Project Dissertation Report on

CARBON FINANCING

EMBA – 407: Major Project (IVth Semester)

Submitted by

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CERTIFICATE

This is to certify that Raj Kumar Rakhra**,** Roll No.: 2K19/EMBA/541 student of Masters of Business Administration (Executive 2019 – 2021) at Delhi Technological University, Delhi has accomplished the project titled **Carbon Financing** under my guidance and to the best of my knowledge completed the project successfully, for the partial fulfilment of the course in 4th semester of the course Executive MBA.

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DECLARATION

I hereby declare that the Project Dissertation Report titled "**Carbon Financing"** is the outcome of my own efforts under guidance of Mr. Chandan Sharma.

The project is submitted to the Delhi School of Management, Delhi Technological University as a part of Executive MBA Program for the academic session 2020-2021. I also declare that this project dissertation report has not been previously submitted anywhere.

ACKNOWLEGMENT

This project would not have been possible without support of many people. I would like to acknowledge & extent my heartfelt gratitude to following persons who have made the completion of this project possible.

Mr. Chandan Sharma, Assistant Professor – Delhi School of Management, Delhi Technological University for guiding & encouraging me for this project work, my employer, EESL, for sharing information & guidance, my colleagues, senior, EMBA classmates who helped me throughout the duration of this project.

Last but not least, I would like to express my love & gratitude to my beloved family, for their understanding & motivation, throughout the duration of this project.

(Raj Kumar Rakhra)

2K19/EMBA/541

Executive Summary

Climate change has put the world's development in jeopardy today. It is one of the world's greatest problems today, and the awareness that human activity is causing global warming has made it a central mission all over the world.

Day to day activities like driving of vehicle, use of heating & air-conditioning & lighting of household consumes energy. These produces emissions of GHG-Greenhouse gases, major being carbon dioxide (Co2), which are the major contributors to the climate change.

With rise in emissions of GHGs, the Earth's experience a climate change with increase in average temperature & average weather changes.

Agriculture & forest sector is also responsible for the climate change. This sector offers sources, sink & storage for the typical greenhouse gases namely CO2 (Carbon dioxide), CH4 (Methane) & N2O (Nitrogen oxide).

Forestry & agricultural practices followed emits these GHGs into the atmosphere.

- Agricultural residue burning leads to rise in CO2 level.
- Usage of fertilizers, soil releases N2O.
- CH4 is released from livestock & also when rice is grown under flood conditions.
- Tree cutting & land conversion to cropland creates a source of CO2 emission.

The emissions of GHGs from industrialization, agriculture, forest practices etc are increasingly threating life on earth. To slow down the impacts of climate change, they must be minimised as soon as possible.

This brought the world together & on March 21, 1994, the United Nations Framework Convention on Climate Change (UNFCCC) was established with the sole purpose of preventing dangerous human interference with the climate system. The convention now has 197 countries as signatories.

The UNFCCC's ultimate goal is to stabilise GHG concentrations at a certain amount. These goals must be met within a certain amount of time. The time period should be long enough for ecosystems to respond to climate change naturally, food security should not be jeopardised, and economic growth should be sustainable.

The convention acknowledged that developing countries are primarily to blame for the increased levels of GHG pollution in the atmosphere. The convention placed a greater responsibility on these countries, and they were required to do the most on their own

soil to reduce GHG emissions to 1990 levels by the year 2000. Some nations have succeeded after taking strong actions within their country.

World's developing & poorer countries need economic development. Even without the added complications of climate change, this is difficult. The Convention anticipated that the proportion of GHG emissions emitted by developing countries will rise in the future. Nonetheless, in the interests of sustainable prosperity, it aims to assist in the reduction of pollution in ways that do not impede these countries' economic growth. Developing world lack resources & herein the developed world needs to chip in.

On December 11, 1997, the Kyoto Protocol to the Convention was conceived. Due to the lengthy approval & complex ratification process, it entered into force on February 16, 2005. The Kyoto Protocol has 192 countries/parties as of today.

The Kyoto protocol operationalized the UNFCCC by getting commitments from industrialized countries & developing economies to limit & reduce GHGs emissions with agreed individual targets. Over a five-year term, the binding carbon reduction goals were revised upwards by 5% more as compared to 1990 levels (from 2008-2012, the first commitment period).

On December 8, 2012, the Doha Amendment was enacted & approved under the Kyoto Protocol for the second commitment duration (2013–2020). In the second commitment cycle of eight years, the parties to the convention agreed to reduce GHG emissions by at least 18 percent below 1990 levels.

The convention compelled the nations across the world to go green across all the responsible sectors. Is the set target achievable? How polluting industries will reduce their emissions. This issue was more predominant to the industrialized world. How their emission producing sector will respond as this need lot of investment. Either they should adapt to new technologies which reduces the impact of emissions but also impacts their bottom line or they should close which would have catastrophic impact on nation's economy & employment.

One of the most important core elements of the Kyoto Protocol was built on this principle – "flexible market mechanisms," which were focused on the trading of emission permits. According to the protocol, countries must first fulfil their primary commitments by national initiatives. However, the Protocol provided these countries

with three market-based mechanisms as a secondary means of meeting their expected obligation targets:

- Clean Development Mechanism (CDM)
- International Emissions Trading
- Joint implementation (JI)

The above mechanisms promote greenhouse gas reduction, starting with the most cost-effective regions, such as the developing world. If the pollutants contributing to the climate are eliminated from the atmosphere, it makes no difference where they are minimised.

In addition, these mechanisms promote green investment in poorer countries and involving the private sector in these mechanisms to minimise and stabilise greenhouse gas emissions at a safe level has a parallel advantage. It also allows for the replacement of older, dirtier technologies with modern, cleaner systems and facilities, which is initially more expensive but has obvious long-term cost savings.

Here innovative financing solutions, CARBON FINANCE, could play a remarkable role. Worldwide, the carbon markets are created which provides an additional avenue of income for clean energy projects. One of the most valuable sources of funding for climate change programmes is the CDM (Clean Development Mechanism). Countries that signed and ratified the Kyoto Protocol were subject to maximum carbon emission standards for particular time periods, and they traded carbon credits.

What is Carbon Finance –

- A branch of environmental finance that deals with financial instruments such as carbon emission trading in order to reduce the effect of GHGs on the atmosphere by putting a price on carbon emissions.

  This market-based instrument can reduce the financial risk by transferring the environmental risk & helps in achievement of environmental objectives.
- This umbrella term refers to investments in greenhouse gas emission reduction programmes as well as the development of a carbon-tradable financial instrument.
- This broad term refers to funds allocated to a project in order to obtain properly certified GHG reductions (also known as “carbon”). These emission reductions may then be used by the buyer to fulfil his or her own obligations. The first carbon

purchase was made in 1996, and the number of carbon purchases has steadily increased since then. Carbon funds are financial institutions that make carbon finance easier to operate.

- This is a broad term that refers to the revenue streams produced by low-carbon projects and activities through the selling of GHG emission reductions by sources, greenhouse gas emission removals by sinks, or carbon credit trading.
- **Carbon credit:** It serves as a medium of exchange for carbon emissions. One tonne of CO2 emissions equals one carbon credit.
- **Carbon market:** A virtual financial platform where people buy, sell carbon credits.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Industry Profile

Energy Efficiency Services Limited is an Energy service Company (ESCO). An ESCO does the total project investment with no upfront investment by the clients. The recovery of investment is through monetization of energy savings realized from the project.

The USP of an ESCO is innovative financial models which provides customized, comprehensive & cost-effective solutions to clients. By upfront investment by an ESCO the first barrier of investment is addressed & also the performance risk is transferred from client to an ESCO.

As the world focuses on achieving the sustainability goals, the ESCO's are being recognized as cog in the wheels. Still funding remains a major challenge for an ESCO. Agencies like world bank, IFC, ADB, many major banks have come forward with specific allocations for sustainability projects driven by ESCO's.

Under the umbrella of Ministry of Power (MoP), EESL is the world's largest public ESCO leading the county through large energy efficiency projects & contributing to India's sustainability goals.

1.2 Organization Profile

EESL is an entity under the umbrella of Ministry of Power, GoI. It's a joint venture promoted by four public sector undertakings, NTPC Limited, PFC Limited, REC Limited and PGCIL. EESL net worth of as on 31st March 2020 is INR 11.5 billion as per the companies Audited Financial results.

The company is a Super-Energy Service Company (ESCO) that helps governments, businesses, and customers handle their energy needs more efficiently through the use of energy-efficient technologies.

EESL is one of its kind organization supported by Government in implementing the world's largest non-subsidized energy efficiency portfolio. EESL is working across sectors like residential lighting, municipal lighting, building energy efficiency, municipal energy efficiency, agriculture demand side program, e-mobility (Electric Vehicle & its Charging Infrastructure), smart electricity metering and ground mounted decentralized solar power plants at a size that no other company has ever been able to match.

To make the business model/program viable, EESL focuses on solution-driven innovation with no upfront capital investment (CAPEX) from clients and no government subsidies. In mostly all the programs it operates on Pay-As-You-Save (PAYS) model, wherein clients pay from monetized energy savings over the course of a project's life cycle, with no initial capital investment.
EESL adopts energy efficient technologies & programs related to energy sector where cost is the first barrier. By demand aggregation, economies of scale and innovative financial modelling EESL brings and achieve its objective of sustainable market transformation. Now EESL is focusing on Carbon Finance for reduction of project cost to reach a larger cross section of the society.

1.3 Objective of the study

The project's aim is to better understand carbon finance, its concept, its uniqueness in leveraging the cost of funding, how carbon finance can help in achieving the sustainability goals & live example of a project.

2.0 Research Methodology

The purpose of research is explanation therefore **explanatory research** is used in this case.

This research:

- Explains & Answers: Why it is being done? For What purpose? Where? When? Who?
- Explanatory research tends to explain/answers 'Why'.
- This provides clarity to audience to understand the researcher**.**

It attempts to connect different ideas and to understand the different causes, effects & reasons.

The **data collection** method is **secondary research** which would be both **qualitative & quantitative**.

Secondary analysis, also known as desk research, is a method of gathering information from previously collected data. Existing data is compiled/collected in order to improve job performance. This includes the data, which is already published in research reports, papers & journals etc. These are available at websites, public libraries etc. Non-government/government agencies also publish & has a data bank which can be used for case purposes.

Secondary research is very cost-effective to other type of research especially primary research, as it utilizes the already existing data.

Secondary Research Methods:

Since secondary/desk research is cost effective it is one of the reasons which makes it a popular choice among organizations/businesses. Since primary research requires huge sums of money to conduct research & gathering of data therefore not every individual/organizations are able to afford it. Since data can be obtained simply by sitting behind a desk, this research is referred to as desk research.

Forms/methods of secondary data collection:

1. Educational Institutions: The data collection by universities is mainly used for primary research.

2. Government & non-government agencies: The biggest plus is that the data which is obtained from these bodies are authentic & trustworthy.

3. Data on Internet: Popular, readily available & cheapest & popular way of collecting the desk data.

4. Libraries: It is also a source of important research paper & publications for secondary data.

5. Commercial sources: TV Channels, newspapers, magazines, radio stations & Journals are other sources of obtaining secondary data. They provide information on the political agenda, economic trends, demographic segmentation and market analysis, and other related topics.

3.0 Introduction to the case

3.1 About Carbon Finance

At COP 21, the UNFCCC's (United Nations Framework Convention on Climate Change) 21st Conference of Parties, held in Paris in December 2015, world leaders resolved to keep global average temperature rise below 2 degrees Celsius. The agreement encourages parties and governments to make voluntary Nationally Determined Contributions (NDCs) toward sustainable targets. The parties also agreed to step up and accelerate the actions and investments needed to achieve a low-carbon future. To satisfy these NDC obligations, governments will need to expedite the adoption of low-carbon technology and make large investment adjustments.

The Paris Agreement's carbon pricing mechanism and instruments have put a price on the right to emit GHC, and these are emerging as essential enablers for this shift. The Paris Agreement highlights the growing importance of carbon finance/pricing in achieving global climate goals. The agreement acknowledges the value of carbon financing in incentivizing & motivating GHG reductions.

Article 6 of the agreement specifies procedures aimed at assisting in the mitigation of GHG emissions and supporting sustainable development by facilitating and encouraging mitigation measures by private and public parties to achieve a worldwide reduction in emissions. The share of the income from these instruments/mechanisms will go to developing countries to help them adapt to climate change's effects. The national, subnational, and international carbon initiatives enables & promotes cross-border mitigation cooperation.

Global Trend:

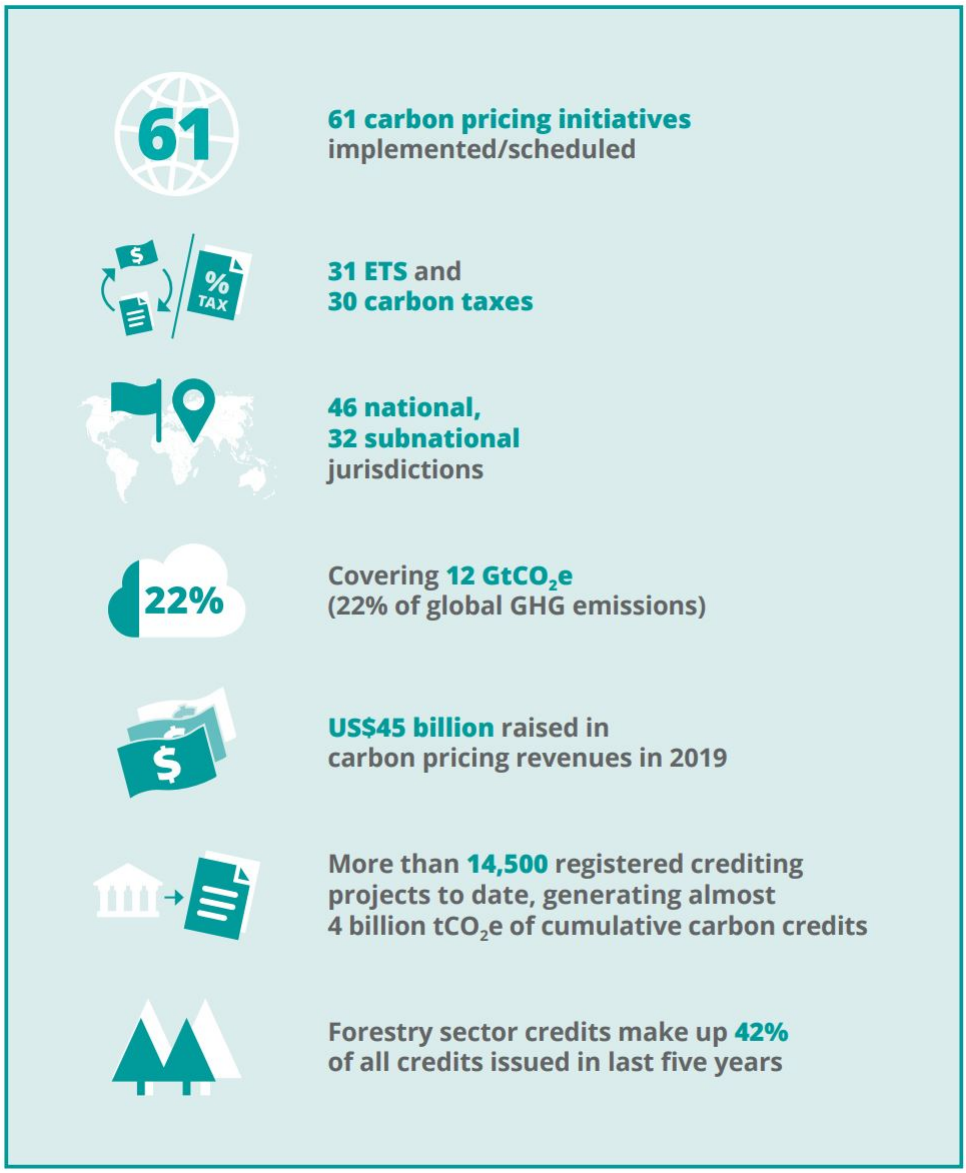

Figure -1

Carbon pricing is being more widely used around the world. According to the World Bank's State and Trends of Carbon Pricing for 2020,

- ✓ In their attempts to reduce emissions, 46 national and 32 subnational regions, states, and cities has adopted some form of carbon finance/pricing.
- ✓ Carbon pricing mechanisms/instruments encompass around 12 gigatons of carbon dioxide equivalent (GtCO2e), or roughly 22% of worldwide emissions.

- ✓ The carbon price range is between US $1 to $120 per tonne of CO2e. Half of the carbon price globally is less than US $ 10 per ton of CO2e.
- ✓ 61 carbon pricing initiative implemented/scheduled which consists of 31 emission trading scheme (ETS) & 30 carbon taxes.
- ✓ More than 14500 registered crediting projects till date.
- ✓ Forestry sector credit is 42% of all credit issued in last five years.

Clean Development Mechanism (CDM) has dominated the crediting market. After the crash of the CDM markets in the year 2012, the crediting activities has stabilized. The companies are trading in the voluntary markets with independent crediting mechanisms. Various governments are also developing the domestic crediting marketplace.

The only two sources of international mitigation outcomes are Japan's and the Republic of Korea's nationally run mechanisms.

The establishment of carbon finance markets and their interconnection provides a platform for the transfer of mitigation outcomes from one jurisdiction to another, allowing for lower-cost reductions and thus facilitating the transfer of funding for reduction efforts. Carbon markets (ETS) are becoming more popular in emerging nations than carbon taxes.

The Indian Context:

INDIA made four commitments under its Intended Nationally Determined Contributions (INDCs) at the United Nations Framework Convention on Climate Change (UNFCCC) 21st session of the Conference of Parties (COP-21) in Paris in December 2015.

i) By 2030, reduce greenhouse gas emissions intensity by 33-35 percent of GDP, compared to 2005 levels.
ii) By 2030, India's non-fossil fuel-based power generation capacity will account for 40% of the country's total power generation capacity.
iii) By 2030, afforestation and tree cover will add 2.5–3 billion tonnes of CO2 equivalent to the atmosphere.

iv) Adaption to climate change by enhancement in investments in vulnerable sectors to climate change, particularly coastal regions, agriculture, Himalayan region, water resources, health & disaster management.

The Indian government has taken a number of steps. Here are some of them:

- ✓ Consumption of coal is subject to a tax.
- ✓ Mechanism of feed-in-tariffs
- ✓ To achieve Renewable Purchase Obligations, market-based instruments such as Renewable Energy Certificates (REC) are used.
- ✓ The Perform-Achieve-Trade (PAT) method improves energy efficiency at the plant level.
- ✓ Complementary initiatives include public awareness campaigns, appliance energy efficiency labelling, and the usage of energy efficient appliances through programmes like BLY and now UJALA, as well as targeted research and development (R&D).
- ✓ The Indian cabinet approved the world's largest renewable energy expansion programme to add 175 GW of electricity capacity by 2022, which would generate 40% of its power from non-fossil fuel sources. Out of 175 GW, solar power target was up scaled from 20,000 MW of Grid connected projects to 1,00,000 MW/ 100 GW by 2022.

3.2 Market Size and Potential

Under the Climate Ambition Alliance, 120 Parties to the UNFCCC are working to attain net zero CO2 emissions by 2050 under the Chilean COP presidency, COP 25 held in December 2019. New Zealand, the United Kingdom, Denmark, Sweden, and France have all declared and established a net zero carbon dioxide emissions target in their legislation as of April 2020, while Bhutan and Suriname are already carbon negative.

More jurisdictions have expanded their coverage for consideration under complementary carbon pricing initiatives. In Europe, Austria, Germany, and Luxembourg are considering carbon pricing for industries not covered by the European Union Emissions Trading System (EU ETS) in order to meet the

EU's goal of carbon neutrality by 2050. Many countries are increasing their use of results-based climate funding (RBCF) and crediting mechanisms in order to achieve net zero emissions.

Carbon prices in the range of US $40 to 80 per tonne of CO2 by 2020 and US $50 to 100 per tonne of CO2 by 2030, according to the High-Level Commission on Carbon Pricing, are required to cut emissions cost-effectively in keeping with the Paris Agreement's temperature limiting goals.

The finalization of norms for international collaboration under Article 6 of the Paris Agreement is moving slowly because it involves a number of difficult rules, including,

- a charge on mitigation outcome transfers to support adaptation efforts in more vulnerable countries
- the transition of Kyoto Protocol credits.
- how to achieve global emission reductions on a large scale

Several pilots have begun to provide important insights into how transnational cooperation can deliver the infrastructure and emissions outcomes that are needed.

4.0 Concepts

4.1 What is Carbon Finance

Carbon finance provides the means to the implementation of the projects, carbon pricing provides the inducement/incentive to mobilize the maximum "cost-effective" mitigation options.

How Carbon pricing is the source of carbon finance?

- With carbon tax wherein tax is levied.
- With emissions trading by auctioning of emission allowances
- The revenue generated can be used for mitigation activities and/or adaption in the form of subsidies, grants, loan guarantees, loan, payment for result based finance, equity investment,
- Setting up of a domestic climate fund for both distributor & recipient of carbon price revenue.
- Unlocking of additional sources of carbon finance through carbon pricing.

Carbon pricing refers to programmes that impose an explicit price on GHG emissions, measured in monetary unit per tonne of carbon dioxide equivalent (tCO2e). Carbon crediting methods, ETSs, carbon taxes, gold standard & the results-based climate finance are examples of pricing methods.

The following are the five types of carbon pricing methods that have been considered:

- Carbon crediting mechanisms: Parties/actors who voluntarily execute emission reduction activities in addition to business-as-usual operations are issued tradable emission units by the system. It differs from ETSs, which impose mandatory requirements on participants. If policymakers decide to give regulated polluters another option for compliance, the crediting units can be tied to carbon prices or ETSs.
- ETSs: It is a policy tool in which covered entities are held accountable/obligated for their GHG emissions and can exchange emission units to fulfil their commitments. There are two types of ETS –
  i) Cap-and-trade: For a given sector of the economy, a maximum limitation on emissions is set, and the emitted units are either assigned

according to defined criteria or auctioned off. Emissions units must be surrendered by regulated emitters every tonne of emissions. They do, however, have the option of trading carbon allowances or reducing their own emissions.

- Baseline-and-credit system: For regulated emitters, a baseline is established. Emitters who exceed their designated baseline must surrender credits for the excess emissions. Polluters who reduce their emissions below a certain baseline obtain credits for their efforts, which they can sell to other emitters.
- Carbon taxes: Taxes, excise fees, and levies that explicitly put a price on carbon fall under this category.
- Results-based climate finance (RBCF): This is a type of carbon finance in which the funds are only paid to the recipient after the provider of the climate finance validates that the recipient has met a pre-determined set of climate change goals.

  Non-compliance based voluntary purchases carbon credits qualifies as RBCF.

- Internal carbon pricing: It is the practice of assigning a monetary value to GHG emissions in decision-making and policy analysis within an organization. Policies that implicitly price GHG emissions, such as the elimination or reduction of fossil fuel subsidies, fuel taxation, and abatement charges, can all help with mitigation.

What needs to be financed? – the mitigation

- Energy Efficiency
- power generation through low carbon usage
- transport using low carbon.
- Phase out of Flue gas emissions.
- Elimination of fugitive & waste emissions.
- Forest protection
- Sequestration

4.2 Concepts & role of carbon crediting mechanism:

Carbon crediting – A procedure of issuing tradable units to implementers who are conducting permitted emission reduction operations (emissions refer to emission avoidance, such as methane absorption from landfills and use for electricity, and emission sequestration, such as afforestation projects).

There are three categories of carbon credit mechanism:

i) International crediting mechanisms – International climate treaties govern these procedures, which are overseen by international authorities. The Clean Development Mechanism and Joint Implementation are two examples.

ii) Independent crediting mechanisms: There are no international treaties or national regulations that control these mechanisms. Independent third-party & private entities, usually non-governmental organisations, administer and control them. The Verified Carbon Standard and the Gold Standard are two examples.

iii) Regional, national, and subnational crediting mechanisms: These procedures are overseen by their respective jurisdictional legislatures and administrations. The Compliance Offset Program of the State of California in the United States and the Australia Emissions Reduction Fund are two examples.

The emissions reductions represent emissions that have been sequestered or avoided in addition to normal operations. It signifies that emissions are fewer to the counterfactual scenario without incentives from the crediting programs.

Figure 2 provides an overview of the concept of carbon crediting.

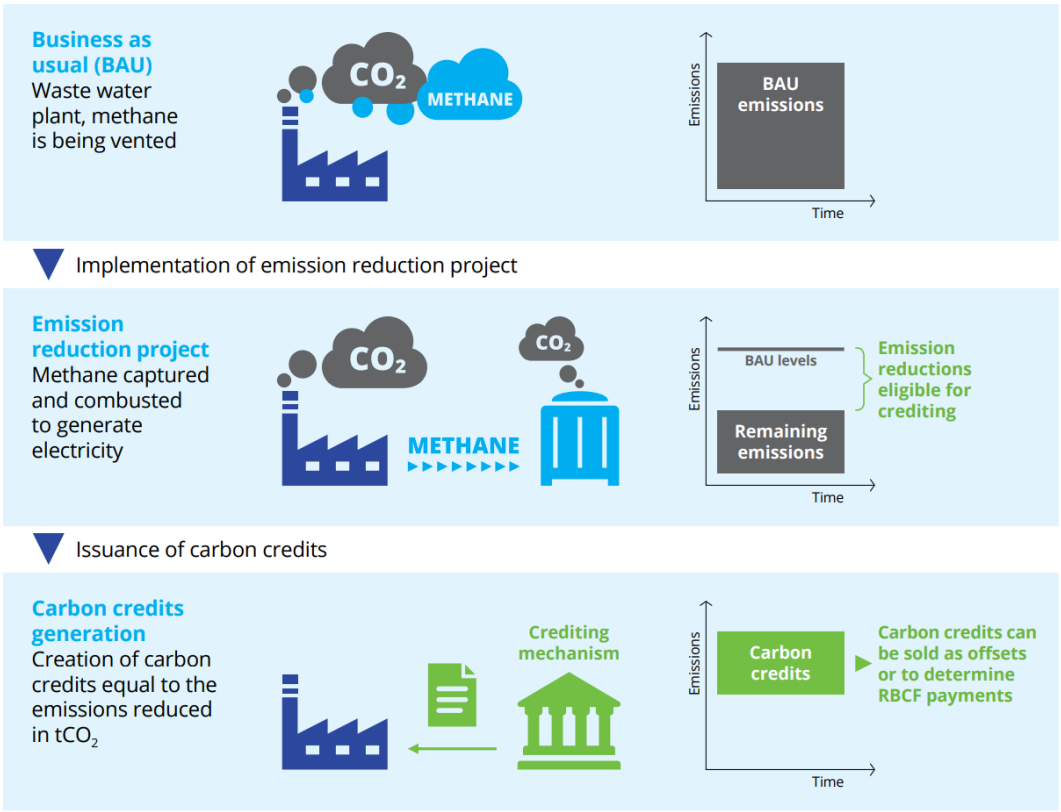

Figure -2

"Offsets" are one of the ways to utilize credits given under the carbon crediting methods. Emission reductions made by one emitter can be used to "offset" emissions made by another emitter. Apart from emissions offsets for mandatory ETS or carbon tax compliance, there is a voluntary market where carbon credits can be used to offset the emissions of organizations and individuals on a voluntary basis. Credits are also utilized to reward measured emission reductions from projects that have received carbon financing. While the majority of carbon credits are used for offsetting, it is critical to distinguish between the unit indicating a certified decrease in greenhouse gas emissions (i.e., the credit) and its specific usage, which may or may not be offsetting the Carbon credits for a variety of reasons. They can be established on a domestic level as part of an entity's ETS or carbon tax requirements.

Regulated enterprises can have some compliance flexibility by providing financial incentives (i.e., monetizable carbon credits) to sectors that are not covered by an obligatory carbon pricing plan, incentivizing them to cut

emissions and promote low-carbon innovation. Companies can also purchase Credits voluntarily to meet CSR (corporate social responsibility) or voluntary climate goals. Furthermore, governments can sell carbon credits as mitigation outcomes to meet their Nationally Determined Contribution commitments (NDC).

One of the main advantages of carbon credits is that it allows buyers to reduce some emissions by supporting mitigation in lower-cost regions or industries. Increased climate action ambition can be facilitated by lowering the cost of mitigation.

Although crediting allows entities to lower their GHC emissions in a variety of ways, their abatement strategy should go beyond offsets. Other types of steps will be required by actors to reduce GHC emissions in their own day to day operations.

The environmental integrity of a carbon credit refers to the environmental and social implications of the actions that created the carbon credit, as well as the accounting robustness of the carbon credit.

The definition itself of environmental integrity is not agreed upon or clear, but the crux is that carbon credit accurately represents genuine and real GHC emission reductions. Carbon crediting mechanisms follow best practised principles, which comprise sets of important conditions that projects must achieve in order to get credits, to reduce the danger of providing credits that are judged to be of poor environmental integrity. Figure 3 shows a few examples from the International Carbon Reduction and Offsetting Alliance (ICROA).

Real: All emission reductions and removals—and the project activities that generate them—shall be proven to have genuinely taken place.

Measurable: All emission reductions and removals shall be quantifiable, using recognized measurement tools (including adjustments for uncertainty and leakage), against a credible emissions baseline.

Permanent: Carbon credits shall represent permanent emission reductions and removals. Where projects carry a risk of reversibility, at minimum, adequate safeguards shall be in place to ensure that the risk is minimized and that, should any reversal occur, a mechanism is in place that guarantees the reductions or removals shall be replaced or compensated. The internationally accepted norm for permanence is 100 years.

Additional: Additionality is a fundamental criterion for any offset project. Project-based emission reductions and removals shall be additional to what would have occurred if the project had not been carried out.

Independently verified: All emission reductions and removals shall be verified to a reasonable level of assurance by an independent and qualified third-party.

Unique: No more than one carbon credit can be associated with a single emission reduction or removal as one (1) metric ton of carbon dioxide equivalent (CO_2e). Carbon credits shall be stored and retired in an independent registry.

Figure -3

The projects which generate credits can also provide/generate additional benefits beyond their emissions mitigation benefits. Health outcomes, habitat conservation, resilience, biodiversity, and water retention could all benefit from crediting methods that are specifically tailored to improve or support certain co-benefits.

5.0 Case Study – GRAM – UJALA (Unnat Jyoti by Affordable LEDs for all)

5.1 Introduction to the case

Since 1971, the Electricity consumption in Indian households has increased approximately 50 times to about 24.20 % with a CAGR of 7.58 % (Source- www.mospi.gov.in) of India's total Gross electricity consumption. It may continue to increase in the future due to following reasons:

a) India has achieved 100% electrification till March 2019 & is aiming to provide uninterrupted (24X7) electricity to all households by 2022.

b) Indian household incomes are increasing day by day & therefore aspirations of buy white goods appliances like refrigerators and air conditioners etc.

c) From 'Kachha Household' to 'Pakka Household' in villages.

d) Population growth to approx. 1.7 billion by 2047.

e) Urbanizations would grow to 51% by 2047. The increase in population would influence the use of energy consumption.

To meet the increasing energy demand, one way is to generate more and more electricity as the demand increases and other way is to utilize the electricity more efficiently by maintaining the same level of comfort. Generating more and more electricity as the demand increases, will not only deplete our natural resources but also increase the Global warming.

The political response internationally towards climate change took shape at the "Rio Convention" during the Rio Earth Summit - 1992, where "United Nations Framework on Climate Change (UNFCCC)" was adopted. The Rio convention brought forward action-based framework to limit & stabilize the GHGs concentration to avoid interference of GHGs with the climate system. The "United Nations Framework on Climate Change" came into effect from 21st of March 1994 & has a membership of 195 countries referred to as parties.

2015 Paris Climate Conference referred as COP21, clearly brough out a targeted aim of limiting the global warming temperature below 2 degrees

centigrade within the ambit of a legally binding universal agreement on climate change. This target set was a path breaking in the sense that it came out in over 20 years of climate change negotiations at the UN.

The COP21 set out landmark goals of,

- keeping the atmospheric temperature rise to well below 2 degrees C.
- to continue the efforts for keeping the atmospheric temperature rise limited to 1.5 degrees C.

For achieving the above goals, all the parties will continue the efforts to avoid reaching peak global emissions at the earliest and – remarkably – all the parties consented for net zero GHG emissions in near future. This is only achievable for the world community if the socio & economic parameters of equality, poverty & sustainable development is accounted for in the plans for emission reductions.

India being the fourth largest carbon emitter in the world has made a bold commitment for reducing its carbon emission by 33–35 % by the year 2030, compared to 2005 levels.

5.11 DELP (Domestic Energy Efficient Lighting Progamme)/ UJALA (Unnat Jyoti by Affordable LEDs for All)

Considering the targeted reduction of carbon emissions & to reduce the Electricity consumption in domestic sector, **DELP** (Domestic Energy Efficient Lighting Program) now referred as **UJALA,** which is one of its kind programs, was implemented by Energy Efficiency Services Limited (EESL) to distribute high energy efficient LED bulbs and educate consumers not to use incandescent or CFL bulbs.

Inaugurated by Hon'ble Prime Minister of INDIA on 05th January 2015, UJALA (Unnat Jyoti by Affordable LEDs for All) , is the world's largest domestic energy efficient lighting program of LED Bulb distribution, designed and implemented by EESL.

The program aims to manage demand side measures on energy efficiency after load research studies across DISCOMS in INDIA. The program is designed in

such a way that it immediately showcased the benefits & that had attracted largely all the state governments, the utility companies & the price sensitive Indian public.

Since launch of the project, under UJALA scheme more than 36.73 Crores of LED bulbs are distributed across the national. This has resulted in tangible benefits to all the stakeholders, State utilities, central utilities, Consumers in terms of energy saved, annual bill reduction, avoided generation capacity & reduction in Co2 (Carbon emissions).

The savings as per UJALA dashboard is as below:

UJALA DASHBOARD

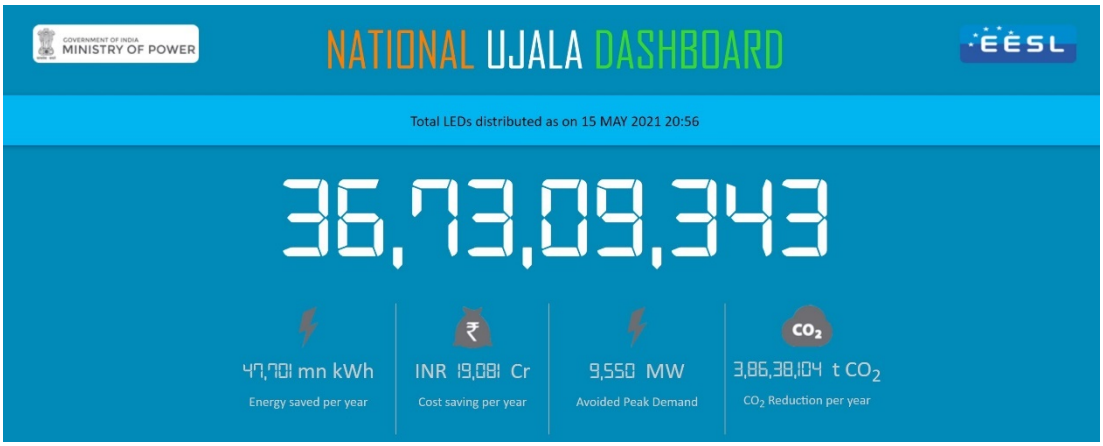

Figure -4

5.12 Urban and Rural Divide under UJALA

An in-house review of the penetration of Ujala in urban & rural households was undertaken. The analysis of the consumer data that was captured during the distribution of LED bulbs & the key findings are:

- Almost 80% of the households that procured LED bulbs under the program are from Urban areas.
- Rural area penetration was low largely on account of the price of the bulb (Rs. 70).
- Penetration in rural households is inversely proportional to pricing – lower the cost of LEDs the higher the penetration.

The INR 135 crore annual market for domestic lighting now largely comprises of LEDs and Incandescent Light Bulbs (ICLs). Most of these light points are in rural households who prefer ICL over any other form of lighting due to higher costs, in addition to low levels of awareness about the benefits of efficient lighting. The data from Ujala distribution affirms to this & also one key factor which comes into play is the LED bulb pricing. If the LEDs are priced at the costs of ICLs, the transformation to efficient lighting will occur massively in rural areas.

5.13 Other Government Initiative

Under the slogan "Sabka Sath, Sabka Gaon, Sabka Vikas" which primarily promotes social harmony, brings awareness of pro-poor government initiatives and to reach the poorest of poor households, Government of India launched Gram Swaraj Abhiyan (GSA) & latter extended Gram Swaraj Abhiyan (EGSA).

Seven flagships' schemes were selected and UJALA scheme was also one of them. These campaigns were run in selected aspiration district & villages across India.

Under GSA: Number of villages covered in one month – 16850 across India
Under EGSA: Number of villages covered were 49178 across 156 districts in three months span period.

The distribution count of LED bulbs under both the campaigns are as below:
1) GSA: 25.05 Lakhs (http://gsa.nic.in/report/ujalaScheme.html) through 27960 Van trips.

2) EGSA: 42.90 Lakhs (http://egsa.nic.in/egsa_report/ujalaScheme.aspx)

The cost per LED bulb for a consumer was INR 70 /- (Inclusive of all taxes). During GSA the bulbs were distributed at a cost of INR 50/- through deployment of mobile vans. The cost during EGSA was INR 60/- and these were distributed through Common Service Centre Village level enterprises, department of Post and through various distribution agencies. The differential in pricing was borne by MoP, GoI.

The villages covered under GSA & EGSA were aspirational and in the remotest corner of the country. Reaching them for successful campaign was a herculean task.

Even though LED bulbs were distributed at a price of INR 50 /- & INR 60 /- under GSA & EGSA respectively and with a warranty of three years, which was less than the normal price of LED bulb of INR 70 /-, it was very difficult for EESL & Ministry of Power penetrate (increase distribution count) because of affordability, availability of ICL at INR 10-15, free subsidized power.

5.14 Outcome/ inference on penetration, Urban & Rural divide

State/UT/ Program	Price per bulb (INR)	Rural Household penetration (%)	Total Bulbs distributed in State/ UT/ Program
Odisha	Free	98	5.2 crore
Puducherry	10	95	6.1 lakh
Andhra Pradesh	10	90	2.2 crore
J&K (including Ladakh)	20	74	79.5 lakh
Gram Swaraj Abhiyan (50,000 villages)	50	45	25 lakh
Gujarat	60	25.6	4.1 crore
Extended GSA in Aspirational Districts	60	20	45 lakh
UJALA	70	18	23.2 crore

Figure -5

One of the key factors which is first barrier to penetration of energy efficient appliance/LED bulbs in rural areas is the pricing. The above figure/table – 5, highlights that the penetration or usage pattern in rural India is inversely

proportional to the price of the product. This is due to socio economic factors, viability, margins, serviceability etc.

If UJALA scheme is to be upscaled to the rural areas, then an innovative financial model is to be developed wherein the cost of the bulb to the consumer would be INR 10/- and the incremental cost (Gap between the actual distribution cost & the cost to consumer) would have to be funded or leveraged.

Therefore, **EESL through its 100% subsidiary CESL (Convergence Energy Services public ltd.) has initiated/ launched the Gram – UJALA scheme** wherein this funding gap would come from leveraging of **CARBON FINANCE.** This also obviates the need for any subsidy/funding from central or state governments for sustainability of the program.

5.15 GRAM-UJALA

Under the program, around 15 million LEDs bulbs will be distributed in phase - I at a cost of INR 10/- per LED bulb with a warranty of 3 years. Each consumer will be provided with 04 No's of 7W/12 W LED bulbs & same no's of working ICL will be taken back from the consumers.

The funding gap with respect to the actual cost of distribution of LED bulb will be recovered by leveraging of emission reductions through CARBON FINANCE CREDITS.

The program will result in following tangible savings per annum.

- Energy savings of 2037.15 million KWh.
- Avoided peak demand of 1116.25 MW.
- CO2 reductions of 1.874 million tCo2.

The program will cover five following districts.

- Arah – Bihar
- Varanasi – UP
- Vijaywada Rural Area – AP
- Nagpur, village Ridhora, taluka Katol – Maharashtra
- Villages of Krishna District – Western Villages of Gujarat

GRAM Ujala program is launched on 19th March 2021 at Arah district in Bihar and on 23rd March 2021 at Varanasi in Uttar Pradesh by Hon'ble Minister of Power, Govt. of India.

5.20 DATA COLLECTION (SOURCES & APPROACH), CDM carbon finance/crediting Program Framework

For Carbon finance/crediting, Clean Development Mechanism (CDM) under UNFCCC is the most prominent framework followed. CDM follows a standard framework for program registration, its approval, baseline & monitoring methodologies, and certified mission reductions (CERs) generation.

5.21 Baseline & types of monitoring methods.

Baseline & monitoring methods are the prerequisite for determining & calculating the quantum of certified emission reductions (CERS) a CDM project activity generates in a host country.

There are five categorizations of CDM Methodologies:

- Small scale project activity methodology
- Large scale project activity methodology
- Small scale afforestation & reforestation referred as A/R project activity methodology
- Large scale afforestation & reforestation referred as A/R project activity methodology
- Carbon capturing & storage referred as CCS project activity methodology

Methodologies are instruments that discuss specific aspects of a project's activity, such as calculating GHG emissions from a specific source.

The above methodologies provide the requisite information.

- Type of Project(s) for which this method is applicable.
- The relevant mitigation action for Green House Gas emission.
- Conditions applicability for the methodology.
- What are the most important parameters to assess and monitor?
- The project scenarios and the baseline parameter are depicted graphically for visual description.

5.21.1 Finding a suitable methodology.

1. Type of categorization based on the mitigation activity.

There are standardized mitigation activities which are covered under various sectoral scopes. The types of mitigation activities which are covered but not limited to are,

- Low carbon energy generation
- GHG destruction
- Energy generation from renewables
- Measures for energy efficiency
- GHG emission avoidance
- Fuel & feedstock switch
- GHG removal by sinks
- Displacement of GHG intensive output

Project developers will define potentially appropriate methodologies after determining which form of mitigation activity would be applied in their project activities.

2. Type of categorization based on type of applied technology.

This section focuses on the technologies that will be used in the project. A project developer can classify technology that will be used in their project activities by categorizing it by technology class, which is similar to a set of methodologies.

After identifying potential applicable methodologies, the project developer should check for standard approved methodologies with UNFCCC CDM. A developer may propose a new methodology or request a revision in an accepted methodology if there is no approved methodology that applies to the proposed project.

In nutshell, one should pursue a new methodology option if a project activity requires a substantial change in methodological approaches which is different from an approved methodology.

5.21.2 CDM project cycle

After a project developer chooses an appropriate approved approach, they apply it to their project activity and create a project design document (PDD), which is the 1st step in the CDM project cycle. The PDD specifies/defines the essential elements.

- The demonstration of additionality in a project.
- Baseline establishment.
- Emission reduction estimates.
- The strategy for monitoring & verification.

The following are the key steps to take in a CDM project cycle:

- Project design by developer/participant
- Approval by designated national authority in the host country
- Project validation by designated operational body
- Registration of the project at CDM-by-CDM executive board
- Project monitoring activities by participant of the project
- Outcome/result verification by designated operational body
- Finally, issuance of certified emission reduction (CER) by the CDM executive board

5.22 Categorization by mitigation activity type

A sectoral scope methodology table is defined which is also further categorized by the identified type of mitigation activity.

The type of mitigation activities is listed below:

- Renewable energy
- Energy efficiency measures
- Electricity generation from low carbon use
- emission destruction
- emission removal by sinks
- Fuel switch
- GHG emission avoidance

Energy sectors are covered by sectoral scopes 1 to 3 defined as generation, supply, and consumption. The sectoral scopes are further distinguished by electricity supply & generation, energy for household & buildings, fuel for the transport sector, energy for the industries.

These are further categorized on the type of mitigation activities such as Displacement of intensive emission in renewable energy, use of low carbon technology for electricity generation, energy efficiency, switch over of fuel, switch over of feedstock.

Energy sectors covered by sectoral scopes 4 to 15 are also categorized.

Methodology Categorization in the Energy Sector:

Sectoral scope	Type	Electricity generation and supply	Energy for industries	Energy (fuel) for transport	Energy for households and buildings
1 Energy industries (renewable-/ non renewable sources) (continued)	Fuel/feedstock switch	AM0049 ACM0006 ACM0011 ACM0018 AMS-I.M. AMS-III.AG. AMS-III.AH. AMS-III.AM.	AM0049 AM0056 AM0069 AM0081 ACM0006 ACM0009 ACM0018 AMS-III.AM.		AM0081
2 Energy distribution	Renewable energy	AMS-III.AW. AMS-III.BB. AMS-III.BL.	AM0069 AM0075		AMS-III.AW.
	Energy efficiency	AM0067 AM0097 AM0118 AMS-II.A. AMS-II.T. AMS-III.BB. AMS-III.BL.			
	Fuel/feedstock switch	AMS-III.BB. AMS-III.BL.	AM0077		
3 Energy demand	Renewable energy				AMS-III.AE. AMS-III.AR.
	Energy efficiency	AMS-III.AL.	AM0017 AM0018 AM0020 AM0044 AM0060 AM0068 AM0088 AM0105 AMS-I.I. AMS-II.C. AMS-II.F. AMS-II.G. AMS-II.L. AMS-II.N. AMS-II.P. AMS-II.S.		AM0020 AM0044 AM0046 AM0060 AM0086 AM0091 AM0113 AM0117 AM0120 AMS-II.C. AMS-II.E. AMS-II.F. AMS-II.G. AMS-II.J. AMS-II.K. AMS-II.L. AMS-II.M. AMS-II.N. AMS-II.O. AMS-II.Q. AMS-II.R. AMS-III.AE. AMS-III.AR. AMS-III.AV. AMS-III.X.
	Fuel/feedstock switch	AMS-III.B.	AM0121 ACM0003 ACM0005 AMS-II.F. AMS-III.B.		AMS-II.F. AMS-III.B.

Figure -6

ENERGY EFFICIENCY:

All steps aimed at improving a system's (EE) energy quality fall under the category of energy efficiency (EE). A facility or particular production demands less energy usage/consumption as a result of the project operation/activity. Use of high-efficiency refrigerators or LED lighting are the two examples.

Use of high energy efficient LED lamps which considerable reduces energy consumption and at the same time reduces the peak demand for existing fossil fuel fired power plants is categorized as below.

Scale of Component project activity (CPA)	Small Scale
Applied methodologies & standardized baseline	AMS-II.C – Demand Side energy efficiency activities for specific technologies
Sectoral scope linked to applied methodology	Sectoral scope – 3, Energy Efficiency

5.23 Categorization by type of applied technology/ measure (methodology family trees)

Over time, methodologies go through stages of evolution, resulting in "families" where one methodology catalysed the creation/development of others. The following is the layout of the family tree: A unique identification number (UIN) is assigned to each technique (denoted by a box). Other methodologies which cover comparable technology & measures that are also the part of the same family tree deal can be found.

Example: Methodologies for industrial energy efficiency:

Figure -7

5.24 Program of activities (POA)

A Programme of Activities (PoA) is defined as a voluntary organized step/action by a public or private agency that coordinates and implements any measure/policy or specified target, resulting in net removals or emission reductions above and beyond any emission reductions that would occur without the PoA, through an unlimited number of Component Project Activities (CPAs).

A CPA is a single measure, or a set of interrelated measures, that results in net removals or reductions in emissions, and is implemented in a specific region/area.

A CDM Board-registered programme of activities can be thought of as a "umbrella programme." Individual CPAs that meet the eligibility requirements outlined in the PoA design document of the registered Program of Activities may be undertaken/included under this "umbrella programme". Thus, it can generate net removals/reduction in order to receive carbon revenue.

Enhanced benefits under POA Benefits in comparison to a regular CDM projects:

- beneficial for particularly less developed regions/countries.
- As compared to the registration process for routine project activities, the process for individual CPAs inclusion under the registered POA is significantly streamlined, resulting in significantly lower costs.
- processing costs, investment risks, and uncertainty are minimized for individual CPA participants.
- The management of PoAs is undertaken by a designated Coordinating and Managing Entity (CME). CME has the responsibility to manage the complete CDM process. This negates the direct engagement in the CDM process by individual project developers.
- Smaller project activities which are not individually viable get access to the CDM process.

- Following POA registration, emission reductions can be scaled up indefinitely since an infinite number of CPAs can be added at different/ later stages.
- Technologies with high co-benefits, such as household technologies, are sponsored/ supported by POAs.

Example of POA:

- AMS-II.C: Demand side energy efficiency activities for specific technologies.
- ACM0002: Grid connected electricity generation from renewables for large scale projects.

5.25 Standardized baseline

Concept: A standardized baseline is a baseline that is defined for a group of parties or a single party for the purpose of calculating emissions and removals reductions and/or determining additionality in CDM project activities.

The elements which may be standardized by a baseline are following:

(a) Baseline scenario/emissions – termed as "baseline."
(b) Additionality in CDM project activities.

A standardized baseline is a list of emission-reduction practices that, if introduced in a region or nation, are automatically considered additionality under certain conditions.

Baseline emission factor e.g. grid emission factors by CEA (central electricity authority) could also be a standardized baseline.

Objectives of baseline standardization:

The aim is to increase the rate of reduction of greenhouse gas emissions while still maintaining environmental integrity. This could be achieved by:

- transaction cost reduction.
- enhancing objectivity, transparency & predictability.
- underrepresented project regions to have access to the CDM process.

- Making measuring, verification & reporting simpler.

AR-ASB0001, Forestry afforestation and reforestation project operations in Namibia, is an example of a standardized baseline.

5.26 Methodologies for the benefits for women & children.

The CDM has two objectives: to promote sustainable development and to reduce GHG emissions. The project's result should improve the living standards of all people, whether directly or indirectly.

Certain methodologies explicitly enhance the lives of children and women.

The criteria which have the potential of benefitting women & children are:

- increased availability of low-cost household appliances and fixtures (e.g., refrigerators, light bulbs).
- optimization of tasks carried out by women and children (e.g., gathering for wood as a fuel usage, collection of water from various sources)
- which improves the living conditions of women and children (e.g., good lighting, heating, and air quality)
- which makes use of community-based methods of participation.

5.27 Methodologies for urban sector

In urban sectors/centres, many opportunities exist for emission reduction. The mitigation measures for transportation, buildings, electricity demand and supply, waste management, and water treatment & its supply network can be targeted for specific city. The programmes may contain a specific measure of each sector aimed at reduction in GHG emissions.

Example of CDM methodology relevant to urban transport:

- Energy Efficiency measure: AMS-IIIC, emission reduction by electric & hybrid vehicles.

A CDM methodology example that is applicable to urban households, building energy generation, and energy efficiency are:

- Lighting measure: AMS-IIC, the use of specific technologies for energy efficiency under demand side activities.
- Street lighting measures: AMS-IIL, the use of energy efficient lighting technology for outdoor use, street light application under demand side activities.

5.28 Methodologies summary sheet

Small-scale and large-scale CDM project operations have different methodology review sheets. The parts of each technique review sheet are as follows:

1) Methodology-relevant projects

   The project activities for CDM methodology that is relevant are listed. For a better understanding of the methodology's basic intent, practical examples are given.

2) Green House Gas emission mitigation action

   The technique categorization table refers to the type of mitigation activity. There is a brief overview of the type of mitigation action, such as energy conservation or switching to a different fuel source.

3) Conditions under which the applicability of methodology exists.

   certain criteria apply to methodologies, and the most appropriate/relevant conditions are specified.

4) Parameters which are to be monitored or determined.

   Baselines must be calculated at the start of the project activity when it is validated in order to measure net removals or emission reductions. During the project's ongoing operation, the identified parameters must be controlled.

   As a result, this segment is divided into two sections: "at validation" and "monitored." Furthermore, certain methodologies would necessitate the verification of specific parameters in order to demonstrate that the conditions which are applicable are met.

5) A visual representation of the baseline and project scenarios is given.

   It is critical to use diagrams, which are typically made up of symbols, to highlight and describe the baseline and project scenarios. It gives readers a

better understanding of the scope of methods. The baseline scenario is depicted to illustrate what would happen if project activity were to cease. The project scenario portrays the situation that can be achieved by project operation implementation. In a simplified diagram it is difficult to depict complex scenarios. As a consequence, simpler diagrams must concentrate on the key activities that results in net removals or pollution. To represent the diagrams, there are generic icons that are used.

EXEMPLIFICATION OF DIAGRAMS

	Full intensity in the baseline scenario is depicted with bold colour.
	Reduced, decreased intensity in the project activity is depicted with pale colour.
	Avoidance and replacement is depicted with crossed icons.
	A carbon-intensive fossil fuel is used in the baseline scenario.
	Instead of the carbon-intensive fossil fuel, a less-carbon-intensive fossil fuel is used due to the project activity.
	A less-efficient technology is used in the baseline scenario.
	A more-efficient technology is used due to the project activity.
	Activities in the baseline scenario result in GHG emissions.
	Less GHG emissions are occurring due to the project activity.

Figure -8

5.3 Gram – UJALA, CPA design document

5.31 Component Project activity design document form

BASIC INFORMATION	
Title of the CPA	Distribution of LED bulbs in INDIA
Scale of the CPA	**Small scale** or large scale
Completion date of the CPA-DD	09/04/2018
Title & UNFCCC reference no. of the registered CDM POA	Distribution of LED bulbs in INDIA
Title & reference no. of the corresponding generic CPA	Distribution of LED bulbs in INDIA - XXX
Coordinating/ Managing entity	XYZ limited
Host Party	India
Applied methodologies & standardized baselines	AMS-II.C – Demand side energy efficiency activities for specific technologies; version 15.0
Sectoral scopes linked to the applied methodologies	Sectoral scope 3: Energy demand
Estimated amount of annual average GHG emission reductions	XXX tCo2 Equivalent.

5.32 SECTION-A, Component project activity (CPA) description:

A1) General description, Component Project Activity

Purpose:

The component project activity (CPA) is under the umbrella of POA (Program if activities). The title of POA is – "LED bulb distribution in INDIA". The POA is related to LED bulb distribution under three categories:

- Household domestic lighting
- Commercial enterprises//establishments
- SME sector (Small & Medium Enterprises)

The CPA comes under the category of small-scale component project activity.

CPA envisages to distribute around 3 million LEDs to grid connected low-income households; SMEs & small commercial establishments. The total reduction in emission under this CPA is estimated to be around 400,040 tCO2 eq. per annum.

General operating and implementing framework:

XYZ limited will act as a Coordinating Managing Entity (CME) of small-scale program of activities (SSC-PoA) under this CPA.

The carbon credit generated from the project will be informed to end consumer & also the fact that the credits would reduce the price of LED bulb which at present is a cost barrier and would make LED bulb affordable to the rural household.

While registering for the program, the end consumer will confirm the transfer of rights of carbon credit to the CPA implementer. The consumer information, name of the consumer, his residential address, K number of DISCOM electricity connection, PAN number, unique Aadhar number, the number of LED bulbs distributed or provided will be captured at the time of registration process by the implementer. All this information captured forms the component of database for the project & it is recorded in hard copy and also in the form of a soft copy/electronic format by CME.

Contribution to sustainable development

a) Environmental Sustainability

- Thermal fossil fuel fired power plants accounts for major electricity generation in INDIA. Introduction & utilization of energy efficient lighting technology, LED bulb in this case, will help in reduction of GHGs emissions to atmosphere which are generated by these thermal power plants.
- Unlike CFL & fluorescent tubes, LED technology do not contain any toxic mercury in its hardware.
- Since LED have the longest operating life span than any other lamp technology, there will be a reduction in wastage reduction.

b) Social Sustainability

- India during 2017-18 faced power peak deficit of about 2%. Over the years demand will increase & this deficit will increase till sufficient non fossil fuel-based generation sources starts generating. The electricity unit saved monthly/annually because of usage of LED bulbs in comparison to electricity consumption of FL, ICL, CFL, can be sold/subsidized by DISCOM to other electricity consumers which will truly improve the consumers quality of life.
- The program will help in generating direct employment & other indirect employment.
- Penetration of highly energy efficient lighting technology within the low-income group/rural customers.

c) Sustaining economy

- Technology suppliers will generate new business opportunities & other parties will be utilized for baseline surveys, LED bulb distribution activity & monitoring surveys.
- Usage of LED bulbs will result in reduction of electricity bills of the customers. This bill reduction can be utilized for other aspirational purposes.

d) Technology sustainability

- LED is amongst the most highly energy efficient lighting technology which has rapidly evolved & is now acceptable. The bulbs offer superior quality, durability, better lumens output than any other type of lighting. But the high upfront cost which acts as first barrier is resistant in acceptance by the low-income group in rural areas.
- SMEs & small commercial establishments weigh in the cost while choosing lighting technology for their space lighting requirements. The long-term benefits of LED utilization as now is being ignored by them.
- The program will enable availability of these LED bulbs at extremely low rates as comparable to ICL bulbs by leveraging carbon credits to enable them to avail benefits of this technology.

A2) Location and area covered under CPA.

The component project activity will get implemented throughout INDIA in rural areas.

A3) Technology/measures

The LED lighting technology has longevity, is well stable and it promises enormous energy savings if used in household across INDIA. The technology is evolving day by day achieving higher efficiencies in lumens output. The manufacturing industry is anticipating higher efficiencies of around 200 lumens/watt over the years even though the existing LED lamps has around 100 lumens/watt output as on the date of CPA which is way higher to ICL technology which emits around 12-13 lumens/watt only.

LED lamp has a life span of approximately 13 years for an average burning of 10 hrs/day and emits a pleasant light spectrum. The LED is suitable as retrofit into existing lamp sockets, shapes & voltage ratings. The technology uses a switched mode power supply (SMPS) which is obtained through a driver which converts AC power to DC power and also controls the current requirement to the circuitry.

The lifespan & its performance depends on system design, operating environment, quality, lumen depreciation factor over a period. As per IS, the minimum rated life span of LED bulb is approximately 25,000 hours.

IS 16102 Part 1, which confirms to safety requirements, & Part 2, which confirms to performance requirements are the applicable standards in place for Self-ballasted LED bulbs in INDIA. The LED bulb distributed to end user by the CPA implementer confirms to above BIS standard.

A4) Coordinating/ Managing entity

XYZ limited will act as a Coordinating Managing Entity (CME) of the small-scale program of activities (SSC-PoA) under this developed CPA.

A5) The Parties under the CPA & CPA implementers

Parties Involve	CPA implementers	Indicate if the Party involved wishes to be considered as CPA implementer (Yes/No)
India (host)		No
Malaysia	ABC limited, Malaysia	No
Republic of Korea	DEF limited	No

A6) Is the CPA publicly funded?

This CPA is not publicly funded.

A7) BACKGROUND OF CPA

It is confirmed by CME that the program under small scale-CPA is not registered in other POA & is also not a registered CDM project activity. Moreover, the CPA is not a deregistered project activity.

It is further declared that the CPA has not been left out/kept out form any registered program of activities.

The proposed component project activity will be only implemented in INDIA. CME confirms that no other project which is based on similar technology is operational in the location & area as per the proposed program of CPA.

SECTION-B, STANDARDIZED BASELINES & APPLICABLE SELECTED METHODOLOGIES

B1) Standardized baselines & reference to methodologies

Applicable Methodology	Methodology for small scale CDM project	AMS II C, V15.0, Applicable for demand-side energy efficiency activities for specific technologies
Sectoral Scope	03: Energy Demand	Type: Energy Efficiency

The below mentioned documents are also referred for the execution of the project:

(a) AMS-I. D methodology for Grid connected renewable electricity generation .

(b) Standards: CDM Project Standard for POA, Ver1.0

(c) Methodology tool used – Demonstration of additionality of microscale project activities, Ver8.0

(d) General guidelines which are covered under small scale CDM methodology, Ver22.1

B2) Project boundary, the sources, GHGs

The methodology specifies the project boundaries viz the geographical areas the equipment's, the systems covered under the program project activity.

Activity	Replacement of Incandescent bulbs with LED bulbs
Project boundary review	Physical & geographical location of each LED

Below are the sources of GHGs and the type of GHGs that are included in the project preview/ambit.

Source		GHG	Included?	Justification
Baseline	Power plants servicing the electricity grid	Co2	Yes	Major emission source
		CH4	No	Minor emission source. Exclusion is conservative
		N2O	No	Minor emission source. Exclusion is conservative
Project Activity	Power Plant Serving the electricity grid	Co2	Yes	Major source of emission
		CH4	No	Minor source of emission hence excluded
		N2O	No	Minor source of emission hence excluded

B3) Establishing the baseline scenario & its description.

Baseline: As per generic CPA, "continued use of existing luminaires in household" is the baseline.

In INDIA, no legislation exist which mandates usage & installation of LED as a lighting technology. Therefore, the implementation of this LED bulb programme is free from any regulatory constraints.

The baseline scenario considered is the continuous use of inefficient lighting technology product like ICL, FL in low-income households, SMEs & small commercial establishments. Despite good amount of electricity consumption, ICL & FL still find acceptance amongst the mentioned group owing to their price point.

A 60 W ICL cost between INR 10 to 15 & a 9W LED bulb which has the same lumen output when compared to a ICL bulb costs between INR 400 to 500 few years back & now INR 70.

This high upfront cost even now is a deterrent for LED usage in rural households. Thus, consideration of continued use of ICL is the most reasonable baseline.

B4) Estimation of emission reductions

I) The emission reduction is calculated as per the equation 10 under the small-scale methodology under AMS II-G., V15.0. by the CPA

ERy = (BEy - PEy) – Ley

Where,

ERy = Emission reductions in year *y* (tCo2)

BEy = Baseline emission in year *y* (tCo2)

PEy = Project emission in year *y* (tCo2)

LEy = Leakage emission in year *y* (tCo2)

II) Calculation of baseline for emission reduction, *BEy*

$$BE_y = E_{BL,y} \times EF_{CO2,ELEC,y}$$

BE_y	=	Baseline emissions in year *y* (tCO_2e)
$E_{BL,y}$	=	Energy consumption for the baseline (ICLs) in year *y* (kWh)
$EF_{CO2,ELEC,Y}$	=	Electricity emissions factor. If electricity displaced is grid, the emission factor in year *y* shall be calculated in accordance with the provisions in AMS-I.D (tCO_2/MWh). If electricity displaced is captive electricity, the emission factor in year *y* shall be calculated in accordance with the "Tool to calculate baseline, project and/or leakage emission from electricity consumption"

Energy consumption for baseline in year y is calculated as:

$$E_{BL,y} = \sum_i (n_i \times \rho_i \times o_i / (1 - l_y)$$

Where

n_i = Number of pieces of equipment of the group of 'i' baseline equipment (ICLs or Fluorescent tubes) replaced.

ρ_i = Electrical power demand (kW) of the group of 'i' baseline equipment (e.g. 60W or 100W incandescent lamps).
In the case of more than one type of ICLs (or Fluorescent tubes) are replaced, electrical power demand is the weighted average of the rated power (kW) of group i baseline equipment (ICLs or Fluorescent tubes).

o_i = Average annual operating hours of the group of 'i' baseline equipment (ICLs or Fluorescent tubes).
The operating hours of the baseline equipment in year *y* can be determined using surveys by continuous measurement of usage hours of baseline equipment for a minimum of 90 days. For a large population of baseline equipment: (a) Use a representative sample (sampling determined by a minimum 90% confidence interval and 10% maximum error margin); (b) Apply correction for seasonal variation, if any; and (c) Ensure that sampling is statistically robust and relevant, i.e. the selection of the equipment to be analysed for operating hours has a random distribution and is representative of target population (size, location).

l_y = Average annual technical grid losses (transmission and distribution) during year *y* for the grid serving the locations where the devices are installed, expressed as a fraction. This value shall not include non-technical losses such as commercial losses (e.g. theft). The average annual technical grid losses will be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. The reliability of the data used (e.g. appropriateness, accuracy/uncertainty, especially exclusion of non-technical grid losses) will be established and documented by the project participant. A default value of 0.1 shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable

III) Calculation of Project emission, *PEy*

Project emissions on account of electricity used by the project equipment shall be calculated according to following equations:

$$PE_y = E_{PE,y} \times EF_{CO2,ELEC,y} + PE_{ref,y}$$

PE_y	=	Project emissions in year *y* (tCO2e)
$EP_{PJ,y}$	=	Energy consumption in project activity in year y. This shall be determined ex post based on monitored values
$EF_{CO2,y}$	=	Emission factor for electricity or thermal baseline energy. The emissions associated with grid electricity consumption should be calculated in accordance with the procedures of AMS-I.D. For fossil fuel displaced reliable local or national data for the emission factor shall be used; IPCC default values should be used only when country or project-specific data are not available or difficult to obtain
$PE_{ref,y}$	=	Project emissions from physical leakage of refrigerant from the project equipment in year y (tCO2e/y)

As the project entails replacement of LED in place of ICLs (or fluorescent tubes) hence no refrigerant is involved. The above equation is then modified as:

$$PE_y = E_{PE,y} \times EF_{CO2,ELEC,y}$$

$$E_{PE,y} = \sum_i (n_i \times \rho_i \times o_i / (1 - l_y)$$

n_i	=	Number of group 'i' project devices operating during time interval t in year y.
ρ_i	=	Electrical power demand (kW) of the group 'i' project devices measured during the time interval t in year y.
0_i	=	Operating hours of group of 'i' project devices in the time interval t in year y

B5) Monitoring Plan

The monitoring requirements of defined methodology as per AMS.II.C-V15.0 is as following:

I. In household & commercial establishments energy metering is done for the measurement of consumption of electricity by LED bulbs. Under the project activity, instead of metering a default daily operating hour are adhered to which is $3^{1/2}$ (HRS/day).

II. For household & commercial establishments, the CPA-DD should summarize the following –

- The proposed project (LED bulbs) distribution method.

Batch distribution of LED bulbs will be undertaken by the implementer with the ground support of distribution company of the area (DISCOM) by one of the below methods.

1. Directly installing/ retrofitting the LED bulb at the targeted consumer premises.
2. LED distribution & ICL collection using dedicated distribution centres/points like schools, retail outlets, resident association offices, to be advertised by the CPA implementer through local media.
3. Establishment of dedicated kiosks at local DISCOM offices/centres.

   The SSC-CPA Implementer in coordination with DISCOM will carry out campaigns which broadens the consumer awareness about the benefits of highly using energy efficient LED bulbs. This will boost energy conservation & subsequently resulting in saving of utility bills. It is mandatory for a consumer to enter into agreement with a declaration not to re-sell the LEDs. The replaced ICLs, collected by CPA implementer, will be destroyed so that these inefficient bulbs are not used elsewhere.

   DISCOM is required to provide their consumer database which typically consist of consumer name, K number & consumer address for identification of the consumer under their jurisdiction. For prevention of fraud, customers are required to present/show the latest paid electricity bill for getting the

LED bulb under the program. The database of all the consumers/beneficiaries under this CPA will be maintained in an electronic format. For the installed LED bulbs at the consumer premises the following will be recorded.

Number of LED bulbs	Wattage of LED bulbs	Date of Supply

At the end of the distribution of LED bulbs as per target, the electronic data base format must be submitted to CME.

At the end of distribution phase in SSC-CPA geographical area, the implementer must inform the CME in written representation about the completion of LED distribution campaign. (The replacement activity will continue to honor the warranty period by the implementer). This date of declaration would be scrutinized by CME. The acceptance of this declaration date would be the start for crediting of emission reductions for that particular CPA.

Cumulative/total nos., LED bulbs that would be eligible for the calculation of reduction in carbon emissions during the monitoring period/ interval should not be less that the no's of ICLs replaced & mandatorily collected at the starting point of the project activity.

- The process of ICL collection (baseline bulbs) and their destruction.

  The ICLs which are replaced are to be collected from consumers or from the dedicated distribution centres by SSC-PA implementer.

  The collected ICLs are to be stored till the destruction. The destruction of the ICLs shall be documented & the no of the wattage rating (Power) of ICLs are to be recorded to allow for verification on random basis.

  The date on which ICL bulbs are destroyed shall be communicated to the CME in advance. To prove the credibility of the destruction process, the CPA implementer shall carry this activity in presence of the DISCOM officials or independent verifiers. This is in sync with the methodology requirements.

B6) ISSUANCE OF CERs

The entire process will be overseen by the Validator and will recommend to CDM-EB for issuance of CERs. The CERs are issued based on approved methodology i.e baseline calculation, project calculation, verification.

5.4 DATA ANALYSIS

Target Distribution	: 15 million (1.5 Crores No's)
Geographic area	: 5 states
States	: Bihar – Arah district, UP – Varanasi
	: Maharashtra – Nagpur, AP – Vijaywada
	: Gujarat – Western districts
Wattage of LED bulb	: 12 W
ICL baseline	: 100 W
Year of Carbon crediting	: 7 years
Hour of usage per day	: 5 hrs
Grid emission factor	: 0.92 tCo2/Mwh

5.41 Baseline Estimation: 2658416 tCo2 equivalent as below

BASELINE EMISSON

$$BE_y = E_{BL,y} \times EF_{CO2,ELEC,y}$$

Parameter		Description	Source
BE_y	=	Baseline emissions in year y (tCO_2e)	Calculated as below
$E_{BL,y}$	=	Energy consumption for the baseline (ICLs) in year y (kWh)	Calculated as below
$EF_{CO2,ELEC,Y}$	=	CM emissions factor (MWh) -0.92 tCO2/MWh	CO2 Baseline Database for the Indian Power Sector User Guide Version 15.0 December 2019

$$E_{BL,y} = \sum_i (n_i \times \rho_i \times o_i/(1-l_y) \times 0.95$$

n_i	=	number of equipments of baseline replaced
ρ_i	=	electrical power demand of group i baseline equipment (KW)
o_i	=	average annual operating hrs of group i baseline equipment (hrs)
l_y	=	average annual technical grid losses
0.95	=	Net to gross adjustment factor

Total no of 12 W LEDs to be distributed	=	15000000	(15 million)

Energy consumption for 100 W incandescent bulb (KWh)

Parameter		Value	Source
n_i	=	15000000	
ρ_i	=	0.1	nameplate data (KW)
o_i	=	1825	baseline Survey (hrs)
l_y	=	0.1	Default value (percent)
$E_{BL,y\ 100}$	=	2889583333.000	Calculated
$E_{BL,y\ total}$	=	2889583333	KWh
BE_y	=	**2658416.00**	tCO2 eq.

5.42 Project Estimation: 319010 tCo2 equivalent as below

PROJECT EMISSION			
$PE_y = E_{PE,y} \times EF_{CO2,ELEC,y}$			
Parameter		Description	Source
PE_y	=	Project emissions in year y (tCO2e)	Calculated as below
$EP_{PJ,y}$	=	Energy consumption in project activity in year y.	Calculated as below
$EF_{CO2,y}$	=	Emission factor for electricity or thermal baseline energy.	CO2 Baseline Database for the Indian Power Sector User Guide Version 15.0 December 2019
$E_{PE,y} = \sum_i (n_i \times \rho_i \times o_i/(1-l_y) \times 0.95$			
n_i	=	Number of group 'i' project devices operating during time interval t in year y.	
ρ_i	=	Number of group 'i' project devices operating during time interval t in year y.	
o_i	=	Number of group 'i' project devices operating during time interval t in year y.	
0.95	=	net to gross adjustment factor	
Energy consumption for 12 W LED			
Parameter		Value	Source
n_i	=	15000000	Project survey
ρ_i	=	0.012	nameplate data (KW)
o_i	=	1825	runtime meters (hrs)
l_y	=	0.1	Default value (percent)
$EP_{PJ,y}$	=	346750000.000	calculated (KWh)
$EP_{PJ,y\ total}$	=	346750000.00	KWh
PE_y	=	319010.00	tCO2 eq.

5.43 Emission reduction, *ERy*: 2339406 tCo2 equivalent as below

Emission Reduction first year onwards for 15,000,000 LEDs $ER_y = (BE_y - PE_y) - LE_y$			
Parameter		Value	Source
BE_y	=	2658416.0	Baseline Emission Sheet
PE_y	=	319010.0	Project Emission Sheet
LE_y	=	0.00	CPA DD
ERy	=	**2339406**	t CO2/year

Emission reduction per LED	0.1559604	t CO2 eq.
Energy saved per LED		
Energy consumption in baseline	2889583	MWh/yr
Energy consumption in project	346750	MWh/yr
Energy savings per LED bulb	0.170	MWh/yr

5.5 FINDING

Total cost of components/expenses for a period of 7 years against 1.5 Crores, 15 million, 12W LED bulb distribution is work out below.

The expenses include, LED bulb cost, Distribution & faulty replacement charges, Software expenses, Awareness/PR/launch expenses, miscellaneous expenses & Carbon Asset Management expenses.

COST COMPONENT/EXPENSES FOR DISTRIBUTION OF 15 million LED bulbs OVER 7 Years		
		All Costs in INR
S. No.	Cost Component	Total Estimated Cost including Taxes
1	LED Expenses	1,26,00,00,000
2	Distribution and Faulty LED Replacement Expenses	22,09,66,800
3	Software Expenses	2,18,83,336
4	Awareness/PR/Launch Expenses	41,30,00,000
5	Miscellenous Expenses	13,50,00,000
6	Carbon Asset Management Expenses (CPA+UNFCCC CDM+EESL Expenses) (5 CPA for 5 states)	1,98,22,36,760
	Grand Total (INR including Taxes)	**4,03,30,86,896**

The cost per LED bulb over a period of 7 years is INR: 269/-, which includes the basic cost of LED bulb of INR75 + taxes.

To penetrate LED bulb in low income & rural household where INR 10- 15/- inefficient ICLs are still prevalent, LEDs are to be distributed at a cost of INR 10/-. This will require subsidy from the state or central government. The issue with the subsidies is that the program is not self-sustainable, and it drains the government exchequer.

6.0 Conclusion, The Power of Carbon Finance/ Carbon crediting:

To scale up this program, which is self-sustainable, other forms of financial leveraging is to be investigated. Carbon finance is one of the tools by which the funding gap can be leveraged without a government subsidy.

The below table depicts annual carbon credits generated per annum & over a period of 7 years.

After implementation of this program, the total carbon credits that would be generated would be 1,63,75,842 tCo2.

To offset the cost, the carbon credits are to be sold at a price of USD 3.28 under CDM market.

S. No.	Description	As per CPA
1	Annual Carbon Credits (tCo2)	23,39,406
2	Total Years	7
3	Number of CPAs (5 CPA = 1)	1
4	Total Carbon Credits (tCo2)	1,63,75,842
5	Total cost of programme for 7 years (INR)	4,03,30,86,896
6	Cost per carbon Credit (INR) {S.no 5/4}	**246**
6	Cost per ER Generation (USD) {1USD= INR 75}	**3.28**
7	Cost per LED bulb over 7 year period (INR)	**269**

As on date the average price of per carbon credit in international markets is between 5 – 10 USD. In Korea the per carbon credit is traded at around 15 USD.

The CPA implementer can leverage the carbon finance to fill the funding gap by selling the carbon credits at USD 3.28.

7.0 References:

- CDM/UNFCCC website
- World Bank website
- EESL website (eeslindia.org)
- ADB website
- general websites

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approved, subject to relevant guidelines being followed.

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