

## **Carbon Credits: Relevance to Electrical Industry**

Burning fossil fuel over the last 200 years, we have added 400 Gigatonnes of Carbon Dioxide into the atmosphere. (1 GT = 1000 million tones.) The plants have been able to absorb only 200GT and the balance is still there in the atmosphere. This is the primary cause of Global Warming and Climate Change. The effects of Global Change. The effects of Global Warming is now felt by mankind through climate changes, melting of ice caps in the Arctic Zone, and rise in the sea level – reducing the land area, while threatening marine life etc.

The solution to Global Warming lies in the development of the green cover or forest cover, to absorb the excess CO<sub>2</sub>, together with harnessing renewable sources of energy in lieu of fossil fuel – so as to arrest the pollution level from further increasing. Sustainable development our Nation depends upon the source and cost of energy, as industry has become highly energy intensive. At present we are dependant on Grid based, and polluting the environment.

Sustainable development of the Nation in general and our industry in particular, can be achieved through opting for Renewable Energy programs such as Wind, Biomass, Solar, and MiniHydel etc. Renewable Energy contributes both towards sustainable development protection by sheer virtue of its inexhaustible nature. Renewable Energy Sources will offer long term Energy Security to our Nation as well as contribute to Environment through Clean Energy. In turn, this will save for our Nation equivalent Grid power for which the Country has to import fossil fuel – be coal or petroleum.

Till recently, we have been speaking about the Energy Security of the Nation. In his recent address our President, Sri Abdul Kalam has given a new challenge i.e. Energy Independence of our Nation by the year 2030. This is possible only through harnessing renewable energy sources as well as implementing Energy Efficiency programs.

### **The need for energy efficient technologies, in Demand Side Management**

India has over 125,000 MW installed capacity in power generation, and another 100,000 MW has been planned in the next five years-before 2012. While generation has a mix of Hydel, Nuclear, Wind, Biomass, and Thermal – the major contribution is still from thermal power generation, based on fossil fuel, which is either coal or lignite.

The cost of power generation has been steadily going up over the years, with steep increase in fossil fuel prices. In addition, with depleting sources of fuel, Energy Security is also threatened. Further use of fossil fuel has been clearly proved to be the cause of Global Warming, and there is an urgent need to reduce the use of fossil fuel.

Most of the States have been subsidizing the cost of electricity to the common man. While the cost of generation is around Rs.3.00 per unit on an average, the consumer pays as low as Rs.0.50 per unit. Besides, millions of homes have been given free electricity in rural areas and in addition to farmers.

All the above factors point towards the urgent need for energy efficient the urgent need for energy efficient technologies on the Demand Side Management in Utilities. This lead to several benefits for various stakeholders namely:

- 1) Reduction in the Monthly Electricity Bill to the consumer.
- 2) Reduction in the subsidy given by various States to the consumer, by virtue of reduces consumption of Electricity due to Energy Efficiency.
- 3) States can deploy the energy thus saves, to more productive and profitable purpose.
- 4) States can strive for long term Energy Security by conserving fossil fuel, and contribute to Environment by reduced emission of Carbon Dioxide.
- 5) The State can look towards Sustainable Development, with reduced dependence on fossil fuels.
- 6) The programs will bring in very large investments into the States – providing improved employment generation.

## Introduction to Carbon Credits

16<sup>th</sup> Feb 2005 marked the coming into force of the Kyoto Protocol to the UNFCCC (United Nations Framework Convention on Climate Change). The Kyoto protocol provides impetus for trading in Carbon as a commodity. This is driven by the fact that the Protocol delineates the commitments of developed countries to reduce their GHG (green house gases) emissions.

Apart from taking measures domestically, flexibility in achieving these reductions is granted through three instruments – ET (emission trading), JI (joint implementation), and CDM (clean development mechanism). While ET and JI involve trading and project partnership among Annex I countries (developed countries and economics in transition), CDM envisages collaboration of Annex I countries with developed countries on GHG reduction projects.

With the Kyoto Protocol coming into force, there is renewed vigour for mechanisms such as the CDM, which will not only help Annex I countries meet their binding emission reduction commitments, but also provide for implementing projects that meet sustainable development criteria for non-Annex I countries. It thus becomes important for developing countries, particularly India, to explore various opportunities for emission reduction that along with the national development priorities.

## What is CDM?

### The Kyoto Protocol and CDM

While global warming has been a subject of discussion and concern of the global community since 1987, it was at the Rio Convention in 1992 that a special purpose vehicle was instituted to study the impact of Global Warming and suggest measure to arrest further deterioration of the environment.

In the year 1997, at the Third Conference of Parties (COP 3), to the United Nations Framework Convention on Climate Change (UNFCCC) in Kyoto Japan, a protocol was adopted, to reduce the carbon emissions by at least 5% less than the benchmark year 1990. The Kyoto Protocol demands the developed nations to reduce their carbon emission at least by 5.2% less than that of the year 1990, by the end of year 2012 – the commitment period starting 2008. The protocol also defines Clean Development Mechanism (CDM) to facilitate the developed nations to achieve the objective.

CDM offers opportunities to developed nations to undertake Clean Energy Programs in Developing Nations (developing nations do not have emission deduction obligation) and take credit of such emission reduction to their account, and comply with the protocol. Thus carbon has become a tradable commodity.

Carbon emission – a major cause of global warming, is primarily due to use of fossil fuels such as coal and petroleum in thermal power plants, and automobiles. Therefore any project undertaken to improve the energy efficiency in the utilities, or renewable sources of energy or clean energy projects supporting emission reduction, qualify for carbon credit.

## Value of carbon

As a result of the Kyoto Protocol, Carbon has become a tradable commodity with an associated value. One tonne of CO<sub>2</sub> reduced through a CDM activity, when certified by a designated entity, is known as a CER (certified emission reduction), which can be traded.

Revenue from CERs can form part of a project's annual inflow, equity, and debt.

At present Carbon is traded at around Euro 8 to 10 per CER, and the prices can be expected to rise as the deadline for meeting the Protocol targets draws nearer. And so, the countries/companies save carbon credits to meet strict targets in the future.

## CDM project cycle

As defined in Article 12 of the Protocol, CDM is defined as a mechanism to address the following objectives: 1) Assist non-Annex I countries in achieving sustainable development. 2) Help Annex I countries comply with commitments. 3) Contribute to the ultimate goal of the UNFCCC, i.e. stabilization of GHG concentration in the atmosphere.

Examples of CDM project activity includes:

- 1) CO<sub>2</sub> displacement through use of renewable energy for power generation (such as Wind Turbine generators) and thermal energy.
- 2) CO<sub>2</sub> sequestration through afforestation and reforestation.

- 3) Landfill capture and energy generation.
- 4) Landfill capture and energy generation.
- 5) CO<sub>2</sub> displacement through fuel switching from fossil fuel to Bio fuel.
- 6) CO<sub>2</sub> reduction through waste heat recovery.

To get certified, potential CDM projects need to undergo a series of following steps:

#### **STEP I (Preparation of PDD)**

Upon identifying an eligible project, the project developer has to prepare a Project Design Document (PDD) in the prescribed format.

#### **STEP II (Approval by DNA)**

Submit the PDD to the Designated National Authority (in our case it is the Ministry of Environment and Forest) for approval.

#### **STEP III (Validation)**

Then submit these documents (PDD and approval Designated Operational Entity (DOE) for Validation. There are a few DOEs in India like DNV, TUV, JGA, and SGS.

#### **STEP IV (Registration)**

After validation, the DOE forwards its reports to the Executive Board, which normally registers the project as a CDM project within eight weeks.

#### **STEP V (Monitoring)**

Monitoring is the systematic surveillance of project performance by the project developer. For this purpose, a transparent and reliable monitoring plan must be specified to collect and archive all data needed to estimate GHG emission occurring within the project boundary, determine the baseline emissions, and determine leakage.

#### **STEP VI (Verification)**

Verification is the periodic independent review and ex-post determination by the DOE of the monitored emission reductions resulting from the CDM project. In case of small-scale projects, the same agency that did the Validation can perform the Verification too.

#### **STEP VII (Certification)**

Certification is the written assurance by the DOE that the project has achieved the emissions reductions as verified.

#### **STEP VIII (Issuance of CER)**

Within fifteen days of the DOE making its certification report public, the Executive Board issues the necessary CERs. A registry for the issuance and tracking of CERs is under development by the Executive Board.

The project developer has two options for the period of receiving credits: 1) Ten years without any revision in the base line. 2) Twenty-one years with a reassessment of the base line after every seven years.

#### **Possible eligible CDM project activities**

Possible Eligible Projects of RE/EE Programs would include:

- 1) Wind turbine generators – for captive consumption / grid connected.
- 2) Improvement of energy efficiency at the Utilities.
- 3) Waste heat recovery programs.
- 4) Fuel switching from fossil fuel to Bio fuel.
- 5) Biomass Power Generation.
- 6) Biomass Gasification.
- 7) Biomethanation.

- 8) Bio fuel oil.
- 9) Small Hydro Projects.

### **Wind turbine generators**

Wind Turbine Generators, being a renewable source of energy qualify for Carbon Credits. Projects can be either for captive consumption or Grid connected. Every MW of WTG, operating at 30% Plant Load Factor is capable of reducing approximately 2000 tons of CO<sub>2</sub> annually, or can receive 2000 CERs annually.

### **Improvement in energy efficiency**

Possible programs in improving energy efficiency at the Utilities will include:

- 1) Replacement of old motors with EEF motors
- 2) Replacement of old lighting with EEF lighting and electronic chokes.
- 3) Replacement of old spindles with EEF spindles.
- 4) Replacement of old electro mechanical drives with invertors.
- 5) Replacement of old compressors with EEF compressors.
- 6) Replacement of old humidification fans with EEF fans.

A 100 KW energy saved will result in net CO<sub>2</sub> reduction of approximately 900 tonnes per annum and earn a Carbon revenue of Euros 9000 per year.

### **Particular relevance to the electrical industry**

Power has a direct equation to Carbon Credits. Every unit of electrical energy either saved, or generated through renewable source, that contributes to reduction in CO<sub>2</sub> in the atmosphere, is eligible for Carbon Credits. At the present value of CERs, we can look forward to revenue of Rs.0.50 per unit of electricity thus saved, or produced. And, that the credit will be applicable for a minimum period of 10 years, is an added advantage.

This has direct relevance to the electrical industry and in particular to manufacturers of energy efficiency equipments, namely:

- 1) Energy efficient transformers such as low loss Amorphous Core Transformers.
- 2) Energy efficient motors with efficiency in the range of 94%.
- 3) Energy efficient lighting – both lamps such as CFL and LED, and Luminaries.
- 4) Power factor improvement capacitors.
- 5) Variable speed drives.
- 6) Energy efficient pumps and fans.
- 7) Energy efficient airconditioning and refrigeration (such as VAM).

The manufacturers of the above equipments can make use of Carbon Credits either as a marketing tool for their sales promotion, or can also consider carbon revenue as an additional revenue stream as an additional revenue stream for their organization. The underlying philosophy is that the ownership of Carbon Credit will vest with the project developers – and equipment manufacturers can at best be instrumental to the program.

In many instances, the credit through energy efficient equipments will be small – and for the projects owners, it may not be attractive to pursue the CDM cycle with high transaction cost. Here is the opportunity for the equipment manufacturing to bundle all their clients into a sizable project, and share the cost among the owners, by acting as a Bundling agent, and thus making CDM feasible.

While the above equipments will form improvement of energy efficiency in Demand Side Management, there are equal opportunities available in the Supply Side Energy Management – in particular, in the programs of reduction of transmission and distribution losses.

## **Energy efficient transformers**

As such transformers are stationary equipment, the efficiency is of the order of 98%. The losses are mainly categorized as Core Losses (No Load Loss) and Copper Losses (Load Losses). While the Copper Loss is a function of load, the Core losses are the main concern as they continue to happen so long as the transformer is energized – and transformers are energized for almost 365 days a year; 24 hours a day.

Hence much research has gone into the reduction of Core losses. The Amorphous Core Transformer is the latest development in the transformer industry. These energy efficient transformer offer additional 0.5% efficiency over conventional transformers. As the transformers are in use over 365 x 24 hours, the cumulative savings can be tangible.

However, the Carbon Credit generation from a single transformer is too low, even with very high KVAs. Therefore it may not be attractive for the user industry to pursue Carbon Credit for his transformer.

At the same time, State Utilities, undertaking distribution of power to the people can make best use of this application, where the use of these transformers will be in 1000's and all these can be bounded into one CDM application.

The manufacturer and supplier of these transformers can very well build the Carbon Revenue proposal while bidding for the project, as an additional marketing tool.

## **Energy efficient motors**

Unlike transformers, a motor is a dynamic equipment and hence losses (Iron Loss and Copper Loss) are high. Further, the losses are more with lower HP motors – and 80% of the motors belong to low HP category.

Today, we have motors with efficiency as high as 94.6%, while conventional motors offer efficiency of 88% or 89%. The difference in the energy saved can be eligible for Carbon Credits. One of the chief concerns of the users of energy efficient motors is in the rewinding these motors in case of burn out. The local mechanics still continue to be in the old technology, and thereby will reduce the efficiency of the motor in case it is rewound. Alternatively, the user has to send these motors to the manufacturer for rewinding, or replace it with a new one – which can be an expensive process. Here, the user may use Carbon Credit to address such risks faces by him, by investing in high cost energy efficient motors.

## **Variable frequency drives**

Variable Frequency Drives (VFDs) have become a boon to the user as against conventional Electro Mechanical Drives. These VFDs adjust the input energy according to the variation of the loads, thereby offering savings in energy used. At the same time, these VFDs use highly sensitive electronic components such as Thyristors and IC chips. These are susceptible to voltage fluctuations and likely to be damaged. The manufacturers often do not offer guarantees for these products.

Costs of VFDs are as so very high, and not affordable in lower KWs. Here is where the carbon revenues can support the user to opt for these drives, to address the risks and high costs. Manufacturers of VFDs can use carbon revenues to leverage these sales as well.

## **Waste heat recovery programs**

Waste heat from exhaust gases in power plants, process kilns, and furnaces can be captured and converted into a useful form of secondary energy such as:

- 1) Steam for use in processing.
- 2) Hot water
- 3) Hot air for pre-heating.
- 4) Chilled water for air conditioning.
- 5) Chilled brine – for use in Cold Storages.
- 6) Combined cycle power generation through steam turbines. CO<sub>2</sub> reduction through WHR is by way of displacing conventional fossil fuel or power required to produce equivalent amount of secondary energy.

### **Biomass power generation**

Renewable Biomass is an eligible project under CDM. Biomass power can be either for captive consumption or Grid connected. The energy generated can be:

- 1) Only power through Steam Turbine Generator (STG)
- 2) Combined heat and power, with use of waste steam for secondary energy.
- 3) Combined cycle power plants using heat from exhaust gases. A one MW power plant operating at 95% Load factor can earn Carbon revenue of the order of 4500 CERs annually. Wherever a small quantum of fossil fuel is used, there will be leakage to be accounted for.

### **Biomass gasification**

Renewable woody biomass can be used in gasification to produce Producer gas (chiefly CO + H<sub>2</sub>). These can be used in IC engines for power generation or as fuel in boilers / furnaces. Therefore the utilization can be:

- 1) Only power generation through IC engines
- 2) Combined Heat and Power.
- 3) Fuel switch in boilers/furnaces.

One MW power plant operating at 95% Plant Load Factor can earn a Carbon revenue of approx. 4500 CERs, annually. We need to consider a leakage if a small amount of fossil fuel is used in combustion.

### **Biomethanation (Biogas)**

The concept is similar to gasification except that in Methanation we do anaerobic decomposition of organic matter/animal dung to produce methane (CH<sub>4</sub>), and the same is used as fuel.

### **Bio fuel oil**

Bio fuel oil is the raw vegetable oil extracted from non-edible oil seeds, such as Jatropha, Hongai, Neem etc. This oil is the best substitute for Petro Diesel. The calorific value is close to that of diesel, so the use of Bio fuel oil forms a renewable source of energy, and has multiple advantages.

Therefore the utilization can be:

- 1) Only power generation through IC engines.
- 2) Combined heat and power.
- 3) In transportation

### **Small hydro projects**

Small hydro is a Clean Energy Program eligible under CDM. The power produced is seasonal, and lowers the plant load factor. In addition, the risks associated with draughts and floods can be mitigated through Carbon revenue. One MW of small hydro is capable of generating over 3000 CERs annually.

### **Small scale CDM**

In order to encourage small projects to participate in CDM activity, the Executive Board has formulated simplified procedures for small-scale projects, with reduced fee structures. Upto 15 MW renewable energy project is termed as small-scale project.

### **Bundling of few small projects**

The whole procedure of CDM involves high cost of Preparation, Validation, Registration, Monitoring, Verification and Certification. In our Indian context even a small scale project is expensive. The CDM provides a bundling of similar projects and shares the common expenditure among the participants.

### **Time lines**

Time Lines required to carrying out various activities shall be:

Development of PDD: 3 months from date of agreement

Validation: 4 months from date of submission of PDD

Registration: 2 months from the date of Validation

Verification and Certification: 2 months from Registration

The electrical equipment manufacturers, manufacturing energy efficient equipments are encouraged to integrate CDM in their business models, and bring Carbon Credits available to the users. In addition they can boast of contribution to environment by the measured quantum of CO<sub>2</sub> reduction through their equipments.

**Reference book:**

Electrical India

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