economy is pressing strategic challenge widely accredited by policymakers. Poignant to a lower-carbon economy requires measures, including stringent regulation, hi-tech innovation, investments, financial incentives, education, and organisational change. Climate change is also linked to the consumption of households and their choices and behaviours of products they consume. It has therefore become a focus for academic research, much of which was comprehensively synthesised by Tim Jackson (2005) in his research, *Motivating Sustainable Consumption*. Jackson's synthesis, as such consumer behaviour is multidimensional experience. Influence by their demographics,

values, knowledge, emotions, attitudes, and circumstances.

Scientifically climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. However, from the regulatory perspective, as defined by United Nations Framework Convention on Climate Change (UNFCCC) climate change refers to "A change of climate which is attributed directly or indirectly to human activity that alters the composition of global atmosphere and which is in addition to natural climatic variability observed over comparable periods".

Climate change is an extreme case of externality its origin is in global human activities for production as well as for consumption and its implications is global and long term. Responding to climate change is therefore a global venture governs by international legal, regulatory and institutional frame work and includes business response through fast emerging carbon market globally. Like all environmental markets, the global 'carbon market' is a creation of regulations. The dynamics of global carbon market results from institutions, and specific measures agreed periodically by the nations which are party to the UNFCCC.

There are many dimensions to the climate change-corporate accounting of greenhouse gas emissions (Carbon foot prints), business strategies to include climate change challenges and opportunities in corporate business plan, mitigating greenhouse gas emissions by business.

Various other factors influences consumer behaviour like attitude, perceived self efficacy, and situations. (Bagozzi, et.al. 2002) also researched unconventional, as well as sustainable, consumption contexts. Grob's (1995).

REVIEW LITERATURE

Sustainability-orientated consumer research encompasses a variety of concepts of more sustainable consumption using a range of labels for consumers and their behaviour (including green, greener, sustainable, pro-environmental, ethical, environmentally conscious, ecological Jackson, 2005). Consumers in relation to sustainability concerns to enable markets to be meaningfully segmented (Straughan & Roberts, 1999); types of consumer to understand how they are motivated to consume more sustainably (Jackson, 2005); testing the acceptability of price premiums for more sustainable products (Laroche, Bergeron, & Barbaro-Forleo, 2001); and exploring why there is frequently a significant gap between consumers' reported willingness to consume more sustainably and actual behaviour (Vermeir & Verbeke, 2006). One contentious issue affecting early attempts at profiling consumers and segmenting markets for sustainability were that they were often largely based on sociodemographic variables (Straughan & Roberts, 1999). However, as Schlegelmilch, Bohlen, and Diamantopoulos (1996) the value of using sociodemographic variables became increasingly contentious, particularly given the tendency for different studies to produce inconclusive and contradictory results for particular demographic variables (Kilbourne & Beckman, 1998; Robinson & Smith, 2002). Diamantopoulos et al. 2003 provides a critical review of the literature linking sociodemographics to environmentally orientated consumer attitudes and behaviours and concluded that sociodemographics alone are of limited value for profiling, but are more potentially useful when used in combination with other influences such as values, attitudes, or knowledge. This study builds on this insight by testing the value of sociodemographic variables when used with other sociopsychological variables. Research profiling consumers and segmenting them in terms of sustainable consumer behaviour also has another acknowledged weakness, which is a tendency to focus on individual behaviours (such as recycling or purchasing of a particular type of product) and on specific impacts such as energy usage (Spangenberg & Lorek, 2002). This is problematic because the research literature

indicates that while some types of sustainable behaviour are influenced by factors such as values, others are not. Even amongst those behaviours influenced by values, particular values influenced different behaviours in different ways (Barr, 2007; Corraliza & Berenguer, 2000; Pepper, Jackson, & Uzzell, 2009). Another problem with the overemphasis on individual behaviours and impacts is that it is the cumulative impact of all a consumer's behaviour that is significant. This is demonstrated by the 'rebound effect' associated with behaviours such as energy saving. Reducing domestic energy use apparently lessens a consumer's environmental impact, but if the resulting financial savings are spent on energy intensive goods and services, this may not be the case (Herring, 1999). This paper seeks to gain insight into overall consumer lifestyles and their perception by considering a range of behaviours and by evaluating their effect in relation to climate change.

EVOLVING NOTIONS OF CONSUMER RESPONSIBILITY

CSR has received significant attention academically (Peng, 2009, Jenkins, 2009), an equivalent concept of 'consumer social responsibility', have received relatively little attention (Brinkmann & Peattie, 2008). The marketing literature consider the social responsibility of consumers, it has restricted to the behaviour of the consumer rather than the company, and of consumer deceit rather than positive behaviours (Brinkmann & Peattie, 2008). However, there is an emerging normative concept of the 'citizen consumer', which Gabriel and Lang (1995) define as 'a responsible consumer, a socially-aware consumer, a consumer who thinks ahead and tempers his desires by social awareness, a consumer whose actions must be morally defensible and who must occasionally be prepared to sacrifice.', such a concept of consumer responsibility is still immature in marketing, but other disciplines of social-science such as health, personal responsibility tend to be more prevalent (Attell-Thompson, 2005; Bricas, 2008). Williams (2005) discusses roles consumers play, suggesting an increasing role for consumer social responsibility to complement CSR. Williams suggests, since 66% of consumers believe they can influence a company's environmental and ethical behaviour, they might therefore be prepared to accept some responsibility for how companies behave. He urges the development of a proactive notion of consumer social responsibility that encourages more socially and environmentally

* Assistant Professor Amity Business School, Amity University
Uttar Pradesh

favourable behaviour by companies. This could include information relating to companies' practices and policies (Peters, 2005) and to the consequences of consumers' choices. Consumer response also depends on their ability to understand the information, Shaw and Clarke (1999) note, individuals are often confused about environmental issues and are inconsistent in making connections between an issue like climate change and aspects of their own lifestyles and consumption (Anable, Lane, & Kelay, 2006). Ability to act on relevant information will also depend on the consumer's sense of perceived behavioural control (Armitage & Conner, 2001; Giles & Cairns, 1995) and their wider sense of self-efficacy (Terry & O'Leary, 1995). Rodrigues et al. (2008) and Lenzen et al. (2007) use ecological economics to frame responsibility in terms of ascribing who is accountable for (a) environmental pressure and (b) the environmental impacts of producers or consumers respectively. Munksgaard and Pedersen (2001) sought to ascribe responsibility for CO₂ emissions from a policy perspective. From a marketing perspective, what is more significant is the consumer's sense of responsibility, and how they perceive and ascribe responsibilities for the environmental consequences of products, production impacts, purchase behaviour, and consumption and disposal behaviours. For companies and policymakers seeking to develop more sustainable systems of consumption and production, the role that consumers' sense of responsibility plays in their willingness to engage in pro-environmental behaviour (PEB) is potentially vital and needs to be researched and understood. Kaiser and Shimoda (1999) in discussing the psychology of PEBs stress the need to develop personal responsibility, stating that 'If a person is aware of the consequences of certain behaviour, the ascription of personal responsibility becomes crucial'. Despite the growing emphasis on consumer responsibility, it remains under researched (Carrigan & Attalla, 2001), and is mostly discussed normatively and theoretically (Caruana & Crane, 2008). Relatively little empirical work has built on these ideas, and that which does exist explores the idea with a relatively narrow focus (Wray-Lake et al. 2010). There is an irony that 'environmentally responsible' is one of the more commonly used labels for more sustainable consumer behaviour, when consumer environmental responsibility remains a comparatively under-researched and poorly understood concept.

UNDERSTANDING CONSUMER SOCIO-ENVIRONMENTAL RESPONSIBILITY

Webster's (1975) early extensive exploration of the 'socially conscious consumer' used as the dependent variable a measure of social responsibility, based on a scale developed by Berkowitz and Lutterman (1968) and refined by Anderson and Cunningham (1972). A weakness in the literature is a tendency to consider 'social responsibility' as a broad construct, and to assume that concepts like social responsibility, environmental responsibility, and altruism are interrelated and can be used interchangeably. Tucker, Dolich, and Wilson (1981) sought to break down the differences between general social responsibility and specific individual environmental responsibility. They suggested that individual environmental responsibility was a subset of social responsibility, and the term individual social responsibility can be used interchangeably with altruism or prosocial behaviour. Anderson and Cunningham's (1972) Social Responsibility Scale, the working assumption within marketing scholarship has been that the socially and environmentally concerned consumer will be much the same thing. Another weakness is the tendency for research to focus on consumer perceptions of their personal responsibility in relation to an issue without attempting to understand the perceived allocation of responsibility to others, if consumers feel that others, such as governments or businesses, are more responsible than they are for causing climate change, how would this affect their own behaviour and attitudes? Zacca (2006) observed that the attitude-behaviour gap often noted amongst consumers with strong pro-environmental attitudes was linked to uncertainty about consumer effectiveness combined with an expectation that government should tackle sustainability issues through regulation.

Objective of the Study

The present study will try to explore, examine the following objective:

- To analyze the consumers' environmentally related behaviours
- To analyze Demographic variables and their role in consumers' responsibility orientations

Research Hypothesis

- For analyzing the awareness of environmentally related behaviours among Indian Customers, we attempt to identify the association between consumers' awareness for

environmentally related behaviours, their preference for the purchase with their demographics characteristics.

RESEARCH METHODOLOGY

Data for the present study was collected from the respondents from different respondents at Mall at Bareilly, U.P. India, through a structured undisguised questionnaire, using mainly the questions based on the 5-point Likert scale (e.g. 1. Strongly Disagree, 2. Disagree, 3. Do not know, 4. Agree, 5. Strongly Agree).

Our population area is the Mall at Bareilly city, since they attract customers from different places and constitute of all age groups, educational background and different income classes for their purchases. The sample size for the present study is 248 respondents; the questionnaires were administered personally to the respondents.

RELIABILITY AND VALIDITY

The questionnaire was reviewed by experts in the field and suggestions given by them were incorporated. The result of pilot testing among 50 respondents was studied and necessary amendments were done in order to make questionnaire more valid. The present study had adopted internal consistency analyses, to conduct reliability testing Cronbach's came out to be .692, and the value is high enough to proceed with the questionnaire.

DATA ANALYSIS AND METHODS

Information gathered from different sources after filtration generates relevant data, which is edited and coded subsequently. The data was analyzed and interpreted with the help of SPSS. Hypothesis framed for the research work have been tested with the help of t-test and Chi-square test.

As far as respondents are concerned Service class were 87 (35.2%), Self Employed were 69 (27.9%), Business Class were 91 (36.8%), 11 (4.5%) were in age group of 25 yrs to 35 Yrs, 131 (53%) were 36 yrs to 45 Yrs, 62 (24.7%), 44 (17.8%) were 56 Yrs and above, 160 (64.8%) were male and 87 (35.2%) were female respondents.

Table 1 Independent Samples Test

| | | t-test for Equality of Means | | |
|-----------------------|-----------------------------|------------------------------|-----------------|-----------------|
| | | df | Sig. (2-tailed) | Mean Difference |
| Act on climate change | Equal variances assumed | 245 | .113 | -.401 |
| | Equal variances not assumed | 184.164 | .109 | -.401 |

H01: Demographic variables do not have any role in consumers' environmentally related behaviours and climate change

For gender of respondents as far as t value is concerned value of p is greater than .05, (Table 1) and so we may conclude that there is no significant difference between the means of the two values. For Age group and Profession Anova (Table 2.a and Table 2.b) was performed and we could not find any significant difference among means of different age groups and different professions. Hence we may conclude age, gender and profession has no role to play in consumers' environmentally related behaviours and climate change.

H02: There is no correlation among awareness and act on consumers' responsibility orientations on climate change

The value of correlation among Belief in Climate change and act on climate is .797 and it is highly correlated and we may conclude that respondents who are aware about climate change and they feel that they shall act in their behaviour for their purchase as far as climate change matters are concerned.

CONCLUSION

Research demonstrates a relationship between consumers' environmental responsibility and their environmentally related consumption behaviours. Respondents those who are aware about climate change and they feel that they shall act in their behaviour for their purchase as far as climate change matters are concerned. Consumer environmental attitudes and knowledge are two of the most common factors for concern. Consumers' socio-demographic variables can still be useful in understanding and predicting pro-environmental behaviours, as far as our study is concerned age, gender and profession is concerned, we could not find a role to play in their environmentally related behaviours and climate change. But certainly consumers can help reduce the impact of climate change if they can change what they buy on a regular basis as they are aware about the consequences to the damage to the environment.

Table 2. a Multiple Comparisons
Dependent Variable: Act on climate change
LSD

| (I) Profession | (J) Profession | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|----------------|----------------|-----------------------|------------|------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | -.278 | .307 | .366 | | -.88 |
| | 3 | .042 | .285 | .883 | | -.52 |
| 2 | 1 | .278 | .307 | .366 | | -.33 |
| | 3 | .320 | .304 | .293 | | -.28 |
| 3 | 1 | -.042 | .285 | .883 | | -.60 |
| | 2 | -.320 | .304 | .293 | | -.92 |

Table 2.b Multiple Comparisons
Dependent Variable: Act on climate change
LSD

| (I) Age | (J) Age | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---------|---------|-----------------------|------------|------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | .348 | .597 | .560 | -.83 | 1.52 |
| | 3 | .626 | .623 | .316 | -.60 | 1.85 |
| | 4 | .045 | .641 | .944 | -1.22 | 1.31 |
| 2 | 1 | -.348 | .597 | .560 | -1.52 | .83 |
| | 3 | .278 | .295 | .347 | -.30 | .86 |
| | 4 | -.303 | .331 | .361 | -.96 | .35 |
| 3 | 1 | -.626 | .623 | .316 | -1.85 | .60 |
| | 2 | -.278 | .295 | .347 | -.86 | .30 |
| | 4 | -.580 | .376 | .124 | -1.32 | .16 |
| 4 | 1 | -.045 | .641 | .944 | -1.31 | 1.22 |
| | 2 | .303 | .331 | .361 | -.35 | .96 |
| | 3 | .580 | .376 | .124 | -.16 | 1.32 |

Table 3 Correlations

| | | Belief In Climate change | Act on climate change |
|--------------------------|---------------------|--------------------------|-----------------------|
| Belief In Climate change | Pearson Correlation | 1 | .797** |
| | Sig. (2-tailed) | | .000 |
| | N | 247 | 247 |
| Act on climate change | Pearson Correlation | .797** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 247 | 247 |

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Self-Charging Hybrid moped for changing demography

K. O. Balaji*

Hybridization of two wheelers is in its nascentcy but it ensconces substantial potential. The objective is to design a two-wheeler that would run on both petrol and electric energy thereby reducing the dependence on petrol while cutting down on poisonous gas emissions. There are three modes of operation. The moped can run on petrol, on electricity and even on both. For riding on a slope, one has to use the third mode of operation – both petrol and electricity – thus equalizing the use of both sources of energy. One of its main features is that to recharge the battery, one does not have to plug it in. When the vehicle runs on petrol, the DC motor charges the battery automatically. Normally, it can generate upto 6 volts, but with a voltage multiplier module, it doubles the voltage produced to over 13 volts.

Keywords: Hybridization, self-charging, Voltage multiplier

INTRODUCTION

Hybrids offer a gradual transition from total dependence on fossil fuels to partial independence to switch to an alternative source of energy to drive the conventional mode of transportation. There has been a long standing interest in the field of hybridization and hence early hybrids in four wheeled vehicles has been a success like the Toyota prius, but such an interest in Two wheeled vehicular segment is still in its nascent stages. The ease of housing a large engine and battery is found more comfortably in a four wheeled vehicle than a two wheeled moped. A hybrid vehicle combines any two power (energy) sources. Possible combinations include petrol/electric, gasoline/fly wheel, and fuel cell (FC)/battery. Typically, one energy source is storage, and the other is conversion of a fuel to energy. The combination of two power sources may support two separate propulsion systems. Thus to be a True hybrid, the vehicle must have at least two modes of propulsion.

Therefore the propulsion unit that utilizes energy from two or more sources should be modified in a way to establish smooth transition between one mode of operation from one energy source to the other mode of operation from the other energy source. Coupled with battery issues such as recharging and ports for recharging the battery increase the obstacles manifold. These conditions

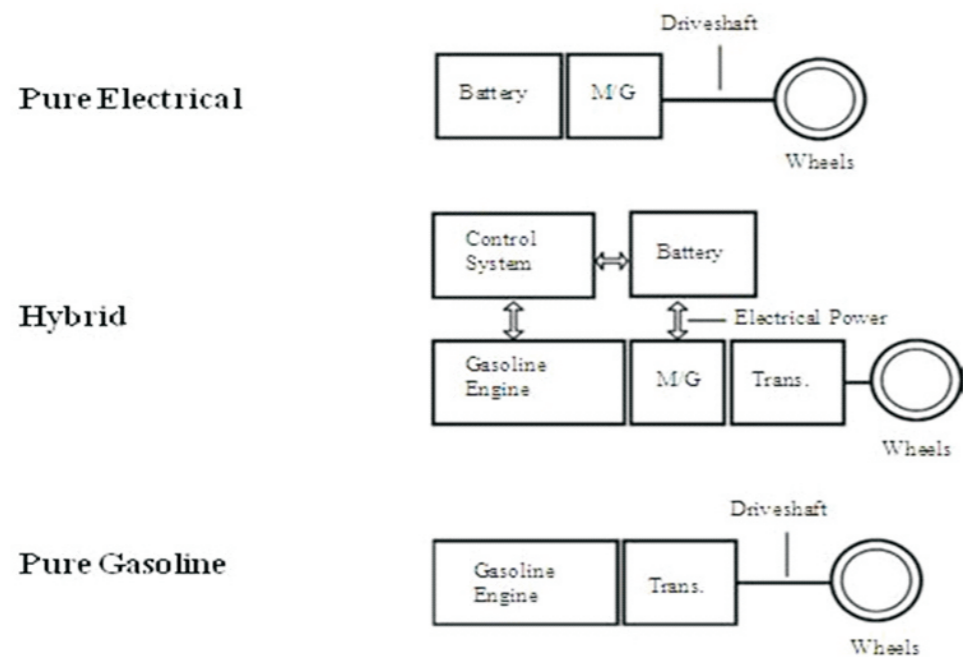
pose a substantive hindrance when it comes to its implementation in a moped. To overcome such an issue, two methods are effective; 1.To design separate propulsion units to drive various sources of energy or 2. To redesign the existing unit to house two modes of propulsion. While the first design is compatible with sedan class cars but incapable of being housed in a moped that has space and weight constraints. The heavier the propulsion units are that are mounted onto the moped, more is the torque requirement to propel the vehicle. In addition to increase in torque that would utilize more energy and subsequent increase in cost makes the separate propulsion systems an inefficient model to be implemented in a moped. In addition to the charging portals for the battery poses a grave logistical and technical issue.

This paper stands to analyze and design a model for a moped that can house two separate modes of operation in a single propulsion unit along with self-charging module resolving the battery recharging issue. Through modification of the wheel hub of the vehicle, a link can be established to derive energy from two separate modes of operation into a single unit to propel vehicle while recharging the battery on the go.

MODEL DEVELOPMENT

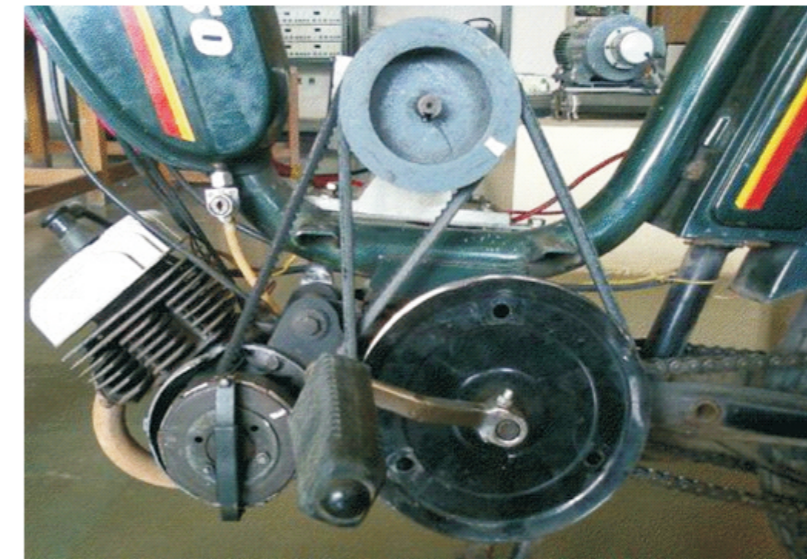
- The vehicle used is a TVS 50 XL moped.
- The devices used for propulsion are :petrol internal combustion engine and DC(permanent magnet direct current) motor.
- There are 3 modes of operation and 2 different sources of energy powering the vehicle.

* *Automation Engineer, HSB electro-Hitech pvt ltd & IEC pvt Ltd Bangalore*



Generic Model of various modes of propulsion

- The modes of operation are:
 - a>when the vehicle is running on the electric motor.
 - b>when the vehicle is running on the petrol engine.
 - c>when the vehicle is running on both electric motor and the petrol engine.
- The sources of energy are: electric energy stored in the battery and petrol.
- When running on electric motor the speed is controlled through the speed control module developed using 555 timer IC working in astable configuration. The technique is called Pulse Width Modulation or PWM.
- When running on the petrol internal combustion engine the battery of the vehicle is charged automatically as the clutch wheel of the internal combustion engine is interfaced with the DC motor. The dc motor acts as generator producing dc voltage which is multiplied or doubled and is limited to 13.5 - 14.00 V DC and fed to the battery for charging.
- The voltage produced by the motor when acting as a generator on normal traffic condition is about 6V DC (minimum) this is multiplied or doubled to around 13V DC using a voltage multiplier module. As the output voltage 6V DC from the motor is variable and increasing with increase in speed of the vehicle the output of the Voltage multiplier module varies directly with variation in motor voltage. ie if the motor provides an output of 6V the output of the voltage multiplier will be 12V and if the output from dc motor is 8V the o/p from the voltage multiplier will be 16V and so on.
- But since the battery requires only 13 - 14V DC to charge and would be damaged if the limits are overshoot we use a voltage limiter which keeps the voltage in limits 13 V dc(min) to 14 V dc (max) hence the battery is recharged without an external source for charging it like at home or stations for example the REVA car is charged using plug at home which consumes more energy which is averted in this project.
- when the torque requirement is more ie when the user has to climb a steep slope there is an option for him to use both the Dc motor and the petrol engine simultaneously. Thereby reducing the usage of petrol with same or more torque as per the requirement.
- the switching between various operations is done using a triple pole switch mounted on the vehicle which switches between dc motor operation ; battery charging operation and both petrol and dc motor operation.
- the max speed of the vehicle when on electric motor = 15 kmph (reduction in speed due to regulations by the RTO , and also due to usage of a 1/2 HP or 373 watt dc motor)
- milleage= 60 km per 6hrs of charging (partially tested).
- petrol engine as per the ratings of the moped



Twin Hub propulsion system

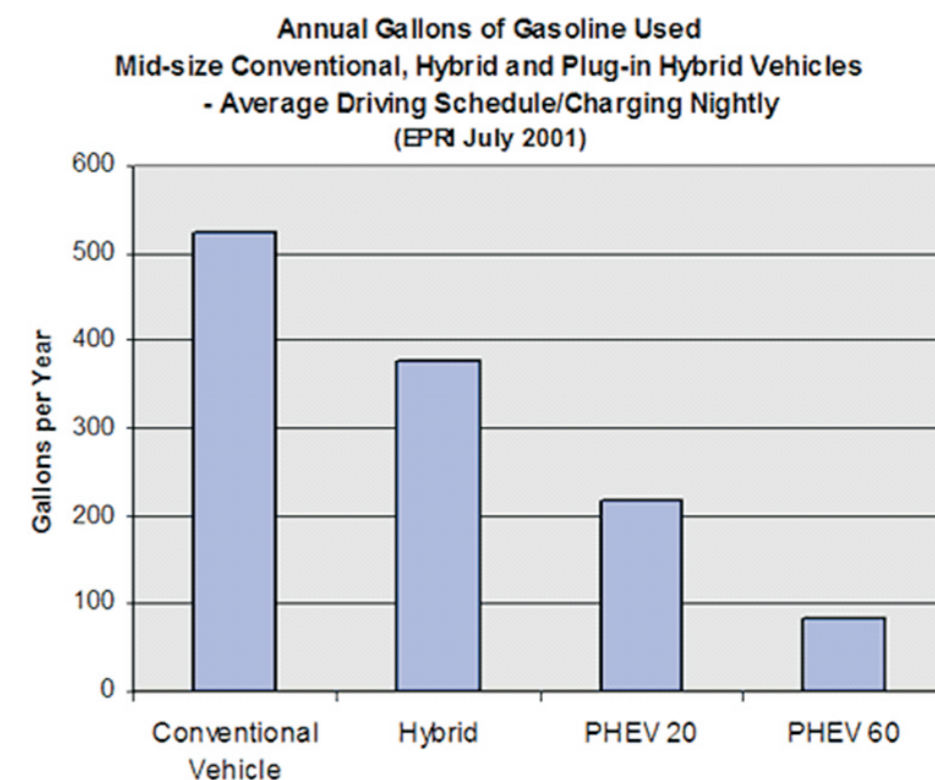
RESULTS

The regular mileage of the vehicle which is about 60kmpl, 2 litres of petrol would deliver 120kms which translates to 5-6hrs of vehicle operation in the internal combustion mode which is sufficient condition for charging the battery to its threshold. Therefore the total distance covered by the vehicle would be 180 kms for 2 litres of petrol (Approximately, under flat road conditions). This does not include additional weight other than the rider and the vehicle itself.

Pollution through vehicular emission is substantially reduced compared to the conventional use of petrol for the entire operation.

NEED FOR SELF CHARGING HYBRID-VEHICLES

Minimal to research in this genre has been undertaken in INDIA but there has been substantial study that has been empirically tested in countries like the united states department of ecology;



Where the plug in hybrid vehicles (PHEV) delivering 20 miles per gallon or 60 miles per gallon which require a dedicated port to charge its batteries, in addition tends to utilize substantial amount of fuel. This can be further reduced in case of Un-Plugged or Self charging hybrids which are charged while on the run. Though not completely eliminating the possibility of a dedicated charging point, the novel design illustrated in this paper has

reduced the fuel consumption directly in form of conventional fuel and indirectly in the energy utilized to charge the 12 volt battery as compared to PHEV's (established through actual field trials).

The poisonous gas emissions are reduced drastically with use of PHEV's as stated by Department of ecology state of Washington:

Total Annual Air Emissions of a PHEV 40 Charged on the NW Grid vs Conventional and Hybrid Vehicles for years 2005 & 2020

| Emissions | PHEV 40 2005 WSCC-NPP | PHEV 40 2020 WSCC-NPP | Conv.Vehicle Bin 8 ¹⁷ | Conv. Vehicle Bin 5 ¹⁸ | Hybrid Vehicle Bin 3 ¹⁹ |
|-----------------------|-----------------------------|-----------------------------|-------------------------------------|---|--|
| CO ₂ (lbs) | 2,668.6 | 2,434.7 | 10,000 | 10,000 | 6,000 |
| SOx | 3.3 | 2.4 | 7.0 | 7.0 | 4.2 |
| NOx | 4.3 | 3.6 | 20.1 | 16.5 | 11.8 |
| Mercury | 0.021 | .00012 | 0 | 0 | 0 |

CONCLUSION

Hybridization of two wheeler through modification addresses the key issues of design, weight, power and pollution. The twin hub configuration make it feasible to operate the moped in triple mode in addition to charging the battery without the help of an external port. Triple mode operation reduces the fuel usage drastically and exponentially increases the mileage capacity of the vehicle. Consequently poisonous emissions are enormously reduced while operating in the electric mode.

The simplex design of the speed control that consists of a 555 timer and subsequent usage of ICL 7660 to multiply the voltage generated by the motor makes it extremely cost effective to be implemented in a low-mid range moped in India. Where the least cost of a hybrid is priced between 65000-75000 this home grown moped might capture larger market share with its competitive pricing and unique utilities.

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<http://www.ecy.wa.gov>

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Business Case for Green Buildings in India

Saurabh Verma*

Anil Kashyap**

Spenser J. Robinson***

Green commercial buildings have been an emerging trend in India cities over the conventional building for more than a decade now since LEED rating systems came to India in the year 2001 in partnership with CII-IGBC. This paper attempts to explore if incremental costs of building green do result in tangible benefits during the life cycle of green building. Indian cities have been engines of growth with more than 60% of GDP contribution which is expected to increase to 75% by the year 2030. Services sector has been a major contributor to the GDP in cities which needs Commercial real estate. Our cities have resource challenges with commercial energy shortage, water demand supply imbalance, significant increase in solid wastes that a building generates and hyperinflation in the price of building materials because of resource-supply challenges. Green buildings globally are considered resource efficient and environment friendly. The green rating systems in India and all around the world claim resource and environment efficiency of green rated buildings but more evidence based research is needed. This papers uses qualitative approach using secondary data analysis and exploratory interviews with green consultants, architects and developers to access if building green has tangible benefits or not. This basic classical ethnographic research method involved secondary data analysis, field visits and conference visits where unstructured interviews were conducted. The paper finds out that green buildings though comes out as resource efficient over conventional building but tangible benefits needs further evidence based research in terms of rental premiums, occupancy rates and energy efficiency savings. There is lack of data for doing quantitative research in this area and this paper recommends data collection and analysis of green vs conventional buildings in the same location. The data collection, analysis and deduction can help validate weather green buildings bring tangible benefits compared to conventional buildings.

Keywords: Green rated building, resource efficient, tangible benefits, incremental costs.

INTRODUCTION

Buildings are responsible for more than 30% CO₂ emission worldwide leading to climatic changes and looking at a rapid urbanization in India; it is set to become world's top two CO₂ emitter by the year 2030. Another facet per Planning Commission, Government of India, India experienced commercial energy shortage of 41% in 2012. We already have water demand supply imbalance which will reach to 50% by 2030 if nothing is done per McKinsey report. Solid waste increased by 50% in 2011 over the last decade. Indian Buildings in our cities consume 30-35% of the total energy produced in the sector where energy demand and supply has huge mismatch. Cities have been engine of growth by contributing 60% to the GDP but face resource challenges and are polluting the environment. Contribution of cities and specially these services sector will increase cities GDP contribution to 75

% by the year 2030.

The coal and fossil fuel dependent Indian economy; resources are limited and energy requirements are projected very high for the future. The amount of construction activity that happened over last decade had taken toll on resources and there is hyper-inflation in the price of cement, sand, steel, glass and other construction materials. There is a need for alternate building materials to reduce supply bottlenecks and resource challenges. As per USAID Eco III Project 2010 the total commercial floor space in India was 659 Msq.m which will increase to 1900 Msq.m by year 2030; with 66% new stock is yet to be built. This will involve hyper consumption of building materials which has supply bottlenecks and resource challenged. Green buildings globally are considered globally resource efficient and environment friendly. My research focuses on commercial real estate sector where 66% of the stock is going to be built by the year 2030. Looking at resources challenges mentioned above its important that new stock is built sustainably in India. In the market place currently there are Green rating system companies that provide systems for designing, construction, maintenance and measurement of green buildings throughout the life-cycle. Rating agencies claim 20 -

* Adjunct Faculty, RICS School of Built Environment, Amity University, F Block, 5th Floor, Amity University Uttar Pradesh, Sector 125, Noida -201313. vsaurabh@gmail.com

** Distinguished Professor, RICS School of Built Environment, Amity University, F Block, 5th Floor, Amity University Uttar Pradesh, Sector 125, Noida-201313. akashyap@rics.org

*** Director, School of Real Estate, Central Michigan University, SL 301, Mt. Pleasant, MI 48859, USA

30% energy savings and 30-50% of water savings and payback period of average five years which are more normative indicators and needs evaluation. Global research has indicated more tangible benefits of green buildings like higher occupancy rates, rental premium associated with green buildings which needs evaluation in Indian conditions.

If incremental costs of constructing green energy efficient rated buildings, is worth the financial benefits in terms of faster payback then market will definitely adapt green practices. Developers, Financial Institutions, Banks and Investors will make significant investments in green if green provides better economic value. Commercial real estate in India has either Build and Sell model or Build, Lease and Operate models. The benefits of green buildings will accrue mostly to later models as most of the benefits of green are monetized when the spaces are leased and the benefits like low energy and water bills, better occupancy rates and better rental bring in economic efficiencies. Currently there are three green rating brands in India after launch of IGBC new rating for green buildings in September last year; which is LEED, GRIHA and IGBC. LEED has been the leader in India with 1883 LEED certified projects and presence since more than a decade in India.

LITERATURE REVIEW

Climate change caused by the release of greenhouse gases has been recognized as one of the greatest threats to modern civilization. Researchers globally have found that buildings were responsible for 33% or 7.85 Gt of greenhouse gas emissions worldwide (Price et al. 2006). The emerging economies in southeast Asia including India, south America, middle east and Africa are expected to exceed the greenhouse emissions from the developed world by the year 2030. The negative effect of emissions on environment and human health has acted as a catalyst for proliferation of green building technology worldwide. The importance of sustainability concepts in the commercial real estate is of vital importance for reducing the negative impact of the built environment on this planet. However, without financial justification and feasibility of the required investments it will be difficult for sustainability to come up in a big way.

In Indian context it's also the shortage of electricity supply over ever increasing demand for electricity. As per Planning Commission report 2013, India witnessed 41% shortage of electricity in the year 2012. Buildings account for more than 41% energy consumption in the developed world (Perez-Lombard, 2008)

and in India the electricity consumed by buildings is more than 30% (Jones Lang LaSalle, 2008) which is increasing every year. India government has made significant investments in power sector in last decade, but the multiplying demand is far ahead of supply challenges and investments needed. The coal and fossil fuel dependent Indian economy; resources are limited and energy requirements are projected very high for the future. The amount of construction activity that happened over last decade had taken a toll on resources and there is hyperinflation in the price of cement, sand, steel, glass and other construction materials. As per USAID Eco III Project 2010 the total commercial floor space in India was 659 Msq. m which will increase to 1900 Msq. m by year 2030; with 66% new stock is yet to be built. In India demand for energy has been forecasted for 40% increase over the next decade. From demand of 630 Mtoe in year 2012 to around 900 Mtoe (U.S. EIA 2013a) in a decade. Indian Government and Ministry of New and Renewable Energy has been actively working on building regulatory obligations and incentivization for energy efficient buildings which needs more awareness and research. The Ministry targets to install 22 GW of solar capacity by 2022, and over 40 GW of new wind power (Ministry of New and Renewable Energy - India, 2012a; GWEC, 2013; GWEC, 2012). The incentive for commercial real estate buildings already exists with capital costs subsidies and electricity tax exemption which should encourage investments. As per researched literature both decentralized, off-grid systems and larger scale, grid connected solar power are recommended highly for Indian conditions. The solar intensity of the sun in India is the highest annual solar energy yield of 1,700 to 1,900 kilowatt hours per kilowatt peak (kWh/kWp) of installed capacity (Germany has an average of 900 kWh/kWp) (McKinsey, 2008, 2013b). Research done on number of solar days available in a year shows that India has about 300 clear, sunny days per year (Muneer, Muhammad, and Munawwar, 2005).

Normative benefits surrounding green buildings focus on what green buildings "should" deliver and impact market value instead of what "actual" it delivers and actual capital values. KatsG (2003) research on 33 green buildings in California concluded there is average incremental cost of \$4/sq. ft for going green based on selected interviews with developers, architect and others which was very less compared to perceived not in of 5 -

15% incremental costs of building green. The productivity, health and operating expenses saving benefits contributed to 85% of savings which were more indicative numbers based on interview with tenants, developers and architects in comparison to having actual numbers supporting green. Many costs and benefits were modeled based on indicative numbers given during the interview. Work done by Paumgartten (2003) and Bartlett and Nigel (2000) also focused on how Sustainability "should" affect market value instead of evidence based actual benefits. Industry and government also developed persuasive business cases surrounding green buildings to give financial justification to the real estate developers, architects, consulting firms, designers and owners of commercial real estate. Few of the research papers on these lines were from US Green Building Council (2003), Frej (2003), Paumgartten (2003), Madew (2006), Luick (2005), RICS (2005), New Zealand Ministry for the Environment (2006, 2007) and Bartlett and Nigel (2000). The industry consulting firms also undertook normative research to show relationship between sustainability and market value which includes JLL (2004, 2007a, b, 2008), Colliers International (2007), David Langdon Consulting (2004, 2007) and CBRE (2007). These studies concentrate on reduced operating costs and increased occupant productivity, employee retention, payback periods and net present value. However, the conversion from "should be" to "what" is has been limited, particularly in the production of evidence to demonstrate the relationship between sustainability and value.

For classifying the various stakeholders' adoption of green and their outlook has undergone evolution. Surveys conducted by JLL and CoreNet (JLL, 2007b) shows very strong sentiments from tenants and occupiers for willingness to pay for sustainability but the actual deals done in the market are evidence of inclination in the market are lacking.

Commercial building developers and Institutional Investors will only build, buy or lease green buildings if the performance and value for money is superior to the conventional buildings. The first step in this cost-benefit analysis is to find what the incremental costs of green building is over traditional counterparts. In the developed world the incremental cost of green certification is around 2-8% based on the green rating certification. Research done in Singapore suggests that green premium is different according to certification level. For a platinum rating it's 4% and for gold rating it's 1.8% (Eang 2008). LEED is one of the popular Green certification measures in the developed world. US General Services Administration (2004) have agreed that green cost premiums range

1 - 8% depending on LEED achieved. Platinum rating in few US researched literature has shown premium of 15% in terms of costs and the literature suggests optimization of the rating and not going overboard with the rating to have return efficiencies so that benefits accrue better (Eichholtz 2009)

Among the developed world literature Eichholtz et al (2008) used regression analysis of rents from a significant sample size of over 8000 properties and concluded green building rental premium of 2% over traditional buildings in nearby location. Wiley et al (2008) conducted modelling that provides evidence that green buildings in the US command higher rent (8% Energy Star and 16% LEED) and higher occupancy rates. Co-star Group (2008) compared 223 Energy Star rated buildings with 2077 Non Energy star buildings. The green rental premium found was 6% over traditional building and over fifteen months' period the average rent grew by 8.2% compared to 7.6% on the traditional buildings. DTZ Research (2008) in Australia and New Zealand estimated the Green Premium rental to be 10-15%. Table I shows the quantitative research work done in US where LEED and Energy star buildings showed significant rental, sale price premium and occupancy rates of green buildings were higher than conventional buildings. Rental premium ranging from 2- 17% and occupancy premium ranging from 1 - 17% is significant benefit which needs assessment and evaluation in the Indian green buildings located at various metros.

METHODOLOGY

The research method followed is basic classical ethnographic research method which involves secondary data analysis, field work and exploratory interviews. The exploratory interviews were unstructured interviews conducted at the stakeholder's office or at the conferences conducted for green buildings where all important stakeholders like rating agencies, architects, green consultants and developers participated. Another purpose of conducting unstructured interview was preparation for structured interviews and variables to be considered during structured interviews as a part of PhD Dissertation on assessment and evaluation of green value in green rated buildings as compared to conventional buildings. Out of 50 unstructured interviews conducted 80% of them were architects and green consultants working on LEED, IGBC or GRIHA rating system. Most of them by qualification are Architects who have completed green certification program with LEED, IGBC or

GRIHA and have delivered projects for developers, institutional clients or government. All the interviews conducted had stakeholders working in the NCR region only and may or may not be carrying project experience of other important metro cities where green buildings are located. Most of the secondary data analysis done was literature provided by green rating agencies and few research agencies actively working on sustainability and green construction. Websites of rating agencies, green consultants and research firms were also actively sourced for finding relevant data and literature for evaluating whether there really exists a business case for green buildings.

INCREMENTAL COSTS OF GREEN BUILDING

CII-IGBC had given indicative numbers of LEED Certified green buildings on its website for few initial buildings that were certified given in Table below.

The first certified building in the country CII-Sorabji Godrej GBC got Platinum rated in 2003 with an incremental cost of 18%. The incremental cost of making building green has come down significantly since then. Passive design strategies are important part of designing green building without much incremental investment. Active design strategy like Solar energy and photovoltaics increases the costs significantly but here too there are lifecycle benefits

realized along with subsidy of 30% available from the government for using solar energy. Green consultants consider cost of green buildings as minimal if the building is in pre-design phase or project phase; has a clear green mandate and experienced integrated teams working on it. Green building construction costs can be the very same as conventional building but in design element there are additional costs involved. During the design phase one add on costs associated with green building is the co-ordination costs where various project design teams work together to put forward a common design, material selection, specification sheet and execution strategy for the green building. Amount of time and teams involved in co-ordination can make the project complex if clearly defined goals are not set in the pre design phase. Also working with experienced teams brings in time efficiencies and decrease in co-ordination costs. As an investor or developer it's important to understand cost-benefit implication of the active green strategy e.g. Solar photovoltaics and financial benefits derived from electricity costs savings. This is important to developers and financiers involved in maintenance and operations of the buildings as well to look into life-cycle savings derived from solar energy. Below table on initial lot of green buildings highlights significant energy costs saving possible which should make the payback period much shorter.

| Name of the Project | City Location | BUA sq.ft | Rating | % Increase in Cost | Payback Period | Year | Solar Power Yes/No |
|------------------------|---------------|-----------|----------|--------------------|----------------|-----------|--------------------|
| CII-Sorabji Godrej GBC | Hyderabad | 20,000 | Platinum | 18 | 7 | 2003 | Yes |
| ITC Green Center | Gurgaon | 1,70,000 | Platinum | 15 | 6 | 2004/2012 | Yes |
| Wipro-Gurgaon | Gurgaon | 1,75,000 | Platinum | 8 | 5 | 2005 | No |
| Technopolis | Kolkata | 72,000 | Gold | 6 | 3 | 2006 | No |
| Spectral Services | Noida | 15,000 | Platinum | 8 | 4 | 2007 | No |
| HITAM | Hyderabad | 78,000 | Silver | 2 | 3 | 2007 | No |
| Grundfos Pump | Chennai | 40,000 | Gold | 6 | 3 | 2006 | No |

Source: CII, 2010

| Name of the Project | City Location | BUA sq.ft | Rating | Normal Building KwH | Actual Building KwH | % Reduction | Actual Savings in Lakhs |
|----------------------------------|---------------|-----------|----------|---------------------|---------------------|-------------|-------------------------|
| CII-Sorabji Godrej GBC | Hyderabad | 20,000 | Platinum | 3,50,000 | 1,30,000 | 63% | 9 |
| ITC Green Center | Gurgaon | 1,70,000 | Platinum | 35,00,000 | 20,00,000 | 45% | 90 |
| Wipro-Gurgaon Development Centre | Gurgaon | 1,75,000 | Platinum | 48,00,000 | 31,00,000 | 40% | 102 |

Source: CII 2010

As per the claims given by the rating agencies 20-30% reduction in energy costs is possible with passive design strategies and 30-50% of water efficiency can be achieved at minimal costs but more evidence based research is needed to prove the same.

This leads to the conclusion that investment in green can definitely bring in efficiencies but the awareness regarding green buildings has to be increased by more evidence based research. The developers specially in north India practice "Ceremonial Greening" instead of having clear mandate for green and one of the main reasons is more evidence based research. Ceremonial Greening is more related to achieving competitive advantage and creating a differentiation in the market to reduce their sales cycle instead of front end investment in green

Also few other benefits associated with green buildings need data based research e.g. Occupancy premium and Rental premium associated with green buildings over conventional and other health and productivity benefits. The conclusion drawn from exploratory interviews suggest that optimal greening can definitely bring in energy and water efficiency without incurring much of costs. An average payback period of three to seven years is achievable with green building done right.

RATING SYSTEMS AND DEMAND FOR GREEN

Currently there are three rating systems prevalent in India along with BEE Star rating for energy efficient building program of Ministry of new and renewable energy. Out of these three rating system LEED has been inexistence since 2001 and earlier was in partnership with IGBC till July 2014. IGBC and LEED parted ways and IGBC introduced its own rating system in September 2014. LEED is considered popular with Businesses and

corporations with MNC clients. IGBC has been gaining momentum recently from various corporate houses after getting their rating system registered with local authorities for various incentives and scheme of local authorities surrounding green building.

GRIHA the very indigenous rating system stated by The Energy and Resources Institute in partnership and endorsement with Ministry of New and Renewable Energy has been very active on the government, institutions and public sector buildings. Currently there have around 400 + registered projects and have been popular with government and institutional clients as GRIHA rating buildings have financing incentive available from Ministry of Finance. Also GRIHA rating has incentives associated with few local authorities like 5% extra FAR and reduced Property taxes. Also there is support available from Ministry of Environment and Forestry where project above 20,000 sq.m have a special window for faster environmental clearance if the project is GRIHA rated. Many consultants during the exploratory interviews found that GRIHA is more suitable for Indian climatic conditions and has more points for water efficiency, an important parameter for Indian cities as compared to LEED. Also GRIHA has elements derived from Indian traditional architecture system where passive design strategies were actively engaged. GRIHA rating is considered more robust by few consultants but there are concerns related to marketability and material selection section of the rating. GRIHA final rating is given to the building only after its occupied for one year where operations and maintenance performance are measured instead of energy simulations based on which LEED rating is given. The incentives associated with GRIHA makes it attractive option whereas LEED's popularity and global brand name makes with successful with businesses which have international operations or aspire to be one.