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HOW CARBON PROJECTS CAN ADD TO SUSTAINABLE DEVELOPMENT GOALS OF INDIA', AN ASSOCIATIVE STUDY OF CDM PROJECTS

Keywords: carbon credit risk, energy sector, clean development mechanism, sustainable development goals, India.

J E L Classification: O31, O13, Q01, Q56.

Abstract: Growing concerns of climate change have necessitated a re-examination of business activities and their viability, not only from a financial viewpoint but also so-

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cial as well as environmental dimension, popularly known as the 'Triple Bottom Line approach'. The paper is an attempt to bring around the focus on Clean Development projects that deal with carbon credit in India. The sector is a niche in its numbers but huge in potential. This study mainly examines the CDM project risk associated with carbon credit in the organizations from energy sector that had registered and implemented CDM projects in Gujarat. The analysis is based on purposive data collected for large--scale CDM projects. Statistical analysis was done through non-parametric tests named descriptive analysis, Spearman correlation analysis, and Mann-Whitney U test applied. Analysis of the result reveals that all the enlisted risk has a high degree of association with large scale projects. Correlation results indicated that all kinds of carbon risks have a meaningful positive relationship with each other irrespective of the phase of the CDM project. Type of organizations (public/private sector) also creates differences in CDM project risks. The findings of the research will assist managers in decision-making about carbon emission project risks.

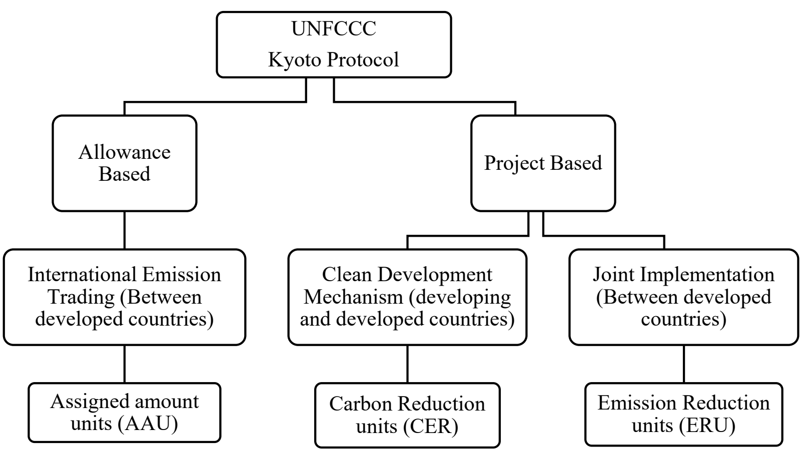
Introduction

Global warming refers to the compounding effect that anthropogenic greenhouse gas emissions on a natural atmospheric warming phenomenon called the greenhouse effect (Hansen, 2008). In recent years, climate change has become the most important environmental problem. The changing ecosystems affect physical and biological systems and a rise in the temperature causes the extinction of species and would harm society and human health (Kolk & Pinks, 2009). The scientific mainstream guardedly predicted gradual change, with deep effects in the mid-term; increasingly, scientists encounter the signs of climate change manifest in real and present hurricanes, melting polar ice caps, and drought in the Amazon. It is estimated that under current emissions trends, by 2100, the average temperature will increase between 4° and 7°C, with potentially catastrophic social and environmental consequences, including rising sea levels, inundation of coastal cities, and large-scale ecosystem transformations (Moutinho & Schwartzman, 2005). The threat of human-induced change to the Earth's climate due to increased emissions of greenhouse gases (GHGs) is one of the greatest challenges confronting the international community. Both anthropogenic emissions (emissions related to human influence) of GHGs and their concentration in the atmosphere are increasing (Breidenich, Magraw, Rowley & Rubin, 1998). Though, global platforms putting their efforts to delay the global warming effects results in transitioning to a lower-carbon economy and it requires participation from all economies which are highly contributing to carbon emission.

Developing economies are potential markets to invest in energy supply technologies and so, will be a most critical factor in low-carbon future market. That is why it is very important to encourage low-carbon investment in these economies for an effective global climate policy (Hultman, Pulver, Guimaraes, Deshmukh & Kane, 2012; Pettersson, 2018). In September 2015, the General Assembly adopted the 2030 agenda for sustainable development that includes 17 Sustainable Development Goals (SDGs). The objective was to produce a set of universal goals that meet the urgent environmental, political, and economic challenges. Ziółkowska (2018) indicated that sustainable development is about the use of solutions based on institutional arrangements as well as ethic-and-moral governance leading to a balance among the economic, social, and ecological spheres. This study focuses on the seventh sustainable development goal (SDG 7), i.e. affordable & clean energy. Among various states in India, Gujarat is the front runner in achieving this goal by 2030 with enhanced international co-operation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency, and advanced and cleaner fossil-fuel technology, and by promoting investment in energy infrastructure and clean energy technology.

United Nations Framework Convention on Climate Change (UNFCCC) stresses finding out ways and means to control tropical deforestation and forest fires, both to prevent dangerous interference in the climate system, and to achieve sustainable development in the tropics (Moutinho & Schwartzman, 2005). In 1990, United Nations Organization (UNO), to decrease the emission of greenhouse gases into the atmosphere, released the Kyoto Protocol (Chotalia, 2013). In the year 2005, all the world's nations met in Kyoto in Japan in 1997 to discuss global warming. As an outcome, Kyoto protocol came into force (which was agreed at the Earth Summit at Rio-de-Janeiro in 1992); its implementation got delayed for more than 7 years because there were difficulties in obtaining the necessary number of ratification from the countries, who accounted for 55% of carbon dioxide as compared to emissions level of the year 1990. There is valuable impact on global market by greenhouse gas emission market (IISD, 2009). As a result, under the UNFCCC, industrialized nations entered into a legally binding agreement to reduce the collective emissions of greenhouse gases (GHGs) by 5.2% as compared to the 1990 level; calculated at an average over the five years of 2008–2012 (Chotalia, 2013). It provides legally binding emissions targets for Annexure I countries, based on a five-year budget period. UNFCCC has defined the Kyoto protocol mechanism which is presented in figure 1. The framework of Kyoto Protocol defines three mechanisms for greenhouse gases (GHGs) emission such as Joint Implementation (JI), Clean Development Mechanism (CDM), and International Emission Trading (IET). The CDM and JI are international credit mechanisms to limit GHG emissions. (UNFCCC, 2011; Shah & Baser, 2016). The association between Annexure I and Non-Annexure I country parties defines in CDM mechanisms (Sarkar & Dash, 2010). It provides flexibility concerning the parties' national implementation of their commitments (Breidenich et al., 1998). Moreover, it also allows flexibility in the international context by providing for the use of emissions trading and other market-based mechanisms, including mechanisms for cooperative projects between developed and developing countries. The carbon trade allows countries that have higher carbon emissions to purchase the right to release more carbon dioxide into the atmosphere from countries that have lower carbon emissions. Emissions trading or Cap and trade include the International emission trading between developed countries (Sivasangari & Rajan, 2016).

Figure 1. Kyoto Protocol Mechanisms



Source: UNFCCC, 2011.

India, one of the fastest-growing economies which has witnessed accelerated economic growth since the early 1990s, initiated economic reforms aiming at market orientation and globalization. It supported the improvement in the environment for businesses and foreign investment, and growth-focused policies, the average economic growth rate between 2005 and 2010 increased to over 8%, but was also accompanied by higher energy consumption. As per IEA report 2020, India has set a target growth rate of 9%, which would place it on a path towards becoming a $5 trillion economy by 2024–25 and to make India, the fastest-growing economy in the world. India's sustained economic growth is placing an enormous demand on its energy resources, energy systems, and infrastructure development (IEA, 2020). India's integrated energy policy assumes an 8% average growth rate for India between 2007 and 2032 (Shukla & Chaturvedi, 2012; GoI, 2006). Various studies discussed the importance of carbon risk. Hultman et al. (2012) analyzed firms' perceptions towards carbon market risk and rewards in Brazil and India. The results show that international regulatory jeopardy, financial benefits, and uncertain revenue stream play a major role in CDM project risk. Carbon emission reduction being one of the greatest challenges to businesses risk of firms in the carbon-intensive sector stalling or even abandoning investments in low emitting carbon projects continues to loom (Linares & Pérez-Arriaga, 2009). However, Aifuwa (2020) reported that sustainability disclosure level was poor in developing climes compared to other developed climes. The transfer of low-carbon technologies to developing countries has a key role to play in reducing carbon emissions associated with future economic development. To achieve this, it requires both vertical and horizontal technology transfer and must facilitate a broader process of technological change and capacity building within developing countries (Ockwell, Watson, MacKerron, Pal & Yamin, 2008). Butterworth, Subramaniam and Phang (2015) also analyzed carbon risk management with focusing on energy firms of Australia. There is a large number of studies reporting the impact of carbon risk on financial performance. Majority of the studies focused on carbon emissions, carbon risk exposure by firms with mainly focused on carbon-intensive industries, has become one of the dominant themes for business (Labatt & White, 2007; Hoffmann & Busch, 2008; Butterworth et al., 2015). According to Clarkson, Li, Pinnuck and Richardson (2015), before formal implementation of regulations, a firm should minimize the impact of carbon risk by utilizing external source of finance to cover the cost of carbon emissions. The initiatives taken for development of carbon-related regulations and policies, firms are more likely to internalize the cost of carbon emissions making carbon risk a significant business consideration. Past research examined carbon risk at the global platform, but very limited studies addressed the issues related to carbon risks of the Indian economy with a focus on energy sectors. The present study attempts to fill this gap, specifically in the Indian context, and tries to access the CDM project risk focusing on the energy sector.

The research questions this study attempts to answer are:

RQ_1: What is the need for renewable energy sources for energy generation in India?

RQ_2: What is the taxonomy of risk associated with CDM projects?

RQ_3: Are risks associated with CDM projects interrelated?

RQ_4: Does carbon risk vary regarding ownership of organization (Public/Private)/ methodology (Solar/Wind) of CDM projects?

The rest of the paper is organized as follows: section 2 discusses the theoretical review of literature focusing on the energy sector scenario in India and carbon risk. Section 3 outlines the research methodology and process. Section 4 presents an analysis of the data followed by a discussion of results and the final section concludes the study with its implications and states directions for future work.

Theoretical Review of the literature

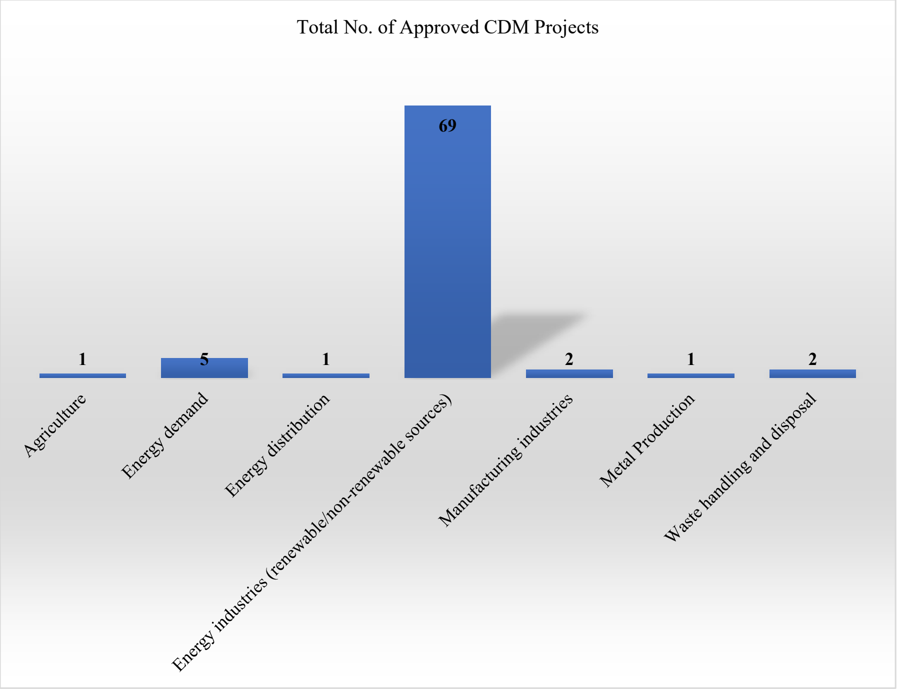
Energy sector scenario in India

Energy is a basic human need. Developmental statistics confirm a strong correlation between energy consumption and economic development (TERI, 2004). The world became a global village due to increasing daily requirements of energy by all populations across the world, while the earth cannot change its form. The need for energy and its related services, to satisfy mankind's social and economic development, welfare and health, is increasing day by day (Owusu & Asumadu-Sarkodie, 2016). To meet the energy requirements, the role of renewable energy has become crucial for the power generation, accessibility and reducing consumption of non-renewable energy sources. This will help India to achieve its low carbon development path. Ahead of the Conference of Paris (COP) 21, India submitted its post-2020 climate actions plan to the UNFCCC. India's INDC builds on its goal of installing 175 gigawatts (GW) of renewable power capacity by 2022. It also supports the need for renewable energy (MNRE, 2019). Parikh, Panda, Ganesh-Kumar and Singh (2009) analyzed carbon emission in the energy sector in India focusing on household final consumption.

Lifestyle differences across household expenditure classified into the urban top ten percent account for emissions of 4099 kg per capita per year, while the rural bottom ten percent account only for 150 kg per capita per year. Abdullahi (2015) emphasized renewable energy sources as an important alternative source of energy generation. Shukla (2007) analyzed energy sector in India taking time series data to study the issues of energy consumption and supply CO_2 emissions, applying the I-O model (Input-Output model). In India, thermal power is a major source of energy generation with renewable energy contributing about 21.95% to it. This shows that there is an untapped market available that can help to delay the critical crisis of global warming.

In India, the Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters which deal with new and renewable energy. The use of renewable resources of energy is rapidly increasing worldwide. The economy has started generating electricity from various renewable sources including hydropower, wind, solar, and bioenergy. The Government has defined renewable electricity targets considering short and medium term. It was estimated that the country will be able to install 175 GW capacity renewable energy (IEA, 2020). As per report published by IEA (2020), GoI plan to increase renewable capacity to 275 GW by 2027 (IEA, 2020). The Prime Minister of India announced a new target of 450 GW of renewable electricity capacity, without specifying the date (IEA, 2020). As of November 30, 2020, the installed renewable energy capacity stood at 90.39 GW, of which solar and wind comprised 36.91 GW and 38.43 GW, respectively. Biomass and small hydropower constituted 10.14 GW and 4.74 GW, respectively. Power generation from renewable energy sources in India reached 127.01 billion units (BU) in FY20. It is expected that by 2040, around 49% of the total electricity will be generated by renewable energy as more efficient batteries will be used to store electricity. At the same time, due to the increasing population and environmental deterioration, the country faces the challenge of sustainable development. The gap between demand and supply of power is expected to rise in the future (Kumar & Majid, 2020). Graph 2 also represents the number of CDM projects registered. Energy Industries also contributes to 85% of the total no. of CDM projects.

Figure 2. Number of Approved CDM Projects in India

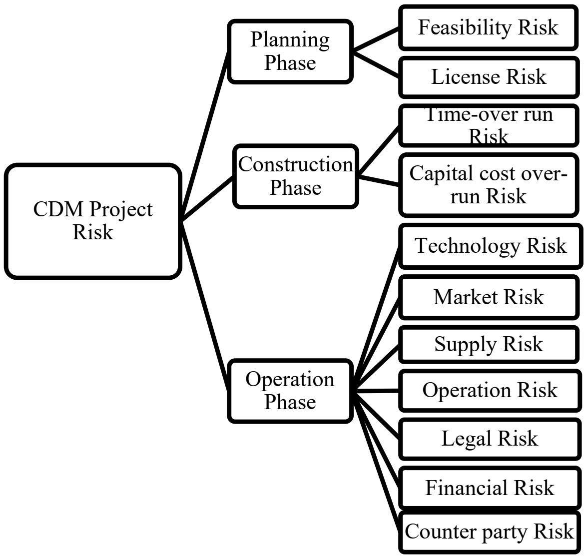


Source: NCDMA Authority, 2021.

Carbon Risk

Yu and Tsai (2018) examined entrepreneurs' carbon reduction behavior on their sustainable development from high-carbon-emission industries in China. There is positive influence of carbon emission by firms and significantly influence firms sustainable development (Yu & Tsai, 2018). Wang and Choi (2016) examined the impact of carbon emission reduction mechanisms on uncertain make-to-order manufacturing. Market-based characteristics of the cap-and-trade mechanism motivate firms with economic benefits to adopt low-carbon technologies and environmental-friendly facilities to curb greenhouse gases emission. In contrast, administrative issues and outdated technologies negatively impact carbon emissions. Popp, Newell and Jaffe (2010) emphasized three dimensions such as energy, environment, and technological change. The long-term nature of many environmental problems, such as climate change, makes us understand the evolution of technology as an important part of projecting future impacts. There are mainly three challenges such as technology changes, cost-effectiveness, and environment-friendly energy generation for drafting energy policy for any economy. Chung, Pyo and Guiral (2019) investigated the relationship between carbon risk and a firm's financial data taking cost of equity. The study also highlighted challenges for financing project and utilization of funds (Chung et al., 2019). Financial challenges negatively influence firms to adopt clean technologies (Ashraf, Comyns, Arain & Bhatti, 2019). Carbon-efficient production can be valuable from both operational and risk management perspectives (Trinks, Mulder & Scholtens, 2020). Cadez, Czerny and Letmathe (2019) suggested that managers in developing countries take economic as well environmental concerns into account when planning business strategy (Cadez et al., 2019). Ashraf, Comyns, Tariq and Chaudhry (2020) suggested that market returns, supporting policies, and financial dropping are important antecedents in a developing country context. Krey and Riahi (2009) identified two major factors affecting greenhouse gas emissions such as delay in participation and failure in technology in the 21st century. ICAI (2009) covered the concept of carbon credit applied in India. India is part of Non-Annex country and has no restrictions for carbon emission. Larkin, Leiss, Arvai, Dusseault, Fall, Gracie, Heyes and Krewski (2019) suggested that risk assessment and risk management need to be comparable to ensure the long-term reliability and carbon emission reduction standards should be at the international level. This also relates to issues identified by Pawar, Bromhal, Carey, Foxall, Korre, Ringrose, Tucker, Watson and White (2015) in their assessment of what needs to be done to improve overall risk management and to remove barriers associated with large-scale deployment. IPCC (2007) and Kim, An and Kim (2015) classified climate change-related risks into six categories: physical risk, regulatory risk, litigation risk, competition risk, production risk, and reputation risk. Taking into the base, the study classified CDM risk into five categories: Country risk, Registration risk, Performance risk, and Counterparty risk and Market risk. Classification of risks has been considered from literature and presented in graph 3.

Figure 3. Risk associated with CDM project

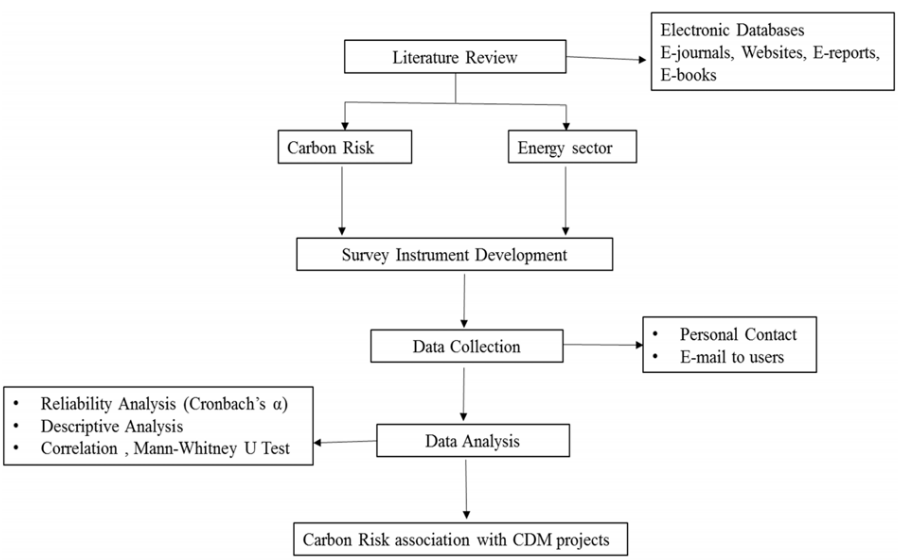


Source: created by authors.

Research Methodology

The study has been carried out for risk associated with CDM projects registered at a large scale. A comprehensive literature review was conducted using bibliographic database such as scopus, ebsco, google scholar etc. The key words used to identify appropriate literature were carbon risk, energy sector, sustainable practices, developing economy etc. Selected research articles were used to identify key variables for this study. Carbon risks were taken as dependent variables and CDM project methodology and firm ownership were taken as independent variables. A survey instrument was developed including identified variables to analyze association of carbon risk with CDM projects. Test methods which do not require that normality assumptions be met and as a rule do not test hypothesis about population parameters are called nonparametric methods or distribution-free methods (Fitzgerald, Dimitrov & Rumrill, 2001). As the sample size is very small and comparing two independent samples, non-parametric tests are warranted for analysis. The primary sampling unit was energy industry firms. We used a clustered sampling method, where clusters represent a group of Indian firms. The energy sector (renewable/non-renewable) has registered the highest number of projects that have taken the base for the selected sector for study. Large scale CDM project (> 15MW) registered by an energy sector organization was taken as the base for the selection of samples. A firm was randomly selected from the group. Employees of the chosen firms were asked to respond. We used personal interviews, telephonic and internet-based methods to administer the survey. Data collected samples from 22 energy firms out of 33 energy firms. By using non-parametric tests, the research attempts to provide insights into the question raised about the risk associated with CDM projects and checks whether the risk involved in the project is independent of the methodology of the project (wind/solar) and firm ownership (public/private). The study also attempts to address the issue of the inter-relationship of carbon risks. The study employs descriptive statistics and Spearman correlation, Mann-Whitney U test to answer the research questions raised in the introduction section. The developed hypothesis was tested using SPSS version 20. Figure 4 describes the step-by-step methodology incorporated indicating sources of data, variables, and analysis techniques.

Figure 4. Flow Chart of Methodology

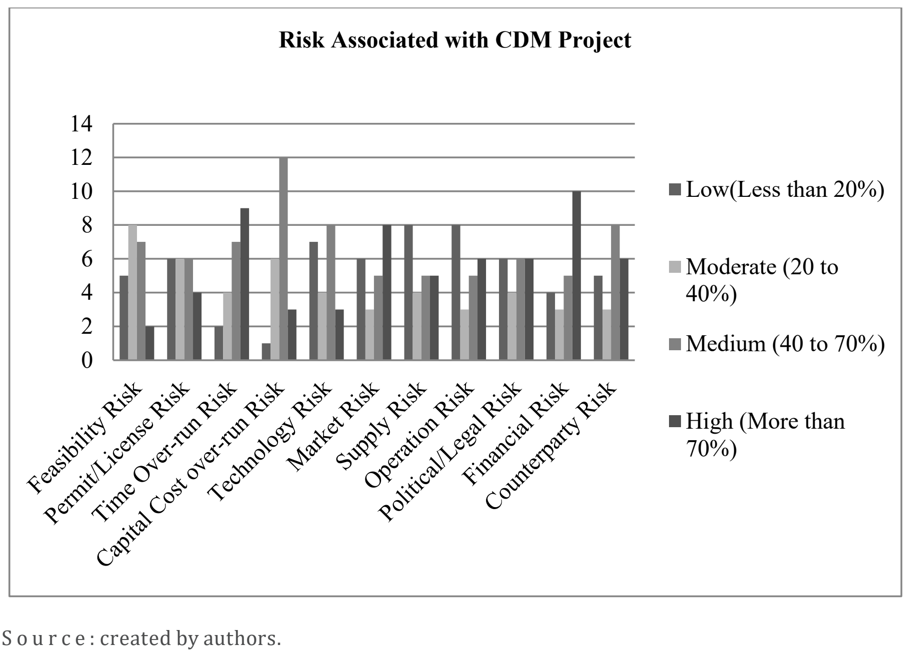


Source: created by authors.

Results and Discussion

To check the reliability of instruments used for data collection, Cronbach's alpha test was applied, and the results obtained are presented in table 1. The summary of independent variables considered for the study is presented in table 2. Descriptive statistics were applied to check the weightage of all categories of risks as shown in table 3. Spearman correlation analysis was used to check whether the risks associated with CDM projects have a significant association with each other or not. Mann-Whitney U test was applied to check differences for carbon risk with type of organization (Public/Private) and methodology of the project (Solar/Wind).

Figure 5. Graphical presentation of risk involve in CDM projects



Source: created by authors.

Table 1. Reliability Test

Cronbach's Alpha	Cronbach's alpha based on standardized items
.869	.857

Source: author's calculations.

The most widely used reliability test that is applied is Cronbach's alpha (Cronbach, 1951). The value of test (table 1) is greater than 0.750 which indicates the reliability of the instrument.

Table 2. Independent variables summary

Methodology of CDM Project		Classification of Organization	
Solar	Wind	Public	Private
10	12	4	18

Source: author's calculations.

Table 2 represents an independent variables profile taken for analysis. 10 firms have applied solar technology and 12 firms where wind technology has been adopted. Out of 22 firms, the majority of the energy organization samples are from the private sector (18 out of 22).

Descriptive Statistics

Table 3. Risk level associated with the CDM project

	N	Minimum	Maximum	Mean	Standard Deviation
Feasibility Risk	22	1.00	4.00	2.2727	.93513
License Risk	22	1.00	4.00	2.3636	1.09307
Time Over run Risk	22	1.00	4.00	3.0455	.99892
Capital Cost Overrun Risk	22	1.00	4.00	2.7727	.75162
Technology Risk	22	1.00	4.00	2.3182	1.08612
Market Risk	22	1.00	4.00	2.6818	1.24924

Table 3. Risk level associated...

	N	Minimum	Maximum	Mean	Standard Deviation
Supply Risk	22	1.00	4.00	2.3182	1.21052
Operation Risk	22	1.00	4.00	2.4091	1.25960
Legal Risk	22	1.00	4.00	2.5455	1.18431
Financial Risk	22	1.00	4.00	2.9545	1.17422
Counterparty Risk	22	1.00	4.00	2.6818	1.12911
Valid N (list wise)	22				

Source: author's calculations.

Table 3 lists the descriptive statistics of the CDM project risks. The results indicate minimum, maximum, mean, and standard deviation of the different categories of risk. Time overrun risk has the highest mean score that is 3.0455 followed by financial risk, counterparty risk, and market risk. The results show a greater standard deviation between operational risk and market risk. During the registration of a project, the planning of execution of the project may vary concerning technology adoption in company operation creating risk. The price of CER is expected at the time of contract and at the time of delivery varies and results in market risk. The results indicate that India being a part of non-annexure I countries, companies were highly relying on counterparties. Technology risk leads to operational risk and delay in implementation with the cost of technology leading to support financial risk. The developed project must be able to meet the target emission to gain credits that lead to performance risk (ICAI, 2009).

Association of Carbon risk

Table 4. Correlation: Risk associated with CDM project

Carbon Risk	**Feasibility Risk**	**License Risk**	**Time over-run Risk**	**Capital cost over-run Risk**	**Technology Risk**	**Market Risk**	**Supply Risk**	**Operation Risk**	**Legal Risk**	**Financial Risk**	**Counter-party Risk**
Feasibility Risk		**0.032**	**0.025**	**0.000**	**0.001**	0.302	**0.000**	**0.000**	0.484	0.054	**0.009**
License Risk			**0.019**	0.645	0.729	**0.014**	0.055	0.511	0.241	0.325	**0.036**
Time over-run Risk			.	**0.01**	0.889	0.183	0.584	0.654	0.437	0.07	**0.015**
Capital cost over-run Risk				.	**0.049**	0.601	0.066	**0.021**	0.590	**0.011**	0.186
Technology Risk					.	0.351	**0.000**	**0.000**	0.061	**0.009**	0.051
Market Risk						.	0.175	0.287	**0.001**	0.063	**0.015**
Supply Risk							.	**0.000**	**0.016**	**0.006**	**0.001**
Operation Risk								.	0.137	**0.001**	**0.013**
Legal Risk									.	**0.008**	**0.040**
Financial Risk											**0.002**
Counter-party Risk											

Source: author's calculations.

Table 4 presents the correlation analysis expressing the strength of inter-correlation among carbon risk parameters. Feasibility risk has an association with all risks except market risk, legal risk, and financial risk which are part of the construction and operation phase of the project. License risk has an association with time over-run risk, market risk, and counter-party risk. Time over-run risk has an association with capital cost over-run risk and counter-party risk. Capital cost over-run risk has an association with technology risk, operation risk, and financial risk. Technology risk has an association with supply risk, operation risk, and financial risk. Market risk has an association with legal risk and counter-party risk. Supply risk has an association with operation risk, legal risk, financial risk, and counter-party risk. Operation risk has an association with financial risk and counter-party risk. The result indicates all the risks interrelated with each other.

Carbon risk differs with ownership of firm and methodology of project

Carbon risk

The firm's ownership and methodology adopted for the project creates no difference in carbon risk. To check this, Mann-Whitney U Test was applied.

Table 5. Mann-Whitney U Test: Carbon risk and Methodology of CDM projects

Test Statistics											
	FR	LR	TOR	COR	TR	MR	SR	operation	Legal	Financial	Counter-party
Mann-Whitney U	39.000	58.000	54.500	46.500	55.000	53.000	54.500	51.000	57.000	60.000	59.500
Wilcoxon W	117.000	113.000	109.500	124.500	133.000	108.000	132.500	129.000	112.000	115.000	114.500
Z	-1.452	-.136	-.383	-.985	-.345	-.481	-.377	-.619	-.205	.000	-.034
Asymp. Sig. (2-tailed)	.146	.892	.701	.325	.730	.630	.706	.536	.838	1.000	.973
Exact Sig. [2*(1-tailed Sig.)]	.180[b]	.923[b]	.722[b]	.381[b]	.771[b]	.674[b]	.722[b]	.582[b]	.872[b]	1.000[b]	.974[b]

a. Grouping Variable: methodology
b. Not corrected for ties.

Source: author's calculations.

Table 5 presents a significant difference between carbon risk and the methodology of the project. The results indicate that there is no difference in carbon risk for the methodology of the projects. This analysis reveals that solar and wind technology projects carry the same level of carbon risk.

Table 6. Mann-Whitney U test: Carbon risk and ownership of organization

Test Statisticsa											
	FR	LR	TOR	COR	TR	MR	SR	operation	Legal	Financial	Counter-party
Mann-Whitney U	15.000	27.000	26.000	35.000	17.000	34.000	8.000	13.500	35.000	33.500	21.000
Wilcoxon W	25.000	37.000	197.000	45.000	27.000	44.000	18.000	23.500	45.000	43.500	31.000
Z	-1.875	-.792	-.900	-.094	-1.693	-.178	-2.479	-1.998	-.088	-.226	-1.332
Asymp. Sig. (2-tailed)	.061	.428	.368	.925	.091	.859	.013	.046	.930	.821	.183
Exact Sig. [2*(1-tailed Sig.)]	.081[b]	.484[b]	.434[b]	.967[b]	.118[b]	.902[b]	.014[b]	.053[b]	.967[b]	.837[b]	.227[b]

a. Grouping Variable: type of organisation
b. Not corrected for ties.

Source: author's calculations.

Table 6 represents the association between carbon risk and ownership of an organization (Public/Private). The results show that there is a significant difference in carbon risk concerning the type of organization in supply risk and operational risk. The significant value of supply risk and operational risk is 0.013 and 0.046 respectively. This indicates that in the planning and construction phase there is no difference whether the firm is from a private sector or public sector, but in the operation phase there is a difference in supply risk and operational risk.

Implications and Conclusions

The study provides framework to analyze the factors that influenced firms for decision-making. This study examines the risk associated with large-scale CDM projects registered by energy sector organizations. Classification of risks presented in a theoretical framework. The empirical results confirmed that all the categories of risk are highly associated with the project. Time over-run risk, capital cost over-run risk and financial risk had a high degree of risk compared to other risks in energy organizations. The reason might be that the company is not able to achieve targeted emission in a defined time that leads to increased financial cost of the project. Therefore, companies should take care of one of the major parameters that a CDM project should complete on time; otherwise, it leads to capital and financial risk at the time of planning as well as execution of the project. Carbon risk does not have any difference in the methodology adopted for the project. Ownership of organization influences creating differences among carbon risk.

Apart from carbon risk, two lessons emerged among those firms while engaging with CDM projects. First, financial benefits are considered to be primary motivation for undertaking CDM project by most of the respondents. Secondly, one of the primary risk factors considered against these firms' decisions was international regulatory bodies and its approval process and policies. Risk management includes regulatory, economic, advisory, and community-based, and technology-based approaches. There should be coordinated action at multiple levels and multiple scales are considered best practice in a decision-making context to protect or improve human health and the natural environment upon which we depend. The results of the study align with and contribute to a growing literature that documents risk and mitigation effects. A practical implication was determined in the present study, namely the organization aspects. The organization will be able to understand and define a strategy to mitigate the carbon risk that resulted in effective implementation of the project and achievement of target emission. The results of the study may provide policymakers with insights on carbon risk. It helps government to develop effective energy policies and also help organizations in minimizing project risk. It will facilitate the economy to achieve the sustainable development goal of the economy. Thus, this study contributes to the extension in research field carbon emission and sustainable development practices. The study is limited to large-scale CDM projects registered under energy industries. The study is not focusing on mediating the effect on carbon risk. The outcome may serve as a reference for developing countries and other industries of India for CDM project implementations. The study can be extended for empirical study at the global level. The future study can be targeted to analyze carbon risk with financial indicators of the company. Apart from variables considered in the study, there can be other mediating variables that will be studied in the future.

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