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RESEARCH ARTICLE

PROSPECT OF CARBON CREDIT MECHANISM WITH SMALL AND MEDIUM SIZED SOLAR PROJECT IN EDUCATIONAL FACILITIES; ASTUDY IN KAMRUP DISTRICT OF ASSAM, INDIA

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ABSTRACT

Global warming resulting from high level of greenhouse gases emitted in atmosphere has reached an alarming situation. The global 2010 emissions are 31% above the 1990 emissions. World leaders at the United Nations discussed the possibility to put a cap of how much carbon can be emitted by each country so that the total combined emission all nations should be under the safe limits of greenhouse gas emission of the earth. It is estimated that under the condition of usual business, the emission levels till 2020 would go up to 58 GtCO2, which is higher by 14 GtCO2 than the targeted level of 44GtCO2. Limiting emission to 44 GtCO2 would hold the increase in global average temperature rise in this century below 2°C as compared to pre-industrial levels, resulting in restricting the global warming and its adverse effects (Jane Ellis, 2004). UNFCCC, a division of the UN at the Kyoto Protocol has proposed a way where both the developed and developing nations can join hands to contribute to reduction of emission of these harmful gases. It proposes that developed countries which already have major industries emitting GHG's; instead of reducing these activities, can exchange the carbon emission levels with the developing nations. Since developing nations are still in the phase of gearing up their industrialization and hence pollute lesser than developed nations, these countries can pass on the available limit of carbon emission to the developed nations (Yuvika Gupta, 2011). In exchange for this, the developing nation has to support in building up the carbon reduction mechanism in developing country or pay the prevalent market price of the amount of carbon credits. Total emission levels of the atmosphere of the earth remains constant, irrespective of the country from where carbon is emitted. This practice is termed as Carbon trading which enables the developed countries to share their responsibility of lowering carbon emission with the developing countries whose emission levels have not yet reached the near danger levels. In the process, the developing countries get technology benefits in terms of upgrading their infrastructure to match with the developed nations and that too at a lower cost than that of the developed nations due to lower cost of manpower and land. This paper explores the opportunity for a developing country like India to build up renewable energy projects where carbon credits generated can be exchanged with multinational companies who are in need of carbon credits. The prospects of additional revenue generation through carbon trading projects are really lucrative for an economically less privileged state like Assam. This would also give a strong amount of exposure to Assam in worldwide technology up gradation and open new avenues of development of the state. The study conducted in few of the educational institutions would also give an insight as to how these regulatory frameworks could be designed to make it convenient for people to embrace such projects even at a smaller scale.

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INTRODUCTION

There has been a significant shift in the climatic conditions of earth with increase in level of global temperature. This change has been distinctly visible post the industrial revolution era of our civilization. One of the major reasons for this is the increase in level of greenhouse gases in the atmosphere, majorly *Carbon dioxide* which is a byproduct of fossil fuel burning. Increased level of greenhouse gases traps more heat in the atmosphere and makes the earth warmer. Higher temperature has severe impacts to our ecosystem resulting in increased sea levels due to melting of the ice and at the same time harming various species and ecosystems existing in the earth ultimately threating the existence of human civilization on earth. The IPCC fifth assessment reports have revealed some of the very critical facts. With 1 degree increase in temperature levels, crop yield decreases by about 5 percentages. Due to this increase in temperature levels, global

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average sea levels rose by 19 cm from 1901 to 2010. If this rate of increase of greenhouse gas emission persists, global temperature is likely to increase by 1.5*C. This would lead to increase in sea levels by 24-30 cm by 2065 and 40-63 cm by 2100 (http://www.ipcc-nggip.iges.or.jp/ public/2006gl/ index. html). These facts have raised an alarm that we need to take certain corrective actions immediately to stop or at least reduce these drastic changes for our sustainable future and of next generations of human race. In order to reduce the emission of greenhouse gases, fossil fuel combustion needs to be curtailed, which is the biggest contributor for GHG emission. Thus alternate renewable sources of power needs to be studies and explored cautiously which unlike the conventional sources of energy doesn't emit any harmful gases. Solar energy will reduce the pollutant levels of atmosphere to a huge extent and also make a self-reliant source of energy for such an educational facility. At the same time, such projects can trade the equivalent of carbon emission reduced by setting up these renewable energy projects. The certain amount of carbon emission that is saved from being emitted in atmosphere can be traded to a party who has exceeded their emission levels beyond their tolerance limits with their activities emitting carbon.

A developing country like India has a huge potential to explore the arena of carbon trading market. With the cost of technology being relatively lower in a developing nation, the prospect of developing low carbon emission projects at a lower cost is very lucrative. Since cost of technology development and implementation is lower than developed nation, significant amount of contribution in such project is viable. In a state of Assam where the cost of living is lower than the average of the country, such project has a huge prospect. The amount of carbon emission savings done in such project can be traded in the open market regulated by the UN. This adds up to the revenue generation scope for the state and at the same time an exposure to the international front in terms of technology up gradation and infrastructure development (Ravuru Narasimha Reddy, 2012). Space is a major factor in a renewable energy project implementation. The cost of space in a developing state like Assam is lower than the more developed states like Maharashtra, Gujarat or Karnataka. However the scope of revenue generation and infrastructure development is no lesser. This paper looks into the prospect of development of such emission reduction solar project in Assam and the possibility of such projects to be registered with UNFCCC and earn additional revenue with carbon trading mechanism.

Greenhouse gas emission

Greenhouse gas (GHG) emissions resulting from the provision of energy services have contributed significantly to the historic increase in atmospheric GHG concentrations. Recent data confirm that consumption of fossil fuels accounts for the majority of global anthropogenic GHG emissions. Emissions continue to grow and CO2 concentrations had increased to over 390 ppm, or 39% above preindustrial levels, by the end of 2010. The negative external effects from CO2 accumulation may harm all countries in the world and not only the emitting country. Thus, while the benefits from CO2 emissions are immediate and directed towards the emitting country, the costs will be worldwide and continue as long as the CO2remains in the atmosphere. The changes in the climatic conditions are mainly due to the emission of greenhouse gas like Carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) in the atmosphere. Between 1750 and 2011, cumulative anthropogenic CO2 emissions to the atmosphere were 2040 ± 310 GtCO2. About 40% of these emissions have remained in the atmosphere (880 ± 35 GtCO2); the rest was removed from the atmosphere and stored on land (in plants and soils) and in the ocean. The ocean has absorbed about 30% of the emitted anthropogenic CO2, causing ocean acidification. About half of the anthropogenic CO2 emissions between 1750 and 2011 have occurred in the last 40 years indicating the strong role of economic development activities in past years for high increase of CO2 in atmosphere (Santosh Kumar Sahu, 2013). Emissions of CO2 from fossil fuel combustion and industrial processes contributed about 78% of the total GHG emissions increase from 1970 to 2010, with a similar percentage contribution for the increase during the period 2000 to 2010. Total CO2, CH4 and N2O emissions from India were 592.5, 17, 0.2 and 778, 18, 0.3 Tg in 1990 and 1995, respectively. Globally, economic and population growth continued to be the most important drivers of increases in CO2 emissions from fossil fuel combustion (Joysri Acharyya, 2009). The contribution of population growth between 2000 and 2010 remained roughly identical to the previous three decades, while the contribution of economic growth has risen sharply.

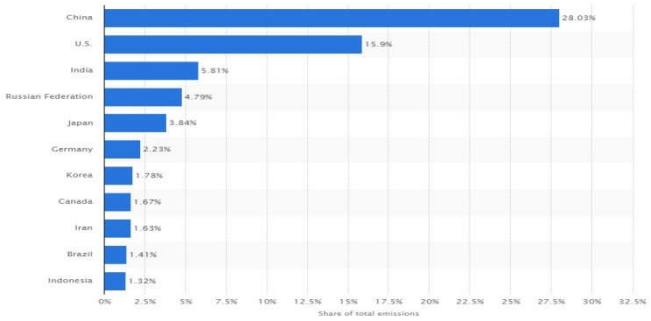


Fig. 1. Share of country wise Greenhouse gas emission: source; Statista

The IPCC's Fifth Assessment Report (AR5) provides us a deep insight of the global impacts of greenhouse emission. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere, where such assessment is possible (http://unfccc.int/ resource/webdocs/sai/2014.pdf). The globally averaged combined land and ocean surface temperature data as calculated by a linear trend show a warming of 0.85 °C over the period 1880 to 2012 (Aviral Kumar Tiwari, 2011). Electric power generation has emerged as the dominant source of GHG emissions, followed by emissions from steel and cement plants. Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010 with only about 1% stored in the atmosphere. Over the period 1992 to 2011, the Greenland and Antarctic ice sheets have been losing mass at a larger rate over 2002 to 2011. There is high possibility that permafrost temperatures have increased in most regions since the early 1980s in response to increased surface temperature and changing snow cover. Observation in the same time period shows that global mean sea level rose by around 0.19 m. The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia. Since the beginning of the industrial era, oceanic uptake of CO2 has resulted in acidification of the ocean; the pH of ocean. Surface water has decreased by 0.1, corresponding to a 26% increase in

acidity, measured as hydrogen ion concentration. Post 1850 the successive three decades in earth has been relatively warmer. Since the beginning of the industrial era, oceanic uptake of CO2 has resulted in acidification of the ocean; the pH of ocean surface water has decreased by 0.1, corresponding to a 26% increase in acidity, measured as hydrogen ion concentration. Observations of changes in ocean surface salinity also provide indirect evidence for changes in the global water cycle over the ocean (Amit Garg, 2001). Averaged over the mid-latitude land areas of the Northern Hemisphere, precipitation has increased since 1901. It is very likely that regions of high salinity, where evaporation dominates, have become more saline, while regions of low salinity, where precipitation dominates, have become fresher since the1950s (Bhaskara Raoet al., 2012). The annual mean Arctic sea-ice extent decreased over the period 1979 to 2012, with a rate that was very likely in the range3.5 to 4.1% per decade. Over the period 1901 to 2010, global mean sea level rose by 0.19 m. The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia.

Many terrestrial, freshwater and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances and species interactions in response to ongoing climate change. Crops shows that negative impacts of climate change on crop yields have been more common than positive impacts (Bhaskara Rao, 2012). On top of this, few of extreme events in terms of climatic changes has been widely visible to us. In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality. Many terrestrial, freshwater and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances and species interactions in response to ongoing climate change. Some impacts of ocean acidification on marine organisms have been attributed to human influence. There are major two factors which is responsible for increase in sea levels which are thermal expansion of sea water and melting of huge reserves of ice. Global warming resulting in increase of average temperature of the earth has induced both these factors proving global warming as a reason of increase in sea levels. This result in displacement of human population settled near the sea which may end up resulting in geo-political unrest among nations.

Assessment of many studies covering a wide range of regions and crops shows that negative impacts of climate change on crop yields have been more common than positive impacts. Climate change will impact agriculture and food production around the world due to the effects of elevated CO_2 in the atmosphere, higher temperatures, altered precipitation, and increased frequency of extreme events. Many of water bodies have changed course of flow during last few centuries due to tectonic changes incurred in the surface of earth. This raised concerns of shift of population causing human settlements to keep changing the locations. Changes in climatic conditions will also make health crisis for population leading to more and more social problems. It is probable that the number of cold days and nights has decreased and the number of warm days and nights has increased on the global scale. Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability. Whether it is poverty, food and water scarcity, diseases, economic instability, or threat of natural disasters, the broad range of changing climatic conditions may be far reaching. These challenges may threaten stability in much of the world.

Corrective actions planned

Constant increase in the level of population have put up a lot of pressure on all countries to keep increasing the rate of developmental activities in terms of industrialization which results in increase of these greenhouse gases. To reduce the level of emission, industries have to either lower the production activities or adopt greener technology. Lowering the production is out of option since it will lead to supply shortage of the economy. Adoption of green technology is being adopted across industries, however since the cost of shifting to a greener technology is higher in the developed countries, there is an opinion that technology transfer should be done in developing countries where cost of execution will be lower (Vivek Birla and Gunjan Singhal, 2012). This cost reduction will ultimately benefit the world economy since irrespective of the location, cost of moving to a greener technology is lowered which ultimately is going to benefit the climate of the entire earth. Threats from global warming resulting from high level of greenhouse gases emitted in atmosphere have reached an alarming situation. This has made people conscious all around the world to start thinking in the direction to take corrective measures. World leaders at the United Nations discussed the possibility to put a cap of how much carbon can be emitted by each country so that the total combined emission all nations should be under the safe limits of greenhouse gas emission of the earth. After multiple rounds of meetings to work upon possible solutions by, it was decided to take steps so as to hold the increase in global average temperature rise in this century below 2°C as compared to pre-industrial levels. Multi-model results show that limiting total human-induced warming to less than 2°C relative to the period 1861–1880 would require cumulative CO2 emissions from all anthropogenic sources since 1870 to remain below about 2900 GtCO2. About 1900 GtCO2had already been emitted by 2011. Nations are faring towards bringing annual emissions down to around 44 gig atones of CO2 equivalent or less by year 2020. Global greenhouse gas emissions are considered a value of 49 GtCO2e for 2010 based on values of various work groups in IPCC reports.

This is already 14% higher than the median estimate (44 GtCO2e) of the emission level in 2020 with a likely chance of meeting the 2°C target. It is estimated that under the condition of business as usual, the emission levels till 2020 would go up to 58 GtCO2, which is higher by 14 GtCO2 than the targeted level of 44GtCO2. The emission scenarios are consistent with a chance of meeting the 2°C target, having global emissions in 2030 of approximately 37 GtCO2e. This is around the same level of emissions as in 1990. It is important to emphasize that the 2030 range depends on where emissions are in 2020. The higher the emissions in 2020, the lower they must be by 2030. By 2050 this amount is to be restricted to 21GtCO2e.

About UNFCCC

Greenhouse gases emission have their adverse effects on our entire planet.

This makes this issue further complicated since not one of few parties are can be hold accountable for such emission of greenhouse gases, whereas the effect is to be borne by the

entire planet. Since developed nations are the major source of pollution, they were the logical sources where emission needs to be curbed. Putting a cap however means that those developed nations have to reduce or slow down the industrial activities emitting pollutants, which will ultimately hamper the world economy. United Nations acts as the connecting bridge among all nations to discuss issues related to matters which impacts the entire world. UNFCCC, a division of the UN at the Kyoto Protocol has proposed a way where both the developed and developing nations can join hands to contribute to reduction of emission of these harmful gases. It proposes that developed countries, instead of reducing their economic activities, can exchange the carbon emission levels with the developing nations (Heller, 2003). Since developing nations are still in the phase of gearing up their industrialization and hence pollute lesser than developed nations, these countries can pass on the available limit of carbon emission to the developed nations. In exchange for this, the developing nation has to support in building up the carbon reduction mechanism in developing country or pay the prevalent market price of the amount of carbon credits. Total emission levels of the atmosphere of the earth remains constant, irrespective of the country from where carbon is emitted. Carbon trading in short enables more developed countries to share their responsibility of lowering carbon emission with the developing countries whose emission levels have not yet reached the near danger levels.

By the end of the century, UN formed the IPCC representing various governments of countries and climate change was discussed at length. This led to the creation of UNFCCC under the UN and entered into force on 21 March 1994 to mitigate and co-ordinate among all nations and come to a sustainable solution to reduce emission levels which was set to discuss and solve the climatic changes issues. Based on reports by IPCC, numerous rounds of meetings and discussions were carried out among participating nations and on 11 December 1997, the Kyoto Protocol was adopted (By Steve Thorne, 1999). Agreements were made among various participating nations in regards of the solutions to tackle the problem of high emission levels of GHG's. It was decided that emission levels will have to be curbed to an extent of emission levels of 1990, taking this year as a baseline. Since developed and industrialized countries are the source of most amounts of greenhouse gas emissions, they are expected to contribute the most towards cutting emissions on home ground. These countries are called Annex I countries. The remaining developing countries are called as Non Annex I countries. These countries also are committed to reduce the level of emission but in a lesser way than the Annex I countries. Developing countries support and facilitate the Annex I countries to meet their goals of reducing the levels of emission to the set quantity.

Carbon Credit Trading

Carbon credit trading is an exchange mechanism among nations where in countries can trade their emission levels of carbon based on their demand and supply levels. Accordingly a developed nation which already has major industries emitting GHG's more than its permissible level, can trade the carbon emission limits witha developing country whose emission levels are well within the limits. In exchange the developed country will have to buy the carbon emission permits in the prevailing market price through trading or support in emission reduction of the similar levels in the developing country which can be done through CDM Clean Development Mechanism or Joint Implementation (IPCC Special Report Carbon Dioxide Capture and Storage Summary for Policymakers, 2011). This way there would be a balance between the emission levels of both developed and developing countries without hampering the economic activities. At the same time this would motivate developed nations to curb their emissions levels and have lower emission trading expenses and also motivate developing nations to build up more and more renewable energy projects. The ultimate impact would be that the total level of greenhouse gas emission would decrease which will ultimately be for the benefit of all nations. CDM is one of the carbons trading market mechanism designed by the UNFCCC. The party installing a renewable energy project can earn Certified Emission Reduction units from the World Bank. The host county (India in our case) keeps a record book of the projects which have applied for the CDM scheme. National CDM Authority, a part of ministry of environment and Forest under the Govt. of India is the concerned authority for the same. The CDM mechanism transactions are maintained and monitored by the UNFCCC secretariat under the authority of CDM Executive Board (Sumita Nair et al., 2013). At a national level, Gov. of 38 Annex B countries maintain their own "National register' which will maintain record related to the parties which have applied for the CDM. After the project applied under CDM is verified and satisfactorily scrutinized, the concerned country will issue HCA (Host Country Approval). On receipt of HCA, the project is put up for further approval at the secretariat in UNFCCC. In between this process, various cross check and reference checks are done on the authenticity of the project. Third parties and independent consultancy firms are appointed both at the NCDMA and UNFCCC secretariat levels to verify the authenticity and relevance of the CDM project. Once all verifications are done, CER (Certified Emission Reductions) are issued to the parties which can be traded in the open market prices. To maintain authenticity and sanctity of carbon trading, CER transfer is not done directly between parties. The registries at UNFCCC secretariat settle emission trades by delivering units from the accounts of sellers to those of buyers making it an infrastructure backbone of the carbon market trading.

Role of World Bank

The World Bank acts as the connecting link to match the supply and demand side of carbon trading transactions. Developed countries in need of permits of emission put up the demands to the World Bank for the required amount of CER points where 1 CER point is equal to 1 ton of Carbon. Exchange of carbon can be done either through direct trading in the open market for carbon trading or by project development exchange between developed and developing country by the method of either Clean Development Mechanism or Joint Implementation. Through this project schemes of CMD or JI, renewable energy project are developed throughout the world. CMD is more of dealing with commercial viability where in the developing countries buys the credits for emission from a developing country where a renewable energy project is set up. The equivalent amount of emission that has been curbed by that project is bought by the foreign entity. In case of JI, a foreign entity will jointly set up a renewable energy project in a developing country with a local partner (Shilpi Tripathi, 2015). The equivalent amount of carbon credits from the project will be added to the quota of the foreign partner. Through these schemes, developing countries will benefit because of the technology transfer and flow of foreign exchange of money in their economy.

At the same time project implementation will be carried out at the lowest cost since cost of project will be lower in the developing nations. Developed county will benefit from the fact that they do not have to slow down or hamper their economic activity for cutting down their emissions.

Prospects for India

A developing country like India stands a great opportunity to utilize such projects. This has a twofold benefit. Firstly this would lead to a great amount of technology transfer in the country which will have a long term benefit in terms of up gradation of the technology in the country along with development of the human resources to handle such technology. The second part is the huge inflow of foreign funds to execute these projects or buying the emission benefits which can serve as a major source to earn foreign exchange and make our economy as the fastest growing among the world. Population increase pressure has made it very important that our economy grows at a faster pace. At the same time new age technology will also engage a lot of man power in these projects thus creating a lot of job opportunities (Namita Rajput, 2014). India is the second largest seller of carbon credits. The country is also a leading destination among non-Annex 1 countries with regards to CDM implementation. It has the highest rating of any CDM host country, with 19.60 percent of the world total of 1,081 projects registered with CDM EB. There are already many projects in India which have been sanctioned by the World Bank for the CMD scheme. Few big industrial houses in India like Jindal and Reliance are targeting these projects (MahankaliArunaKumari, 2013). Renewable energy project like solar installation in public establishments can be looked at as an opportunity to apply under this scheme. Many Schools, Colleges, Universities, Hospitals, Gov. Buildings have adopted solar energy projects incorporated in their campus. These projects serve as a supplemented source of energy since the amount of total electricity consumed in these public establishments are huge. This leaves us with the fact that such a project can be developed and applied for under the CDM mechanism. Setting up a renewable energy project will firstly make the establishments self-sufficient for the electricity requirement and at the same time reduce the cost of electricity consumption drastically since solar project has very little maintenance cost and negligible energy generation cost. Apart from this, the credit of using solar energy project and reducing the emission of greenhouse gases by not using conventional energy source can be traded to foreign entity to earn additional revenue. Solar Projects in these establishments can thus add up to the target of emission reduction, lower the cost of electricity usage and add to additional revenue by trading the CER from these projects.

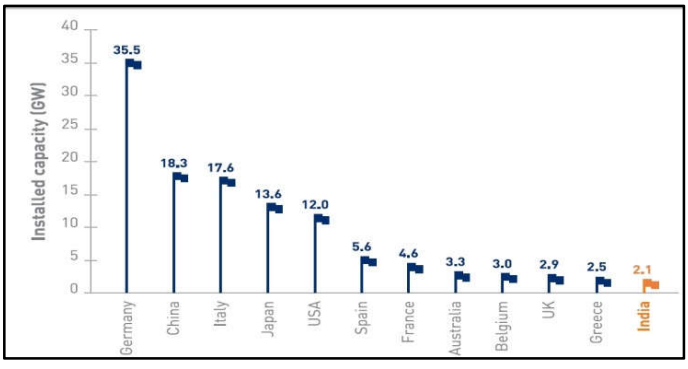


Fig. 2. Country wise cumulative solar capacity, Beehives or elephants report by Tata Solar power and Bridge to India

Implementation, benefits and challenges in India

Awareness of people about solar energy and CDM mechanism carbon trading

Meaning of CDM

CDM is one of the carbons trading market mechanism designed by the UNFCCC. The party installing a renewable energy project can earn Certified Emission Reduction units from the World Bank. The host county (India in our case) keeps a record book of the projects which have applied for the CDM scheme. National CDM Authority, a part of ministry of environment and Forest under the Govt. of India is the concerned authority for the same. The CDM mechanism transactions are maintained and monitored by the UNFCCC secretariat under the authority of CDM Executive Board. At a national level, Gov. of 38 Annex B countries maintain their own "National register' which will maintain record related to the parties which have applied for the CDM. After the project applied under CDM is verified and satisfactorily scrutinized, the concerned country will issue HCA (Host Country Approval). On receipt of HCA, the project is put up for further approval at the secretariat in UNFCCC. In between this process, various cross check and reference checks are done on the authenticity of the project. Third parties and independent consultancy firms are appointed both at the NCDMA and UNFCCC secretariat levels to verify the authenticity and relevance of the CDM project. Once all verifications are done, CER (Certified Emission Reductions) are issued to the parties which can be traded in the open market prices. To maintain authenticity and sanctity of carbon trading, CER transfer is not done directly between parties. The registries at UNFCCC secretariat settle emission trades by delivering units from the accounts of sellers to those of buyers making it an infrastructure backbone of the carbon market trading.

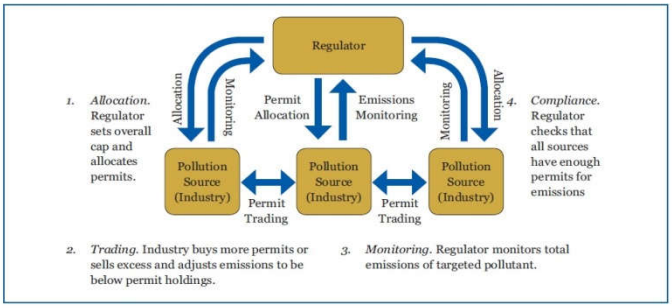


Fig. 3. Mechanism of emission trading scheme; source; towards and emission trading scheme for air pollutants in India

Target group to be studies

This study is conducted taking educational institutions as our target group for the research. Major reasons for considering educational institutions are as discussed as below:

Consumption quantity at institutions is on higher scale

The quantum of energy consumption in educational institutions is quite high. In this study, we are restricting our sample size only to Graduation Colleges and Universities. The selection criteria of sampling the institutions are done based on judgment sampling along with the highest consumption of electricity units in Guwahati city.

Consumption pattern mostly during the day time

Unlike other commercial establishments like industries and factories, the working hours of educational institutions are typically during the day time. So a study of Solar project in the most apt in this setup where the energy requirement is during the day time when solar energy projects provide the maximum supply.

Academic people can be involved

Carrying out of this research in educational institutions will mean the involvement of the professors, lecturers and other academic persons to be involved in this study. This would prove to be a very good opportunity to get inputs from academic scholars for such projects and have the potentiality to open up new gates and innovative ideas from such strong academic persons.

Mix of attitude levels of decision makers

This study will be carried in educational institutions involving the decision makers of such facilities. Decision makers of Public funded institutions would consider costing importance less as it would be funded by the state, whereas for a private institution, the cost has to be borne by the private owners which can have a big impact on the business operations of such institutions (David Reiner). This aspect will give a good insight of stated preference and revealed preference.

Arousing interest of new generation

Solar energy field requires a great deal of further research and study in order to scale up the visibility and presence among the masses. This study carried out in educational institutions can be a boost to the younger generation and spread more awareness among them for sustainable energy projects.

Awareness

Understanding the awareness of our target group towards renewable energy benefits and CDM mechanism is very crucial. Considering the fact that these concept are not very easy to grab in a short span of time, we explain to respondents the brief about these market mechanisms. It is found that very few of the respondents were aware of even such a term as carbon trading, leave apart the theory behind this. People showed a good amount of enthusiasm for a renewable energy prospect taking factors of benefits such as no recurring cost, energy independency, saving the atmosphere, tax saving schemes, regulatory authority funding, excitement of new technology, novelty factor, etc.

Current status of CDM

Developing countries have a major role to play in this arena of renewable energy development projects. The contributing countries in UNFCCC have taken up the responsibility to share the burden of reducing the greenhouse gas emission levels in the atmosphere of the earth. Lot of renewable energy projects has been launched and successfully completed by few countries under the CDM mechanism. India is the second largest seller of carbon credits (IPCC). Credits for emission reduced by such projects are earned by the host countries in the form of Certified Emission Reduction points which can be traded in the open market to interested parties. Below is the list of developing nations contributing to the emission reduction program.

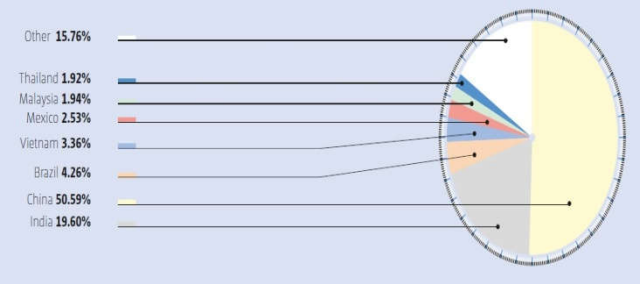


Fig. 4. Share of CER by Non Annex I countries; Source; Annual report on CDM

Understanding the benefits of registering a solar energy project under CDM mechanism:

Opportunity

CDM opens up a new opportunity for solar energy project to earn additional revenue under the carbon trading market mechanism. Certified Emission Reduction is the actual trading instrument that can be earned and traded under the CDM mechanism. Projects that are approved by the board under CDM scheme are awarded CER points. In a zest, one unit of CER is equivalent of emission levels of 1 Ton of Carbon dioxide emission. These CER's earned by the project can be traded in the open market as per the prevailing market price with a party who is in demand who has exceeded their emission levels and requires further emission permissions to meet their targets of emission reduction. Thus the CER trading opens up a very good opportunity for a project to earn revenue by trading and at the same time foreign exchange currency for the host country.

Benefits

As the demand of energy grows every day, sustainable source of energy can prove to be a major source to cater the demands. Traditional forms of energy generation method have two major negative impacts. First one is that generation of energy by conventional methods gives rise to emission of huge levels of greenhouse gases. This has a strong impact in our environment in the way that too much concentration of GHG captures the heat radiated from sun in the atmosphere of the earth. This has led to an average increase in the temperature levels of earth which we call as global warming. The second critical aspect is that conventional energy generation methods are not sustainable, i.e. the sources of energy are depleting and will at some point be exhausted. To cater to these two factors, alternative sources of energy generation are explored which should have no harmful emissions and at the same time be sustainable for a long time. Few of the major benefits of renewable energy are listed as follows;

Additional revenue generation

CDM mechanism and its associated benefits are an add on to the other benefits of renewable energy project in the form of solar energy in terms of generation of additional revenue from a solar energy project. UNFCCC formulated the market mechanism method during the Kyoto protocol where carbon credits points from a renewable energy project in a developing nation can be traded and sold to a developed nation which exceeds its emission limits as set by the UNFCCC. This opens up the doors for renewable projects in developing nation like India to earn additional revenue from such projects.

Knowledge levels

People involved in a renewable energy project implementation and getting this project registered under the CDM mechanism will go through a lot of knowledge transfer activities. Renewable energy itself is a huge field to learn a lot of things, additionally getting a project registered in a national authority require a thorough understanding of the entire process. By working on such a project, a great deal of knowledge is acquired by the persons involved that will prove to be of huge benefit at a later stage.

Exposure to world front

Registration of a CDM project is done at individual country levels where every country maintains its own register for CDM mechanism. Getting involved into the activity of registering a CDM project will provide us with a lot of insights about Gov. rules and regulations. This will create opportunities for us to work in close connect with World Bank and getting the final project approval, its necessary verifications and CER's (Certified Emission Units). Going through this entire circle of getting CER's and trading it on international market will make the concerned persons more responsible and knowledgeable towards CDM mechanism which can be hugely beneficial in the long term.

Foreign exchange for the nation

Trading of carbon credits generated from renewable energy projects would bring a great amount of foreign wealth in our country. Since the carbon credits are sold to developing nations, flow of foreign currency would increase, which would give a major boost to our economic development.

Technology transfer

CDM technology would also ensure a lot of technology transfer from developed nations to our country. Since various manufacturers and suppliers from multinational companies look at this demand of renewable energy project in our country, they would bring in their operations to our nation. This would ensure flow of new technology of renewable energy in our country which will train and upgrade our man force and technology.

Academic exposure to educational institutions

We are concentrating this study to educational institutions and our respondents are mainly the persons who are in constant connect to the academic fraternity. Conducting of such a project in an institution will also provide exposure to the persons from an academic interest to the real time working of a renewable energy project. This would lead to arousing the interest of more people towards renewable and sustainable energy and further more innovative research work on such agenda.

Human resource development

From a holistic view, renewable energy projects will provide with a human resource development of the nation at large. People will become more and more knowledgeable regarding renewable and sustainable energy and at the same time this would create further job opportunities for people in this industry.

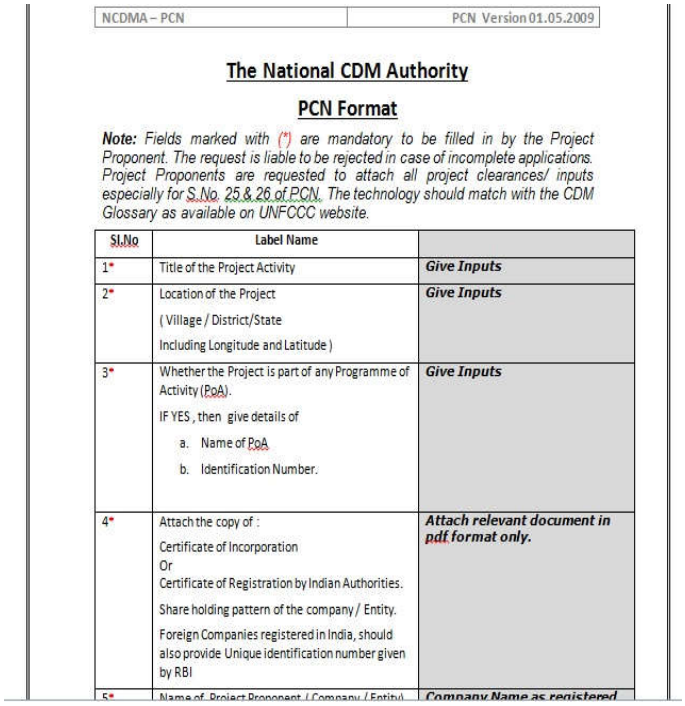
Challenges in implementing solar project and registering under CDM mechanism

Actions to be taken

Our objective here is to understand the next stage of getting the solar project registered under the CDM mechanism. There is a set process and steps that had to be followed to apply for CDM project. The National CDM Authority is the regulatory authority involved in clearance of CDM projects in India. The parties applying for CDM scheme are required to apply to the administrator of NCDMA by filling up a registration form. Once the registration is accepted, the party then proceeds and applies online for further processes.

The Project Concept Note and subsequently the Project Design Document are filled up and submitted as per the required norms and systems defined by NCDMA. The party than give a presentation of the project designed to the members of the authority showcasing the benefits and importance of the CDM project. Once the members of the authority are convinced about the project, they provide a Host County Approval for the project.

Snap shots of the applicable formats are reviewed below;



NCDMA – PCN | PCN Version 01.05.2009

The National CDM Authority

PCN Format

Note: *Fields marked with (*) are mandatory to be filled in by the Project Proponent. The request is liable to be rejected in case of incomplete applications. Project Proponents are requested to attach all project clearances/ inputs especially for S.No. 25 & 26 of PCN. The technology should match with the CDM Glossary as available on UNFCCC website.*

Sl.No	Label Name	
1*	Title of the Project Activity	***Give Inputs***
2*	Location of the Project (Village / District/State Including Longitude and Latitude)	***Give Inputs***
3*	Whether the Project is part of any Programme of Activity (PoA). IF YES , then give details of a. Name of PoA b. Identification Number.	***Give Inputs***
4*	Attach the copy of : Certificate of Incorporation Or Certificate of Registration by Indian Authorities. Share holding pattern of the company / Entity. Foreign Companies registered in India, should also provide Unique identification number given by RBI	***Attach relevant document in pdf format only.***
5*	Name of Project Proponent (Company / Entity)	***Company Name as registered***

Fig. 4. Format of Project Concept Note by NCDMA

Problems faced

The biggest problem as observed from the feedback from respondents is lack of awareness. Our response group showed no knowledge of such carbon trading mechanism concept. The CDM scheme will require a lot of process oriented effort to get the project registered with the National CDM Authority and the subsequent documentation and presentations to finally get through the approval and obtain the CER (Certified Emission Reduction) which are the ultimate instruments to be traded. In most cases a third party will need to be recruited to take charge of this activity and getting the project registered under CDM scheme.

CDM-SSC-PDD-FORM

Project design document form for small-scale CDM project activities

(Version 06.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Bundled Solar Power Plants - INDIA
Version number of the PDD	01
Completion date of the PDD	29/02/2016
Project participant(s)	M/s. Nipur Chemicals Ltd. M/s. Bhageria Dye-Chem Ltd.
Host Party	India
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	**Sectoral scope(s):** 01- Energy industries (renewable - / non-renewable sources) **Selected methodology:** AMS- I.D (Version 18, EB 81) – Grid connected renewable electricity generation AMS - I.F. (Version 03.0, EB 81) - Renewable electricity generation for captive use and mini grid
Estimated amount of annual average GHG emission reductions	2705 tCO_2e/annum

Fig. 5. Format of Project Design Document by NCDMA

Knowledge

The biggest problem faced is the lack of knowledge among people about the benefits of solar energy and the CDM project. People have not even aware of what steps are being taken by the United Nations for the issue of global warming. The prospective as understood from the respondents are very good for a solar project and its CDM registration. With a good understanding og the entire concepts of solar energy and CDM, this can bring a revolution in the add on of such sustainable projects.

Gap in system

One of the major reasons of why the mechanism of Carbon trading is not known to most of the people is because this has not been promoted and marketed as required. CDM mechanism provides a very good opportunity for developing nations to utilize the emission permissible levels as a resource and fasten the growth rate of economic development to match with the more developed nations. This policy should be taken as a source to boost up of development levels and promoted aggressively across the nation.

Economic fluctuations

The market mechanisms designed by the UNFCCC are highly unpredictable. The price of carbon credits are purely market driven, and hence are at risk under all the time. Projects under CDM scheme involve a lot of investments from the developing countries. Everyone is in the race to grab the first piece of cake and earn maximum projects and credits. The idea is highly market driven and volatile, hence the risk factor of such projects are also high.

Regulatory authority

Lot of govt. diplomats and bureaucrats are involved in the entire process of CDM registration. Since registers for CDM entries are maintained by each nation, so a lot of political factors also play a major factor into this process of CDM registration.

Transparency in system

Because of the involvement of regulatory authorities, there are numerous factors which are dependent on individuals to carry ahead the process of CDM registration. The registry system of our county is more people driven rather than process driven. This makes the system prone to corruption by individuals who can take wrong advantages of powers bestowed to them.

Time frame of completion

The total time required right from the time of making the plans up to the final benefit realization for CDM is very high. Projects registration in country, acceptance by the committee members of UNFCCC, verification process, issuance of CER, then trading in the open market takes a lot more time than anticipated. Hence realistic time frame of the entire cycle is very difficult to predict which varies from project to project based on the level of complexity and scale of operation. This time frame is a critical factor which makes it difficult from people to have full confidence on this mechanism.

Authenticity of personnel

As mentioned, the whole process of registration in country registers are much more people driven rather than process driven. Hence there are many loop holes where people may take undue advantages of their positions and work. Verification process will require to be more robust and process driven to ensure authentic of the whole process. Also the genius of the entire project itself is a critical concern. A project applications needs to be scrutiny thoroughly from their actual impact on the environment and quantification process is to be more robust as to how many tons of carbon are being emitted less because of such a project registered under CDM.

Conclusion

Carbon trading opens up a great opportunity for developing countries to accelerate the economic development cycle. Emission limits in one way can be looked at as a resource for the developing nation which can be used to trade with developed nations. Feasibility of Solar energy project is high in India with the supporting fact that irradiation data national average of solar irradiation of 5 $kWh/m^2/day$. The opportunity is for developing countries to invest in renewable energy projects since cost of implementation of such projects is comparatively lower in developing countries and trade the equivalent amount of emission reduction credits generated by these projects to the developed countries. This way the total combined emission of both transacting countries remain within safe limits and at the same time project is executed at the lowest cost possible. Carbons trading opens up a big revenue generation gate to the developing nations and at the same time promote more and more renewable energy projects in these countries which will ensure the reduction in emission of pollutants. The regulatory authorities will require to play a major role in this prospective to start rolling the ball for this actions. Diplomats at the highest levels of government will be a key role in negotiations with World Bank and multinational organizations to bring prospective parties to trade this carbon credit with them. The balance match of the supply and demand side of carbon trading will solve the bigger purpose of contributing to reduce our emission of GHG's and avoid changes in our climate and restrict the problems of global

warming. The major point that is revealed from this study is that people are not aware about the carbon trading mechanisms and its associated benefits. Our study gives an important insight that creating awareness level among people is the primary step to be taken. Also there are other huddles which come up when we try to move beyond and look at the implementation challenges of renewable energy projects and carbon trading mechanism. Only when people are aware of the issue and its remedies, can a solution to drive the issue of global warming can be initiated.

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