SUSTAINABLE IMPACT OF SOLAR PHOTOVOLTAIC IN COMMERCIAL BUILDINGS

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Abstract : As the modernisation and economic growth gathered pace, energy use since 2000 has almost doubled and power deficit has been a predominant problem in the state of Karnataka. Solar Photovoltaic technology was introduced in India, to enhance energy security, sustainability and capacity addition by solar power. The objective of the Solar policy in the state of Karnataka, was to promote and develop Solar Rooftop generation and technology, to develop R&D, skill development and innovation in the renewable energy sector. The government policy has led to the wide spread installation of Solar Photovoltaic in the state.
The Karnataka government policy in Solar Photovoltaic is the Reason for Motivation to install Rooftop Solar Photovoltaic in Commercial buildings in Karnataka. The government provides the external motivation by higher tariff for the exported power to the grid, accelerated depreciation and net metering facility. The idea to incorporate Solar Photovoltaic as a renewable energy source to generate power through a green energy and reduce the energy cost has led to a rippling effect in business. This has made an impact on business and there are business advantages associated with it and it has impacted corporate objectives and developed opportunities for the organization. More over no technology is without pitfalls, the technology comes with its own challenges, which is factored into the scenario. The emerging sustainable benefits of Environmental Social and Financial benefits are assessed through Partial least square structural equation model.

Key words: Solar Photovoltaic, Sustainable benefits, Government policy,

1 INTRODUCTION

India, the third-largest economy, with one-sixth of the world's population is undergoing drastic transformation. As modernisation and economic growth gather pace, energy use, since 2000 has almost doubled and power deficit has been a predominant problem in the state of Karnataka, India, with about 5.2% deficit in energy and 6.8% peak deficit in 2015-16 (CEA, 2015-16). Coal, the abundant fossil fuel resource, is the backbone of the Indian power sector amounting to 70% of generation (IEA, 2015).

India being a tropical country, there is a great potential for solar energy as a prominent energy source of the future. The availability and intensity of sunshine for extended hours during the day has worked in favor of the country. India depends on coal for the generation of electricity. To reduce the usage of Coal and to reduce the carbon emission and conserve the natural resources, Government of India launched Jawaharlal Nehru National Solar Mission on October 9th, 2012, with an ambitious target of 175 GW of renewable energy to be implemented in India by 2022 and the contribution from Solar Rooftop is expected to be 40 GW. The target given to the state of Karnataka is to implement 2300 MW by 2022 (Karnataka Solar Policy, 2014-22). In order to set the momentum, the studies in the field are a prerequisite. Government of Karnataka initiated the development through the Solar Policy 2014-2021. Solar Photovoltaic technology was introduced to enhance energy security, sustainability and capacity addition by solar power. The objective of the policy was to promote and develop Solar Rooftop generation and technology, to develop R&D, skill development and innovation in the energy sector. The government policy has led to the wide spread installation of Solar Photovoltaic in the state.

The Karnataka government policy (GP) in Solar Photovoltaic is the Reason for Motivation (RM) to install Rooftop Solar Photovoltaic in Commercial buildings in Karnataka. The external motivation (EM) is provided by the government by higher tariff for the exported power to the grid, accelerated depreciation and net metering facility. The idea to incorporate Solar Photovoltaic is to generate power through a green clean energy source and reduce the use of fossil fuel. This has led to a rippling effect in business. The solar energy has made an Impact on Business (IOB), Business Advantages (BA), Corporate Objectives (CO) and opportunities (OPP) for the organization. The challenges (CHA) of solar implementation and the sustainable benefits of Environmental (ENV) Social (SOC) and Financial (FIN) benefits are assessed in this paper.

2 Theoretical Foundation of sustainable development in Commercial Buildings

In this dynamic world, Businesses organisations are expected to undertake the responsibilities that were earlier considered as the responsibility of the government. Roles such as job creation and environmental protection, which were earlier under the mandate of the government, are now gradually becoming the responsibility of most business organizations. In the modern-day various different factors such as political, technological, economic, legal and social factors affect the nature of business environment. So the business environment acts as the exterior force, that influence the business operations and the organization as a whole (Kotler &Armstrong, 2004).

The political environment to a great extent affects the business of a country. The political outlook, government ideology, policies, and the nature and extent of bureaucracy, the philosophy, the political stability and its foreign policy influences the political environment (Shaikh, 2010). Multinational organizations have become active in strategic corporate social responsibility efforts and philanthropy and these are influencing their core business (Kolk, 2008). If there are policy restrictions for the multinational businesses in the market, this will directly restrict the business operations and growth of these companies. Favourable policies, R&D, and technological advancements (Watanabe et al., 2000; Curtright, Morgan, & Keith, 2008; Park et al., 2013) have made a favourable ecosystem for the development of Solar PV.

Technological advancements influence the market on the whole and affect the development of business in a country. A major development in the solar industry was due to the falling costs of PV modules. Due to the fall in polysilicon prices, technological innovations and the price of consumables, the price of PV Modules have fallen by more than 80 percent since 2008. This has reduced the system costs considerably and has led to the fast-paced implementation of technology.

The quality of technology incorporated in a company and the nature of plant and equipment used, decides the quality of products and services produced in it (Mühlbacher, Dahringer & Leihs, 2006) and the value system of the society is determined by the social environment and this in turn affects the business operations. The Economic factors like country's economic system, economic structure and policies influence the business. The tremendous demand for environmental friendly products and services can lead to new markets (Coburn, 2008). The market has identified that the sustainable buildings with an advanced environmental and social features improves the occupant's productivity and well being. There is a great impact on the costs incurred, operating and capital funds required and rental income along with the health and safety of the occupants (Boyd, 2005). The need for renewable energy in buildings (Kats, 2003) was a long-time requirement of the market to keep up with sustainable living measures, and the government bodies are enforcing business firms to be more duty bound in this aspect (NAAG, 1990).

International conferences and treaties have opened doors to the new sustainable technology. There has been considerable discussions on development versus environment in The United Nations Conference on Human and Environment (UNCHE) which was held in Stockholm in 1972 (Quental et al., 2009; Seyfang, 2003). The development of renewable energy capacities was inspired by the determination to reduce GHG emissions from the energy sector to mitigate global climate change. The countries implementing favourable policy and regulatory conditions for renewable energies has increased worldwide and it has risen from 43 in 2005 to 164 countries in 2015 (IRENA, 2015). Sustainable development goals are determined to promote clean and affordable energy by way of providing access to sustainable and reliable energy by 2030.

There are numerous studies, which indicate the positive impact with respect to the performance of the company and environmental concern. Hart & Ahuja (1996) stated that concern of company on pollution and prevention of emissions are initiatives that has created a positive impacts on return on assets (ROA) of the organisation, and its return on sales (ROS) and the return on equity (ROE) well within two years. The firm's return on assets (ROA) was found to improve as a firm's environmental performance improves (Russo & Fouts, 1997). It was also noticed that organisations with a favorable reputation in environmental protection generated better returns than firms with neutral or bad environmental reputations (Murphy, 2002; White, 1995).

The commercial sector is expected to be the strong driver of the Solar PV industry, Offices and distribution centers are expected to be active contenders for earlier adoption Solar PV as they are determined and equipped to capitalize on the savings generated by the implementation (Millson, 2014). The investment in the technology is justifiable for industry and Commercial Buildings considering their higher structure of tariff, time the energy is used, electricity demand, and easy means to procure funds. The applications in Solar PV on buildings are expected to expand, as it is integrated into the building design and has become a fundamental part of urban architecture and planning. The global potential of solar rooftop PV in cities alone is assessed at 5400 GW. By 2050 this capacity addition can meet up to 30% of the energy needs in cities (IEA & OECD, 2016).

Organizations have started believing in their obligation of social responsibility. (Freeman & Liedtka, 1991; Keller, 1987; Shearer, 1990). Environmental, social and economic benefits are aligned closely with greening of commercial buildings (Dixon et al., 2008; Lützkendorf & Lorenz, 2005) and there is a great opportunity in environmental marketing to achieve this objectives (Keller, 1987; Shearer, 1990). Sustainability attributes also impact the competitive position of property assets in the marketplace (Schumann, 2010). Higher productivity due to reduced absenteeism of workforce (Lützkendorf & Lorenz, 2005) is observed in green buildings.

The financial benefits of sustainable building according to the research findings of (Kats, et al., 2003; Addae-dapaah et al., 2009) are improved tenant retention, enhanced brand and marketing edge, increased share in the market, lesser operating costs, higher net revenue return, mitigation against future regulatory impacts and higher rents, longer lifespans and higher productivity and well-being of the occupants. The intangible benefits include the positive relations and worker satisfaction in green workplaces, which can translate to lesser absenteeism, better health benefits and higher staff retention (Heerwagen, 2000; Too & Too, 2011). Social benefits include improved environment, better access to goods and services, generation of employment, poverty alleviation contributing to a better society (Natarajan &Nalini, 2015). IRENA's *Renewable Energy and Jobs in the Annual Review 2018*, stated that with solar PV installation reaching 9.6 GW in 2017, employment in solar PV has increased by 36 per cent to reach 164,400 jobs, of which 92,400 were in on-grid applications.

In terms of rental rate, it is observed that green offices command about 2% higher rents than other comparable buildings (Eichholtz, Kok, & Quigley, 2010). The added value is attributed to green buildings. (Lorenz et al., 2007). Further exploration is needed on the quantification of the intangible benefits, productivity, improvement, enhanced reputation and their impact on property and product value. Renewable energy use can reduce the depletion of fossil fuels and avoid the impacts on the environment identified with their use (Turkenburg et al., 2012). There are economic opportunities associated with RE as it can lead to green economic growth (Strupeit& Neij, 2017; Dai, Xie, Xie, Liu, & Masui, 2016) and employment creation (Lambert & Silva, 2012; Strupeit, & Neij, 2017; Lehr, Nitsch, Kratzat, Lutz, & Edler, 2008) and help develop a sustainable business model. The sustainability business model theory treats nature as its shareholder and helps to promote environmental stewardship and fulfils the aspirations of the stakeholders than providing Priority to the expectations of the shareholder (Stubbs & Cocklin, 2008).

3 RESEARCH METHODOLOGY

3.1 Data and Sources of Data

The questionnaire has been developed based on the literature review and guided by the opinion of the experts in the field. All the items are measured on the Likert scale. Primary data was collected from the five distribution companies with Roof top Photovoltaic in Karnataka, namely Bangalore Electricity Supply Company (BESCOM), Mangalore Electricity Supply Company (MESCOM), Hubli Electricity Supply Company (HESCOM), Gulberga Electricity Supply Company (GESCOM) and Chamundeshwari Electricity Supply Company (CESCOM). The offices which operate from Commercial Buildings, with grid interactive Solar PV with one year of installed data are considered for the study from these distribution company limits. Office and industry comprise the majority with 44 samples, which are 62.9 % of the total sample size. Others include resorts and other buildings which pay commercial tariff to the government. Secondary data has been taken from articles with sustainability as core ingredient and the incorporation of renewable energy in commercial organisations.

The researcher has used second generation smart Partial Least Square Structural Equation Model (PLS –SEM) to measure the reliability and validity of the data and model fitness and Hypothesis are tested through Bootstrapping method. Effect of each construct is measured by Blindfolding method. Finally the Importance performance matrix analysis (IPMA) for the importance of constructs and the indicator effect is measured.

3.2 Population and Sample

70 respondents were selected from all five distribution companies. Random sampling method has been used to identify the respondents

Table 1: Details of sampling units surveyed

Sampling units	Total Insallatios by DISCOMs (Population)	Serviced capacity in kWp	Sample of Commercial buildings
BESCOM	1238	94000	32
CESCOM, MYSORE	241	6765.95	4
GESCOM	87	10321	8
HESCOM	402	11556.81	12
MESCOM	533	9449.86	14
Grand Total	2501	132093.62	**70**

Source: The table is constructed by the author for the purpose of this study

As per the statistics available with Karnataka Renewable Energy Development LTD (KREDL), on 31st April 2018, the population of Grid connected Solar PV in the state of Karnataka is 2501, amounting to 132093.62 kWp. The sample taken from the different distribution companies are provided in the Table.1.

4 Objectives of the research

The objectives of the study is to find out the following

1. To examine the extent of application of Solar Photovoltaic after the implementation of Solar policy in the state of Karnataka.
2. To analyse the impact of Solar photovoltaic installation on the Environment Benefits for organisations in Commercial Buildings.
3. To study the impact of Solar photovoltaic installation on the Financial Benefits for organisations in Commercial Buildings.
4. To determine the impact of Solar photovoltaic installation on the Social Benefits for organisations in Commercial Buildings.

5 The significance of the constructs and hypothesis development

5.1 Hypotheses for Commercial Buildings

The hypotheses for Commercial Buildings tries to check the association between Government policy (GP), which is the Reason for Motivation (RM) to install Solar PV, through external motivation (EM) by way of policy measures and encouraged the organisations in Commercial Buildings in incorporation of Solar PV, which led to a rippling effect in business by Impact on Business (IOB), Corporate Objectives (CO), Business Advantage (BA), Opportunities (OPP) and Challenges (CHA) which has brought forth sustainable impacts of environmental (ENV) Social (SOC) and Financial (FIN) Benefits to the organisations that has installed Solar PV. Hence the Hypotheses is as follows.

Hypothesis 1 (HI_0) Solar photovoltaic installation has made a significant impact on Environment Benefits for organisations in Commercial Buildings.
Hypothesis 2 ($H2_0$) Solar photovoltaic installation has made a significant impact on Financial Benefits for organisations in Commercial Buildings.
Hypothesis 3 ($H3_0$) Solar photovoltaic installation has made a significant impact on Social Benefits for organisations in Commercial Buildings.

6 Empirical testing and testing procedures

Composite reliability -The reliability and validity of the constructs are evaluated here. For the Composite reliability, also is known as internal consistency reliability, the threshold value of should be equal to or greater than 0 .70 (Henseler et al., 2012). But it's always better to have composite reliability value equal to or greater than .80 (Daskalakis & Mantas, 2008). All the exogenous variables like the Reason for Motivation, External Motivation, Impact on Business, Busiess Advantage, Business Objectives and opportunities and challenges and endogenous variables of Socio economic and Environmental benefits exibit values higher than 0 .80.
Indicator reliability- Indicator reliability is a communality of an item. Indicator reliability may be understood as the square of the outer loading. There should be a threshold value of 0.50 to obtain acceptable values of indicator reliability (Hair et al., 2014). This indicates that a given construct provides at least 50% explanation for the variance of its items. All the exogenous variables like the Reason for Motivation, External Motivation, Impact on Business, Busiess Advantage, Business Objectives and opportunities and challenges and endogenous variables of Socio economic and Environmental benefits exibit values higher than 0.50.
Outer loadings of indicators- Outer loadings of indicators, in reflective measurement models, indicate the absolute contributions of indicators to their respective constructs. PLS-SEM approach calculates outer loadings of indicators by running simple regression models in which a latent construct is an independent variable and a given indicator is its dependent variable. Therefore, while outer loadings of indicators signify the absolute contributions of indicators, indicator reliability signifies the communality of every indicator. For a reflective model, the threshold value of path loadings should be above 0.70 (Henseler et al., 2012). It may be noted that the survey instruments, adopted for this study, eliminated those indicators, which had weak outer loadings and indicator reliability. All the exogenous variables like the Reason for Motivation, External Motivation, Impact on Business, Busiess Advantage, Business Objectives and opportunities and challenges and endogenous variables of Socio economic and Environmental benefits exibit values higher than 0.70.
Convergent validity- To measure the convergent validity the average variance extracted (AVE) is a strongly recommended test (Naylor et al., 2012). Convergent validity is measured with AVE threshold value should be more than 0.50 (McLure Wasko & Faraj, 2005; Wixom & Watson, 2001). Convergent validity indicates the extent of correlation that a particular measure of reflective construct exhibits in relation with other measures of the construct.
This is illustrated in Table 2.

6.1 Summary of the reflective measurement model

The measurement models was run in order to test the reliability and validity of measurement instruments. The summary of the results after running the measurements models for testing the reliability and validity is given in the Table 2:

Table 2: Results summary for Reflective measurement models

Latent Variable	Elements that the indicator capture	Outer Loadings	Indicator Reliability	Composite Reliability	AVE
BA	BA1	0.710	0.504	0.852	0.659
	BA2	0.906	0.820		
	BA4	0.808	0.652		
CHA	CHA8	0.985	0.970	0.985	0.970
	CHA9	0.985	0.970		
CO	CO1	0.945	0.893	0.938	0.791
	CO2	0.931	0.866		
	CO3	0.805	0.648		
	CO4	0.869	0.755		
EM	EM3	0.872	0.760	0.838	0.722
	EM4	0.827	0.760		
ENV	ENV1	0.855	0.731	0.871	0.772
	ENV2	0.902	0.813		
FIN	FIN3	0.945	0.893	0.971	0.871
	FIN4	0.975	0.950		
	FIN5	0.966	0.933		
	FIN6	0.960	0.921		
	FIN7	0.810	0.656		
GP	GP1	0.784	0.614	0.874	0.778
	GP2	0.970	0.940		
IOB	IOB1	0.723	0.522	0.918	0.652
	IOB3	0.711	0.505		
	IOB4	0.924	0.853		
	IOB5	0.804	0.643		
	IOB6	0.808	0.652		
	IOB7	0.854	0.729		
OPP	OPP4	0.791	0.625	0.823	0.700
	OPP8	0.880	0.774		
RM	RM2	0.867	0.751	0.894	0.679
	RM3	0.860	0.739		
	RM4	0.840	0.705		
	RM5	0.719	0.516		
SOC	SOC4	0.951	0.904	0.941	0.889
	SOC5	0.935	0.874		

The exogenous latent variables of the measurement models developed for the study on the role of Solar PV in Commercial Building, like the Government Policy, Reasons for Motivation, External Motivation, and the subsequent Impact on Business, Corporate Objectives and Business Advantage, Opportunities and Challenges in the present study and the endogenous latent variables construct like the Financial Benefit, Environmental and Social Benefit demonstrate high levels of internal

consistency reliability with the threshhold value of 0.80, Indicator reliability with the threshhold value of 0.50, reliability on the outer loading of the indicators with the threshhold value of 0.70 and convergent validity with the threshhold value of 0.50.

6.2 Measurement model assessment: Discriminant validity among latent constructs: Fornell-Larcker criterion.

Discriminant validity can be assessed using Fornell-Lacker (1981) criterion, which is a comparison between the square root of AVE and other latent variables. Therefore, discriminant validity is a measure of the uniqueness of a given construct. The Table 3 demonstrates how the square root of AVE of every latent variable exceeds its correlation with other latent variables.

Table 3: Discriminant validity by Fornell-Larcker criterion

	BA	CHA	CO	EM	ENV	FIN	GP	IOB	OPP	RM	SOC
BA	0.812										
CHA	0.182	0.985									
CO	0.491	0.260	0.889								
EM	0.563	0.259	0.485	0.850							
ENV	0.684	0.088	0.403	0.457	0.879						
FIN	0.467	0.316	0.508	0.603	0.398	0.933					
GP	0.102	0.511	0.366	0.311	0.078	0.356	0.882				
IOB	0.379	0.021	0.611	0.379	0.192	0.515	0.116	0.807			
OPP	0.599	0.015	0.653	0.682	0.553	0.538	0.299	0.542	0.837		
RM	0.541	0.120	0.708	0.544	0.251	0.528	0.401	0.728	0.662	0.824	
SOC	0.398	0.002	0.274	0.524	0.277	0.532	0.316	0.386	0.614	0.635	0.943

The values shown, in the table 3, reveal that there exists discriminant validity among all constructs of the measurement model as the square root of all latent constructs is higher than their correlation with all the other latent constructs. The above criterion, in accordance with the Fornell-Lecker criterion, is considered by researchers to be conservative in assessing discriminant validity (Hair et al., 2014). The amount to which a given construct of the model is distinct from other constructs (Chin, 1998; Hair et al., 2014; Fornell-Lacker, 1981; McLure Wasko & Faraj. 2005). The diagonal values shown in the (Table 3) is the square root value of AVE of the construct, which is higher when compared horizontally and vertically with other constructs values.

7. Results

7.1 Structural model evaluation

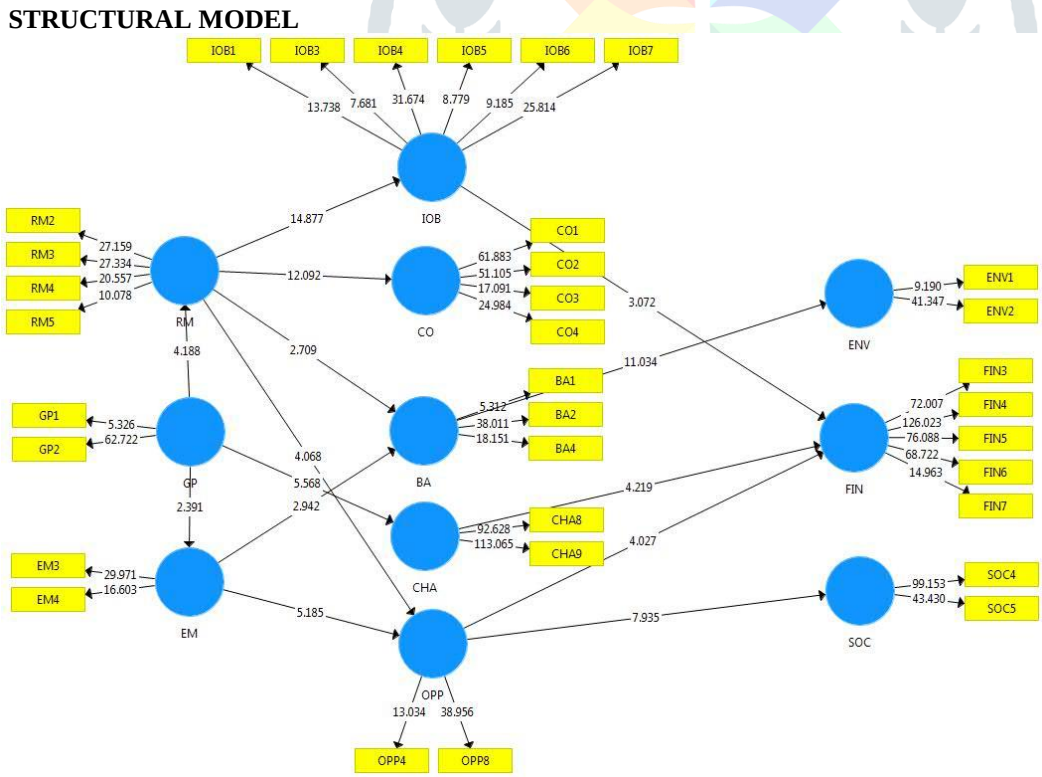

Figure 1: Structural Model

Table 4: Path coefficient, t- values and p-values after Bootstrapping

Relation	Path coefficient	t-value	p-value	Bias-corrected 95% confidence interval
Government Policy → Reasons for Motivation	0.401	4.188	0.000	(0.194, 0.574)
Government Policy → External Motivation	0.311	2.391	0.017	(0.017, 0.528)
Government Policy → Challenges	0.511	5.568	0.000	(0.266, 0.652)
Reasons for Motivation → Impact on Business	0.728	14.877	0.000	(0.617, 0.810)
Reasons for Motivation → Corporate Objectives	0.708	12.092	0.000	(0.574, 0.803)
Reasons for Motivation → Business Advantage	0.333	2.709	0.007	(0.093, 0.576)
Reasons for Motivation → Opportunities	0.414	4.068	0.000	(0.200, 0.594)
External Motivation → Business Advantage	0.382	2.942	0.003	(0.089, 0.604)
External Motivation → Opportunities	0.457	5.185	0.000	(0.280, 0.622)

The path coefficients, t values and p values of Government Policy on Reasons for Motivation, Government policy on External Motivation, Government Policy on Challenges, Reasons for Motivation on Impact On Business, Reasons for Motivation on Corporate Objectives, Reasons for Motivation on Business Advantage, Reasons for Motivation on Opportunities, External Motivation on Business Advantage, External Motivation on Opportunities are given in Table 4. The path coefficient of all the variables is above the threshold value of 0.20 (Table 4). The empirical t value is above the threshold value of 1.96, is found to be important at 5% level of significance

Table 5 –Hypotheses for Commercial Building

	Relation	**Path coefficient**	**t-value**	**p-value**	**Bias-corrected 95% confidence interval**	
Hypothesis 1	Government Policy → External Motivation	0.311	2.391	0.017	(0.017, 0.528)	**Hypothesis** Supported
	External Motivation → Business Advantage	0.382	2.942	0.003	(0.089, 0.604)	
	Business Advantage → Environmental benefits	0.684	11.034	0.000	(0.502, 0.773)	
Hypothesis 2	Government Policy → External Motivation	0.311	2.391	0.017	(0.017, 0.528)	**Hypothesis** Supported
	External Motivation→ Opportunities	0.457	5.185	0.000	(0.280, 0.622)	
	Opportunities → Financial Benefits	0.355	4.027	0.000	(0.169, 0.524)	

Hypothesis 3	Government Policy → External Motivation	0.311	2.391	0.017	(0.017, 0.528)	**Hypothesis** Supported
	External Motivation→ Opportunities	0.457	5.185	0.000	(0.280, 0.622)	
	Opportunities → Social Benefits	0.614	7.935	0.000	(0.443, 0.750)	

In the three hypotheses of Commercial Building, the first hypothesis stating that Solar photovoltaic installation has made a significant impact on Environment Benefits for organisations in Commercial Buildings are supported here. The government policy of net metering and loans at lesser rates as priority lending has motivated the grid connected solar PV installation through external motivation of accelerated depreciation and financial benefit due to lesser electricity bills as benefit. This has led to Business advantage, that Solar PV helps to hedge over future rise in energy cost and by reducing the operating cost of the organization and by generating clean green energy. This has led to the environmental advantage, as Green Energy benefits the community surrounding the organization as the organisation is using carbon free fuel as the fossil fuel adversely impacts climate. Hypothesis 1 is supported here as the path coefficient of all the variables is above the threshold value of 0.20 (Table 5). The empirical t value is above the threshold value of 1.96, is found to be important at 5% level of significance.

Similarly, the second hypothesis stating that Solar photovoltaic installation has made a significant impact on Financial Benefits for organisations in Commercial Buildings are supported here. The Government policy of net metering and loans at lesser rates as priority lending has motivated the grid connected Solar PV installation. The main influencing factor that effect the Financial Benefit is the challenges, that the lack of appropriate rooftop structure and area can impact further installation of the company and Lack of Shadow free area can limit installation is indeed a great influencing factor. If the deciding initial requirement such as these are not available, then the installation itself is not possible. This can be justified as Commercial Buildings are vertical high rise structures, mostly in the urban areas, which may have multiple floors with lesser floor area in a single floor. This may lead to lack appropriate area on the rooftop, as many objects like a generator or lift room or water tank that are already occupying the present available area. Hence challenges plays a major role in on the extend of realisation of financial benefit in a Commercial Building. Hypothesis 2 is supported here as the path coefficient of all the variables is above the threshold value of 0.20 (Table 5). The empirical t value is above the threshold value of 1.96, is found to be important at 5% level of significance.

The third hypothesis stating that Solar photovoltaic installation has made a significant impact on Social Benefits for organisations that working out of Commercial Buildings are supported here. The Government policy of net metering and loans at lesser rates as priority lending has motivated the grid connected Solar PV installation. The main constructs that initiates the social benefit are opportunities that states that SPV contributes to eco- friendly processes and eco friendly processes do not pollute the nature and hence is good for the community that resides near these Buildings and consumer preference for companies using renewable energy are high. As environmentally friendly consumer is willing to spent that extra amount of money to buy eco-friendly products. In the social construct it is observed that that the employees have a sense of pride in working for these organisations and they have personal involvement in the whole process. Hence the third hypothesis is supported here as all the path coefficient is above the threshold value of 0.20 (Table 5). The empirical t value is above the threshold value of 1.96, is found to be important at 5% level of significance. The strong association between the corresponding exogenous latent variable to the endogenous latent variables are demonstrated and the Hypotheses 1, 2 and 3 for Commercial Buildings stands proved by the table 5.

8. Importance- Performance matrix analysis- Constructs wise

In the IPMA map for exogenous and endogenous latent variables, On the X axis, “Importance” is measured which reveals total effect. If the total effect of any construct is higher than another construct then that construct is more significant. On the Y axis, “Performance” is measured and if a construct has higher mean value then that construct has higher performance which reflects solid measurement paths (Hair et al., 2014; Rigdon et al., 2011; Völckner et al., 2010; Schloderer et al. 2014). The values of total effects (importance) and index values (performance) are given in Table 6

Table 6: Total effects and index values of latent constructs

Latent constructs	Importance (Total effects)	Performance (Index values)
ENVIRONMENTAL BENEFITS		
BA	0.684	76.692
EM	0.261	57.610
GP	0.173	69.929
RM	0.228	60.698
FINANCIAL BENEFITS		
CHA	0.318	62.642
EM	0.162	57.610
GP	0.368	69.929
IOB	0.329	49.028
OPP	0.355	57.199
RM	0.386	60.698
SOCIAL BENEFITS		
EM	0.280	57.610
GP	0.189	69.929
OPP	0.614	57.199
RM	0.254	60.698

It is clear from the IPMA analysis, that regarding Environmental Benefits construct, IPMA analysis (Table 6) shows that Business Advantage has high total effects (Importance) in Importance as as well as high index value (performance) in comparison with the other exogenous latent variables. Similarly, in Financial Benefits construct IPMA analysis (Table 6) shows that Reasons for Motivation has high total effects (Importance) and Government Policy has high index value in comparison with the other exogenous latent variables. With regard to Social benefits construct IPMA analysis (Table 6) shows that Opportunities has high total effects in and Government Policy has high index value in comparison to the other exogenous latent variables.

8.2 Importance- Performance matrix analysis- Indicators wise

The important – performance matrix analysis (IPMA) gives us an idea regarding the relative importance and performance of exogenous constructs indicators in their relationship with endogenous construct indicators. Total effects of exogenous constructs indicators represent their importance, while their index values represent their performance.

Table 7 : The IPMA of the exogenous constructs indicators of this study

Latent constructs	Importance (Total effects)	Performance (Index values)	Importance (Total effects)	Performance (Index values)	Importance (Total effects)	Performance (Index values)
	ENVIRONMENTAL BENEFITS		**FINANCIAL BENEFITS**		**SOCIAL BENEFITS**	
BA1	0.232	75.714	NA	NA	NA	NA
BA2	0.294	73.810	NA	NA	NA	NA
BA4	0.314	80.357	NA	NA	NA	NA
EM3	0.164	62.381	0.080	62.381	0.176	62.381
EM4	0.143	50.714	0.055	50.714	0.153	50.714
GP1	0.053	66.786	0.092	66.786	0.058	66.786
GP2	0.135	71.071	0.252	71.071	0.148	71.071
RM2	0.078	46.667	0.100	46.667	0.087	46.667
RM3	0.065	55.000	0.074	55.000	0.073	55.000
RM4	0.064	62.857	0.095	62.857	0.071	62.857
RM5	0.070	72.857	0.133	72.857	0.078	72.857
CHA8	NA	NA	0.142	51.429	NA	NA
CHA9	NA	NA	0.145	73.571	NA	NA
IOB1	NA	NA	0.040	42.143	NA	NA
IOB3	NA	NA	0.050	53.623	NA	NA
IOB4	NA	NA	0.072	49.643	NA	NA
IOB5	NA	NA	0.050	41.786	NA	NA
IOB6	NA	NA	0.049	41.786	NA	NA
IOB7	NA	NA	0.062	60.714	NA	NA
OPP4	NA	NA	0.202	60.476	0.319	60.476
OPP8	NA	NA	0.141	52.500	0.410	52.500

Regarding Environmental Benefits construct, IPMA analysis Table 7 shows that Construct Business Advantage indicator BA4 solar PV generates clean green energy has high total effects (Importance) and Index value (performance) in comparison with the other exogenous latent variables. Similarly, the Financial Benefits construct, IPMA analysis table shows that Construct Government Policy indicator GP2 government initiatives like net metering have high total effects (Importance) and Index value (performance) in comparison with the other exogenous latent variables. With regard to the Social Benefits construct, IPMA analysis table shows that Construct Opportunities indicator OPP8 high customer preferences for companies using renewable energy has high total effects (Importance) in comparison with the other exogenous latent variables and RM5 environmental friendly processes are important for the company has high index value.

FINDINGS

Government policy has directly influenced the installation, as there is a significant rise in the installed Solar PV capacity after the introduction of the solar policy. The Grid connected Solar PV in the state of Karnataka has risen to 2501, amounting to 132093.62 kWp. It is also clear that government policy has played significant apart in influencing the Business Advantage and creating the environmental benefit and net metering policy of the government has induced the financial benefit. Financial benefit is also closely influenced by challenges of the lack of shadow free area that can limit installation. Even if the organisations are willing to extend the adoption of Solar PV, this is restricted by the non-availability of shadow free area. Social benefits are also influenced by Government policy and the status as a green enterprise, as it was observed that when environmental friendly processes are important for the company, the environmental concerns gives rise to social benefit. Hence it is can be stated that Government policy has brought in significant impact on the financial, social and environmental benefits to the organisations which has installed Solar PV.

Conclusion

When the solar policy was introduced in 2014, the end users with grid connected Solar Photovoltaic, who exported the power to the grid was paid at the rate of was Rs 9.56 per unit, which was very high when compared to other states. Then Karnataka Electricity Regulatory Commission (KERC) in May 2016 reduced the tariff for solar plants of 1kw to 10 kw capacity with subsidy from Rs 9.56 to Rs . 7.08. Two years later in May 2018, it once again revised the tariff to Rs 3.56 per unit. But soon back tracked this move and increased the tariff marginally from 3.56 to 4.15 per unit in Dec 2018. The tariff paid by the commercial buildings are the highest energy tariff in Karnataka. Hence they stand to gain from the installation of grid connected solar PV as they may escape from the yearly escalation of tariff, which is being increased at 4% every year (Kunnath & Bagrecha, 2015), and also have power at a lower cost than the present KERC rates and a possible profitable idea after the break even, as the firms break even early with accelerated depreciation and the electricity produced after the breakeven period will be absolutely free of charge and may cut down the operating cost of the organisations considerably.

Energy plays a large part in the price of the product or service and sustainable development is a booming business opportunity, as it opens up better opportunities and also enables environmentally conscious 'green consumers' with sustainable and wiser products. The organisations that work out of these green commercial buildings, will be accepted as of environmentally conscious developers of safer products and processes and organisations that invest in sustainable practices will come across as those that engage themselves in social well-being that generate lesser carbon footprint. These enterprises will have greater competitive advantage and they will be able to attain the good will of the local community and can see the ripples of their efforts reflected in their triple bottom line.

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