


# FRAMEWORK FOR PROGRAMMATIC CDM PROJECTS IN RENEWABLE ENERGY



**Ministry of New and Renewable Energy**
**Government of India**

**May, 2009**

# CONTENTS

# List of abbreviations

| | |
|---|---|
| ACM | Approved Consolidated Methodology |
| APV | Accredited Project Vehicle |
| AM | Approved Methodology |
| AMS | Approved Small Scale Methodology |
| ASSOCHAM | Associated Chambers of Commerce and Industry of India |
| BM | Built Margin emission factor |
| CBP | Community Biogas Plant |
| CDM | Clean Development Mechanism |
| CDM EB | CDM Executive Board |
| CEA | Central Electricity Authority |
| CII | Confederation of Indian Industry |
| CM | Combined Margin emission factor |
| CMP | Conference of parties serving as Meeting of Parties to the Kyoto Protocol |
| CPA | CDM Program Activity |
| CPA DD | CDM Program Activity Design Document |
| cum | Cubic meter |
| DD | Design Document |
| DDG | Distributed Decentralized Generation |
| DNA | Designated National Authority |
| DOE | Designated Operational Entity |
| EB | Executive Board |
| EVI | Emergent Ventures India Pvt. Ltd. |
| FAO | Food and Agriculture Organization |
| FICCI | Federation of Indian Chambers of Commerce and Industry |
| GDP | Gross Domestic Product |
| GEF | Grid Emission Factor |
| GHG | Green House Gas |
| GPG | Good Practice Guidance |
| GWh | Giga Watt hour |
| HCA | Host Country Approval |
| HP | Horse Power |

| | |
|---|---|
| IPCC | Intergovernmental Penal on Climate Change |
| IREDA | Indian Renewable Energy Development Agency |
| KVIC | Khadi Village and Industrial Commission |
| kW | kilo Watt |
| kWh | kilo Watt hour |
| LoA | Letter of Approval |
| LPG | Liquefied Petroleum Gas |
| $m^3$ | Cubic meter |
| MFI | Micro Finance Institution |
| MNES | Ministry of Non-conventional Energy Sources |
| MNRE | Ministry of New and Renewable Energy |
| MoA | Ministry of Agriculture |
| MoEF | Ministry of Environment and Forests |
| MoP | Ministry of Power |
| MW | Mega Watt |
| MWh | Mega Watt hour |
| NCDMA | National CDM Authority |
| NCV | Net Calorific Value |
| NEWNE | North, East, West, North Eastern |
| NGGIP | National Greenhouse Gas Inventories Programme |
| NGO | Non Government Organization |
| NSS | National Sample Survey |
| NSSO | National Sample Survey Organization |
| OM | Operating Margin emission factor |
| O&M | Operation and Maintenance |
| p-CDM | programmatic CDM |
| PoA | Program of activities |
| PDD | Project Design Document |
| RE | Renewable Energy |
| REDA | Renewable Energy Development Agency |
| RGGVY | Rajiv Gandhi Grameen Vidhyutikaran Yojana |
| RoR | Run of the River |
| SD | Sustainable Development |
| SHG | Self Help Group |

| | |
|---|---|
| SME | Small and Medium Enterprises |
| SPV | Solar Photo Voltaic |
| SSC | Small Scale |
| T&D | Transmission and Distribution |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VEP | Village Electrification Programme |

# EXECUTIVE SUMMARY

CDM Program of Activities (PoA) is a relatively new concept in international climate change regime. As an extension of conventional CDM, it allows bundling and registration of similar kind of Green House Gas (GHG) emission reduction (or removal) projects having different implementation schedules over a period of time as a "*program of activities*". As defined by the CDM Executive Board, *A CDM programme of activities (PoA) is a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to anthropogenic GHG emission reductions at source or net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of CDM Program Activities (CPAs).*

The Ministry of New and Renewable Energy (MNRE) perceives CDM PoA as a new window that can be taken up to induce sustainable development and promote renewable energy technologies particularly pertaining to households, small enterprises and rural areas in India. To increase the awareness at all levels and to understand technicalities of this approach, the study *"Developing a Framework for Programmatic CDM projects in Renewable Energy Area"* was commissioned in July 2008. This report aims to develop a framework for initiating programmatic CDM projects in the identified areas of renewable energy sector. The report can be useful as a guide for developing project activities in such areas.

The CDM considerations of the programs are possible if the technology which is used results in effective reduction of GHGs emitted to the atmosphere as compared to a project *in absentia* or the baseline. A CDM PoA must be additional to the business as usual scenario. This should be evident by the actions of the proponents in a PoA and each CPA as reflected in their records and documents. It is fundamental to mention here that CDM is an integral part of the whole program and the program would not have been implemented in absence of CDM.

The selection of baseline and monitoring methodology under which a CDM PoA is designed, is critical to successfully complete the CDM cycle. Realization of CDM revenue is only possible when CERs from a PoA are monitored and verified. Monitoring is done based on the monitoring plan as defined in the Project Design Document (PDD). Hence, in each sector covered in this report, four attributes- baseline, additionality, methodology and monitoring (as a part of methodology description) have been described to enhance the user's understanding. Further details on the methodologies and other clarifications such as project boundary and detailed baseline determination can be obtained from UNFCCC website (link: http://cdm.unfccc.int/methodologies/)

The *first* chapter on the *Background and Introduction* of the study discusses the reasons of suitability of identified sectors for programmatic CDM approach and the key drivers that can help them achieve optimum carbon intensity so as to follow the de-carbonized pathway for development. The seven identified renewable energy sectors are: Family Type Biogas Plants Programme, Medium & Large Size Biogas Plants programme, Solar Water Heating, Solar Cooking Programme, Improved Cook Stove Programme, Biomass Applications in Industry and Village Electrification Programme.

*The second* chapter introduces the concept of CDM Programme of Activities; it highlights the important characteristics of a programme and advantages of this approach. An overview of programs in the pipeline has been given along with the major issues that have emerged in the CDM PoA regulations. Though PoA is a promising approach and it has advantages over conventional CDM, it is not possible to implement it until there is a well defined framework regarding the roles and responsibilities of different entities, sharing of CERs and other minutes. The *third* chapter of this report is on model frameworks which may be helpful for the user in discovering the best possible framework in an Indian set up given the fact that some of the activities identified were already run by few government missions and programmes. PoA can be applied to a mandatory program as well as if it is targeted to implement a policy/measure to the extent beyond its mandatory level. A stakeholder analysis in this chapter also highlights the roles to be played by various entities in de-carbonisation of the Indian economy. Some of the models proposed are: Government's Pilot Model, Technology Prototype Model, Business Hybrid Model, Social venture Model, Co-operative Model, Project Developer/ ESCO Model and Consortium Model. These models can be categorized as Government-Private (GP)/ Government-Government (GG)/ Private-Government (PG) and Private-Private (PP) types, based on the nature of entities managing and implementing the program. It should be noted that these are not the only possible models for PoA implementation. Variants and hybrids can be prepared from these models as per the requirements of the target population/users and target technology/measure which is explained in detail in the chapter.

The subsequent chapters discuss each of the activities one by one and elaborate on the outlined aspects of CDM PoA opportunities, baseline determination, emission reduction potential, additionality and monitoring. Each chapter also harbors a model framework for PoA implementation. Though chosen on the basis of salient features and requirements of the technology/measure, these frameworks are non-exclusive. Other models are also possible and can be understood in the Chapter three. If regional/local needs demand different model which are not covered under this document, new structures to suit the needs may also be constructed.

Chapter *Four* and *Five* discuss the CDM PoA opportunities under Family Size Biogas plants and under medium and large scale biogas plants programme. Biogas can be used for many purposes at family/community level and in small and medium scale industries including heat and/or power generation, lighting and cooking. According to the Integrated Energy Policy, if most of the animal dung available in rural India is fed into biogas plants (either community size with each producing >20 $m^3$ of gas per day or family size plants), supplemented with suitable other biomass and with improved micro-organisms, 30% to 40% of rural cooking energy need can be met by biogas. The variants of the co-operative/consortium model are suggested for implementation of CDM PoA in this sector.

Chapter *Six* explains CDM PoA framework for Solar Cooking programme. In India, biomass, kerosene, and LPG are the major sources supplying cooking energy. One of the world's largest solar cookers is operating at Tirupati in India. Even then, large scale dissemination of solar cooking is yet to be achieved and this is envisioned through CDM PoA in the chapter.

In India, solar thermal systems are used in domestic, commercial and industrial applications. In industries solar thermal energy can be used for supplying process heat and replaces considerable amount of fuel use in boilers and reduces substantial amount of GHG emissions. In the commercial and household sectors also, solar water heating systems can be used to meet hot water requirements and can replace grid power. Solar water heating under a programmatic approach has been discussed in Chapter *Seven*. A technology prototype model has been suggested for implementing CDM PoA in this sector.

CDM PoA opportunities for Biomass application in Industries is the topic of Chapter *Eight*. In this chapter, various uses of biomass in industries including thermal and/or electrical energy generation have been analyzed from a PoA CDM viewpoint. Power generation in industries, specially bagasse based cogeneration in sugar industry have huge potential in India. This also harbors a good history in conventional CDM. Biomass gasifiers are a good alternative for decentralized power generation in rural areas where power demand is low. Agro residues as well as biomass from agro-processing industry can be used to generate power using a biomass gasifier. In addition to conventional CDM, the PoA approach can also play an important role in overcoming hurdles at a larger scale at different places and times.

Traditional *chulhas* (cooking device in rural India) have thermal efficiency as low as 5-10%. Inefficient utilization of non renewable biomass[1] is a major source of CO2 and other GHGs. Biomass burning is also blamed for smoke and particulate matter emissions causing indoor air pollution and health hazards in rural India. Improved Cook-stoves are expected to reduce GHG emissions substantially. The CDM benefits are only possible in two scenarios under improved cook-stoves program- switch from non renewable to renewable biomass, and consumption of less non renewable biomass as compared to baseline. If the baseline fuel is renewable biomass, the project will not be considered as a GHG emission reduction project as renewable biomass is GHG neutral source of energy. The strategies covering Improved Cook-stoves under CDM PoA have been discussed in Chapter *Nine*.

Last chapter *Ten* is on Village Electrification Programme (VEP). Renewable energy based rural electrification is a key for energy independence in India. Decentralized distributed generation will help in not only meeting the basic needs but also will improve the lifestyle of people living in the remote un-electrified villages in India. Electricity can be introduced in these villages with the help of CDM PoA. Assuming the baseline to be grid/ kerosene/diesel, emission the reduction potential has been given for NEWNE grid and Southern grid. A framework for PoA implementation has also been suggested.

This report also contains three annexure. *Annex I* is a model PoA DD for a mock program *viz. Installation of Biomass Gasifier systems in Small Industries. Annex II* is a model CPA DD (typical) for this PoA with the title: *Installation of Biomass Gasifier system in small industry BGO.* A glossary of relevant CDM terms has been given in Annex III.

A summary of chapters 4-10 (sector wise) is tabulated here:

| Sector | Opportunity | Baseline | Methodology | Suggested Model |
|---|---|---|---|---|
| Family type biogas plants | Cooking+ Lighting | NR Biomass, Kerosene, LPG, Grid | AMS I.C and AMS I.E | Co-operatives/ consortium model |
| | Methane Avoidance | Anaerobic degradation | ACM0010, AMS III.D, AMS III.R | |
| | Fertilizer switch | Synthetic fertilizer | New meth. required | |
| Medium & Large Scale Biogas plants | As above | As above | As above | As above |

[1] For definitions of renewable and non renewable biomass, please see the Annex III of this document.

| | | | | |
|---|---|---|---|---|
| Solar cooking | Cooking | NR Biomass, Kerosene, LPG | AMS I.C and AMS I.E | Technology Prototype model/ Business Hybrid model |
| Solar water heating | Water Heating | NR Biomass, Fossil fuel, Grid | AMS I.C | Business Hybrid model/ Technology Prototype model |
| Biomass application in industries | Heat | Fossil fuel, NR Biomass | AMS I.C, AMS I.E, AM0036 | Business hybrid model |
| | Power | Grid, Fossil fuel | AMS I.A, AMS.I.D, AM0042, AM0045, ACM0007, ACM0006 | |
| | Cogeneration | Grid, Fossil fuel (combinations) | AMS.I.C, AM0007, ACM0006 | |
| Improved cookstoves | w/o Fuel change | NR Biomass | AMS III.G | Technology prototype model |
| | With fuel change | NR Biomass, Fossil fuels, Grid | AMS I.C, AMS I.E | |
| Village electrification | Electrification/mechanical energy | Grid/Fossil fuel | AMS I.A, AMS I.D, ACM0002, ACM0006, AM0042, AM0026, AM0019, AM0045.<br><br>AMS I.B (for mechanical energy) | Government's Pilot Model, Business Hybrid model, Social venture model |

NR= Non renewable

# Chapter 1
# Background and Introduction

Human induced climate change is a threatening challenge for the globe. India has a monumental yet delicate task of balancing an emerging economy and ward off the threat of climate change with sustainable development. In this context, the Prime minister's council on Climate Change, Government of India released National Action Plan on Climate Change (NAPCC) on 30 June 2008. The Action Plan identifies possible role of CDM Program of Activities (PoA) in financing efficient technologies and emphasizes on mainstreaming CDM PoA[2].

### Identifying the Priority Sector

The key challenge posed to India is to deal with its huge demographic requirements sustainably in the midst of global climate change with limited resources[3,4]. India is committed to eradicate poverty and empower people with health and education. India's population is expected to reach 1.47 billion by 2031-32, and substantial part of it's population lives below the poverty line. Hence, rapid growth at the rate of 8%-10% per year over the next 25 years is vital to accomplish the stated goals. Maintenance of a sustained growth of 8% per year demands high level of energy security. Primary energy supply needs to grow by three to six folds by 2031-32 with nuclear and renewable energy rising to over 20 folds their current capacities.[5]. A level of 9% of growth rate has been set for 11$^{th}$ five year plan[6].

Integrated energy policy (2006) of India, approved by the union cabinet in December 2008, emphasizes the significance of renewable energy resources given the limited amount of domestic conventional energy sources available. Thus to maintain growth in pace with the needs of growing population, there is an urgent need to explore new and renewable sources of energy.

Approximately 72.2% of the total population in India belongs to rural areas[7] having less access to resources and awareness. The Integrated Energy Policy identifies supplying electricity and clean fuels to all as 'one of the toughest challenges'. Promoting household energy security is one of the main areas of action[7].

"*One of the toughest challenges is to provide electricity and clean fuels to all, particularly rural populations given their poor paying capacity, the limited availability of local resources for clean cooking energy, and the size of the country and its population.*[8]"

[2] NAPCC, National Action Plan on Climate Change. GoI. P 48
[3] NATCOM. India's Initial National Communication, Executive Summary P.iii.
[4] NAPCC. National Action Plan on Climate Change. P.1.
[5] Integrated Energy Policy, 2006. Planning Commission, Government of India
[6] 11$^{th}$ Five year Plan, Chapter 2, P.25.
[7] Census of India, 2001. http://www.censusindia.gov.in
[8] Integrated Energy Policy-2006. P. xxvi.

More than 1.4 million small scale industries in India account for around 40% of the total industrial production[9] with limited awareness and resources for use of clean practices. Non-commercial energy is used in the unorganized small and cottage sector. It is estimated that such consumption of non-commercial fuels was around 23.5 Mtoe in 2003-04. Use of non-commercial energy by the unorganized sector is expected to reach 54 Mtoe by 2031-32[10].

Thus, development in these three sectors (households, small and medium enterprises and rural areas) is significant in economic growth and energy security of the country. Dispersed nature of the activities, lack of awareness about best practices and access to finance has restricted sufficient actions in these areas. The above problem can only be dealt with by establishing social cohesion with increased equity at all levels through innovative mechanisms or policies. Such mechanisms or policies should aim to bring socio-economic upliftment with reduced GHG emissions.

Figure 1-1 depicts constrains to development in three sectors and trains that limit their development of renewable energy for low carbon growth.

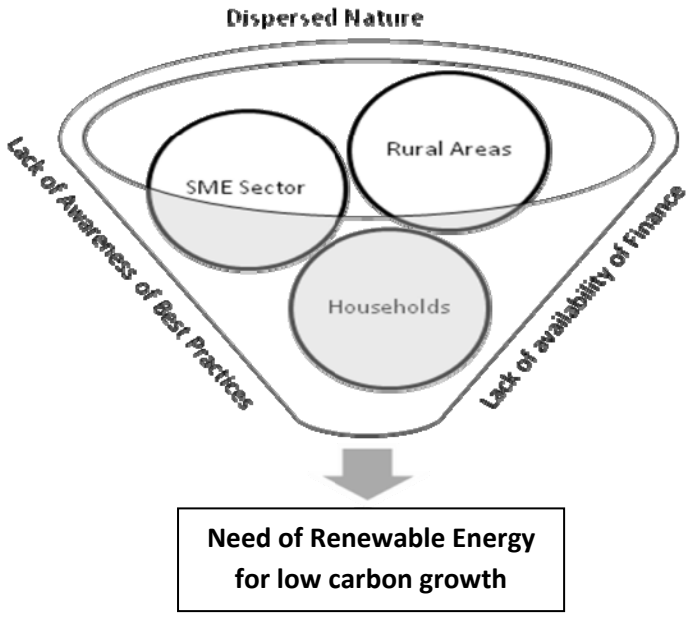



Figure 1-1 Areas of focus

**De-carborization of National Economy**

Sustainable Development and effectively addressing global climate change is an important development goal. Considering a global urgency for actions required to tackle climate change, de-carburization of national economy would be a key factor in the sustainability of the economic growth. Hence, mainstreaming climate considerations into decision making for economic growth is the prerogative way. It will take place only if energy trends are transformed from being high carbon intensive to low carbon intensive. But such a transformation would require introducing new and clean technologies and capacity building for adapting to these changes.

Thus, the **attributes of de-carbonisation** in the days to come would be:

1. **Low Carbon or No Carbon Practices-** To shift from high carbon intensive to low carbon intensive or zero carbon technologies.
2. **Capacity Building-** Creating awareness would be necessary to propagate the theme of sustainable development among the industries and public either through media or through concerned government bodies. This is important to develop the skills to adapt to the changing approach and accept the usage of newer low carbon or no carbon means.

[9] http://www.yourstory.in/resources/featured-articles/153-challenges-of-sme-in-india-sandeep-mancha.html
[10] Integrated Energy Policy-2006 P. 31

3. **Carbon Finance-** To provide enough incentive to shift from the conventional approach and also to maintain this shift.

Figure 1-2 depicts the three attributes of de-carbonization. Carbon finance will be instrumental in running low carbon practices and building capacity for large scale dissemination of these practices.

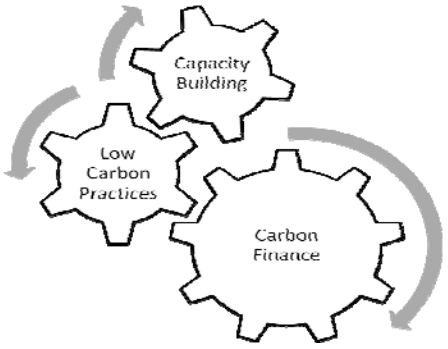



Figure 1-2 Attributes of De-carbonisation

**Climate Change Mitigation and Sustainable Development: CDM**

CDM is the only mechanism among three that involves developing countries in combating climate change. This is done by means of offloading emission reductions in developing countries. CDM has two main objectives- Low cost emission reduction for developed nations and Sustainable development in developing nations. CDM is based on a strong economic foundation intending to optimize reduction of emissions in the developed nations and also to optimize development in developing nations through technology transfer and carbon finance. So far, CDM has been successful in creating a dynamic carbon market, with over 1615 projects registered and more than 4200 projects in the pipeline (May, 2009)[11]. Approximately, 2.9 billion tonnes of $CO_2$ equivalent reductions can be achieved by 2012 with these projects. This is indicative of the fact that CDM has been able to mobilize efforts and finance to mitigate climate change. However, these efforts should be able to percolate across regions and sectors to enhance social cohesion and equity at all levels. Also, owing to the demographic set up of India, huge difference can be made if carbon trends can be altered at the bottom of pyramid.

**Pitfalls so far**

There has not been enough participation in CDM from households, small enterprises and rural areas[12,13]. This is mainly due to dispersed nature and long implementation schedule of such activities, small volume of CERs, high transaction cost and lack of awareness creating unequal distribution of projects. However, equity can be achieved if a new approach involving attributes of de-carbonization can be adopted.

**CDM: Way Forward**

The challenge lies in building on the conventional CDM to generate greater participation from such areas. It can then help them transit substantially to a low carbon intensive development path. The conventional single project activity approach is unlikely to catalyze such profound and lasting effects in these areas. It was therefore suggested that along with project activity based CDM, attention is

[11] http://cdm.unfccc.int/Statistics/index.html
[12] Naydenova, Lucy (2007), Micro project activities under the CDM. CDM investment newsletter Nr. 2/2007. P.10
[13] http://figueresonline.com/publications/policies&programs.pdf

required on programme based approach as well so as to maintain optimum carbon intensity. A programme based approach would also create the incentive for developing countries to implement policies and measures. This approach is also based on effective utilization of attributes of de-carbonization. Hence, unless the impact of the CDM percolates equally across sectors and regions, the desired transformation in the carbon trends is less likely. A programme based approach is therefore suggested which can be used to encourage wide climate friendly policies and measures.

The Clean Development Mechanism Executive Board (CDM EB) of the United Nations Framework Convention on Climate Change (UNFCCC) in its 32nd Meeting, in June 2007 approved Guidance and procedures on the registration of project activities under a Programme of Activities (PoA) as a single CDM project activity and issuance of Certified Emission Reductions (CERs) for a Programme of Activities.

**The Study**

Ministry of New and Renewable Energy (MNRE) perceived it as a new and important window to take up CDM projects with programmatic approach, particularly pertaining to households, small enterprises and rural areas. To increase awareness at all levels and to understand technicalities of this approach this study *"Developing a Framework for Programmatic CDM projects in Renewable Energy Area"* was commissioned in July 2008.

**Objectives of the study**

This study is to develop a framework for taking up CDM projects in identified renewable energy areas under Programme of Activities mode. The study covers the following aspects:

i. Scope and potential for CDM PoA in areas as identified in the section below;
ii. Analysis of possible additionality arguments
iii. Identifying sector specific baseline and monitoring methodologies, validation requirements
iv. Development of a logical framework for CDM-PoA in identified sectors

**Scope of the study**

Following renewable energy areas have been identified for the assessment under programmatic approach:

1. Family Type Biogas Plants programme
2. Medium & Large Size Biogas Plants programme
3. Solar Water Heating
4. Solar Cooking programme
5. Improved Cook stove programme
6. Biomass Applications in Industry
7. Village Electrification programme

## Conclusion:

The Government of India has recognized climate change as a significant challenge and as a step towards mitigation and adaptation, National Action Plan on Climate Change has been released which also identifies potential role of CDM PoA. As per the NAPCC, India's priority in days to come is to maintain the growth to cop up with the demand of increasing population. This has to be done in coherence with the resolution that country's per capita emissions will never exceed those of developed countries. To achieve this, economy will have to adapt low carbon or no carbon measures. Programmatic CDM route can be effective way of doing this. This report covers seven renewable energy areas including: Family Type Biogas Plants programme, Medium & Large Size Biogas Plants programme, Solar Water Heating, Solar Cooking programme, Improved Cook stove programme, Biomass Applications in Industry and Village Electrification programme, for identifying potential in PoA CDM and proposes possible frameworks to implement these programs.

# Chapter 2
# CDM Programme of Activities

**Programme of Activities**

The concept of CDM Programme of Activities (PoA), also referred as Programmatic CDM (pCDM)[14] has been discussed since 2005 at various platforms. The Conference of Parties serving as Meeting of Parties to the Kyoto Protocol at its first session (CMP.1) decided

> *"A local/regional/national policy or standard cannot be considered as a CDM project activity, but that project activities under a programme of activities can be registered as a single CDM project activity provided that approved baseline and monitoring methodologies are used that, inter alia, define the appropriate boundary, avoid double-counting and account for leakage, ensuring that the emission reductions are real, measurable and verifiable, and additional to any that would occur in the absence of the project activity[15]."*

The CDM Executive Board adopted *"Procedures for Registration of a Programme of Activities as a Single CDM Project Activity and Issuance of Certified Emission Reductions for a Programme of Activities (Version 01)"* at its 32nd meeting, June, 2007.

The Annex 38, paragraph 1, of the EB 32, defines PoA as:

> *A programme of activities (PoA) is a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to anthropogenic GHG emission reductions or net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of CPAs.*[16]

The Annex 38, paragraph 1, of the EB 32, defines CPA as:

> *A CPA is a single, or a set of interrelated measure(s), to reduce GHG emissions or result in net anthropogenic greenhouse gas removals by sinks, applied within a designated area defined in the baseline methodology.*[17]

[14] Used interchangeably throughout the report
[15] UNFCCC, 2006: FCCC/KP/CMP/2005/8/Add.1, 30 March 2006, Decision 7/CMP.1, paragraph 20. http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=93
[16] CDM EB 32 Report, Annex 38. http://cdm.unfccc.int/EB/032/eb32_repan38.pdf
[17] CDM EB 32 Report, Annex 38. http://cdm.unfccc.int/EB/032/eb32_repan38.pdf

In a nutshell, PoA is an umbrella programme with number of similar activities called CPAs (Fig. 2-1). These activities are individual project activities, identical in nature, apply the same approved baseline and monitoring methodology. Unlimited number of such activities can be added on geographical as well as on temporal scale.

PoA is implemented at three levels *i.e.* the programme level or PoA; activity level or CPA and end user level. The larger programme (PoA) is governed by a managing or coordinating entity, which takes care of CDM registration and issuance of CERs. The smaller but identical activities (CPAs) are implemented by many implementing agencies or CPA operators, that take care of implementation and monitoring of the activity.

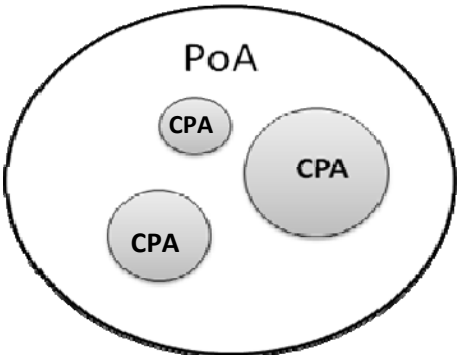



**Fig. 2-1: PoA and CPAs in relation**

**Characteristics of PoA approach**

1. It is a deliberate action, which can be a public sector or private sector initiative and can be voluntary or mandatory in nature. For example there can be a public policy or standard and its private adoption may be a program or there can be a private initiative not guided by any policy or standard.

2. **Dispersed nature:** A PoA is an umbrella programme with many dispersed activities (CPAs) which may 0r may not occur at the same time.

3. **Variables in Program:** PoA has large number of variables including multiple sites and different timeframes. Exact type, size and location of all CPAs may not be known at the time of registration of a PoA. However one live case is necessary to be proposed as CPA along with PoA at the time of validation

4. **Project boundary:** The physical boundary of a PoA may extend to more than one country. Extension of the program across countries will be eligible in non annex I parties (developing countries) only.

5. **Duration:** The duration or lifetime of the Programme of Activities (PoA) can not exceed 28 years (60 years for Afforestation and Reforestation (A/R) PoAs) and should be defined at the time of request for registration of the PoA.

6. **Crediting period:** Like normal CDM project activities, crediting period for CPAs has to be either renewable- seven years (twenty years for A/R project activities) which can be renewed at most two times; or fixed- maximum of ten years (thirty years for A/R project activities) with no option of renewal. At the same time the duration of crediting period of any CPA shall be limited to the end date of the PoA regardless of when the CPA was added.

7. **Project Type:** All CPAs in a PoA must be similar to each of other; shall ap**p**ly same baseline and monitoring methodology, involving one type technology or set of interrelated measures in same type of facility/installation/land. The characteristics of the typical CPA must be clearly defined in the PoA design document (CDM PoA-DD) at the time of request for program registration.

8. **Inclusion of a CPA:** A CPA can be included in a registered PoA at any time during the duration of the PoA. To include an additional CPA in a registered PoA, the coordinating/managing entity should forward the completed CDM-CPA-DD form to the same DOE that requested registration of the PoA for consistency checking. This DOE will scrutinize the information in the CDM-CPA-DD against the PoA and documentation requirements and, if consistency/integrity is confirmed, includes the proposed CPA(s)will be included in the registered PoA.

9. **Erroneous inclusion or erroneous renewal of crediting period** of a CPA in a PoA can be identified by a CDM Executive Board member leading to exclusion of the CPA from the PoA by the CDM EB with immediate effect.

10. **Registration fee:** Registration fee for a PoA is based on the total expected annual emission reductions of the CPA(s) that will be submitted together with the request for registration of the PoA. No registration fee is payable on CPAs which are added subsequently[18] for validation thereby lowering the transaction cost incurred.

11. **Change in methodology:** If the approved methodology applied to a registered PoA is put on hold or withdrawn, no new CPAs is included to the PoA. If the methodology is subsequently revised or replaced by inclusion in a consolidated methodology, the PoA has to be revised accordingly and the changes are validated by DOE and approved by the CDM EB. Once changes have been approved by the Board, each new CPA uses the latest version of the PoA specific CDM-CPA-DD. CPAs that were included before the methodology was put on hold, applies the latest version of the PoA specific CDM-CPA-DD at the time of the renewal of the crediting period.

12. **De-bundling:** A proposed small-scale CPA of a PoA is considered to be a de-bundled component of a large scale activity[19] if there is already an activity using the same methodology:
    a. with the same activity implementer or has a coordinating or managing entity which also manages a large scale PoA of the same sectoral scope, and;
    b. the boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

13. Creating infrastructure (*e.g.* testing labs, creation of an enforcement agency) or capacity to enforce the policy or standard, as such, are not considered as CDM project activities/ CPAs. The eligibility of project activities that are a result of the creation of infrastructure or capacity to enforce the policy/ standard shall be based only on measurable emission reductions which are directly attributable to these project activities[20].

[18] EB 33 Report; paragraph 60.
[19] EB 33 Report; Annex 21. Guidance for determining the occurrence of de-bundling under a PoA
[20] EB 33 report, paragraph 30

**Advantages of the PoA Approach**

1. **Overcoming the size limit to reduce the transaction cost**
   The prospects of extending a clean technology or practice to smaller units in areas with less or no penetration may increase substantially with this approach as transaction cost will drastically decrease. This would in turn help equitable distribution of low carbon practices across regions.

2. **Scaling up mitigation activities**
   Once a mitigation activity is recognized as a PoA, replicating identical CPAs under the umbrella programme would be simpler. This would help in scaling up of the best of the mitigation practices. As this approach aims to reduce regulatory/practical hurdles considerably with simplification of registration process number of concepts can be taken up as possible programs.

3. **Temporal scale of addition of activities**
   In traditional CDM, bundling has been allowed for projects into a single bundled CDM project activity across the geography. Projects implemented or taken up at different time scales can not be taken up as a single bundled project activity. Projects which are implemented in phased manner can be proposed as separate CDM project activities consuming more time and resources. PoA removes this barrier as it allows bundling of CPAs at different points of time in the 28 years lifetime of the program.

4. **Diversified regulatory risks**
   Programmatic CDM faces less regulatory risks (risks related to UNFCCC regulations) than conventional CDM which is of concern from a buyer's perspective. It has advantages over bundling of CDM project activities as it can be registered at the concept level without detailing in advance all its constituent activities; on the contrary conventional CDM necessitates each single project to be identified and qualified before registration. As shown in the figure 2.2, in a bundled project activity the regulatory risk is reduced only after the process of CDM registration which requires considerable time and transaction costs to be borne upfront. Under the programmatic approach, regulatory risk is handled earlier in the process (see figure 2.3). Once a PoA is registered, coming up CPAs can get on with greater certainty. In case a DoE reports non compliance with the requirements of monitoring in a CPA, the very CPA is set aside.

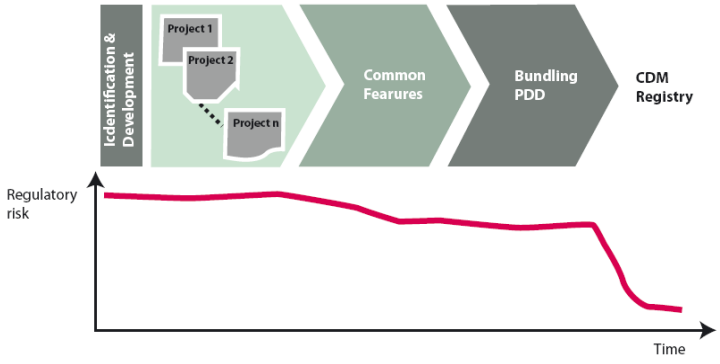



**Figure 2-2- Risk profile for a bundled CDM structure**

However, other CPAs in the PoA can continue. This attribute is especially of relevance for the buyers because the inclusion of PoAs in a portfolio of projects offers an easy method of diversifying risks. Preference from buyers for emission reductions from PoAs will provide a definite push to programmes. However degree of buyers' preference for PoA CERs over bundled project CERs is still not very clear.

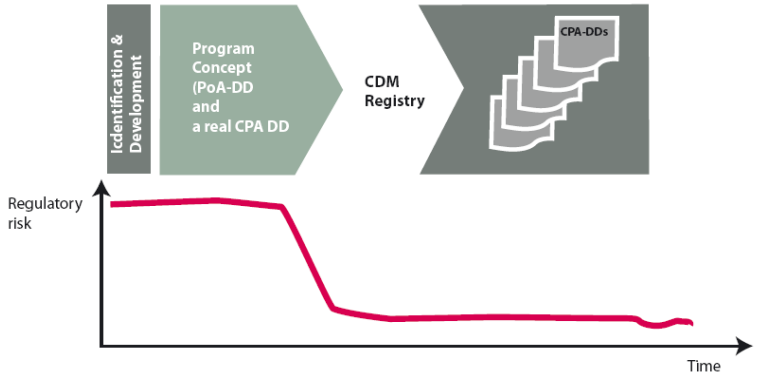



**Figure 2-3: Risk profile for a PoA scheme**

Advantages of programmatic approach over traditional CDM are listed in the table below.

**Table 2.1: Advantages of Programmatic approach**

| Parameters | Traditional CDM approach | Programme of Activity (PoA) |
|---|---|---|
| **Uniqueness** | Dispersed project activities cannot be included once it is registered. | Programmatic CDM approach can involve emission reduction projects which are dispersed in terms of variables like multi-site project implementation, different implementation schedules. |
| **Encourages greater sectoral spread** | Households and small/medium enterprises, each of which could individually achieve only a minimal level of emission reductions are barely represented in CDM pipeline due to the high transaction costs associated. | Programmatic CDM encompasses Emission reduction activities in sectors like households and small enterprises, whose aggregated emission reductions present a potential volume of GHG reductions. |
| **Flexibility** | a. The project activities have to be identified for further registration as separate project activity.<br>b. Similar project addition is not allowed. | a) It is not necessary to list or identify all the projects. A PoA can start with just one identified CDM Programme Activity (CPA).<br>b) Consequent similar project activities can be added through the crediting period. |

| | | |
|---|---|---|
| **Reduce Transaction cost** | Validation is needed for every Project activity registration. Hence, transaction costs are relatively high unless high credit volumes are generated. | Inclusion of CPAs requires only coherence check by the DOE. Thus Validation / Registration Fee is not applicable for registration of subsequent CPAs which translates into reduced transaction costs. |
| **Reduce time/risks for project Registration** | If the project (part of a project activity) fails to register, the entire project activity gets complicated. | Need for validation of every CPA is eliminated thus reducing the time required to validate each CPA. Since, all the CPAs are based on the same baseline and additionality logic; the risk related to rejection gets reduced.<br>Even if one CPA fails, the entire PoA excluding the failed CPA may continue. |
| **Life Cycle** | Max 21 years | 28 Years |

**Issues in PoA approach**

CDM executive board specifically called a public input on CDM PoA which was open from 6 August to 3 September 2008. Total 36 comments were received and are available on UNFCCC website[21]. Result of analysis shows the percentage of comments recognizing an issue. Issues raised in less than 10% comments have not been shown in the bar chart as Figure 2-2. DOE's liability issue in case of erroneous inclusion of a CPA in a PoA is considered an important issue in more than 63% of comments. Other important concerns come out to be- limitation of a PoA in one technology /one baseline, single methodogy use for a PoA and method of CPA inclusion.

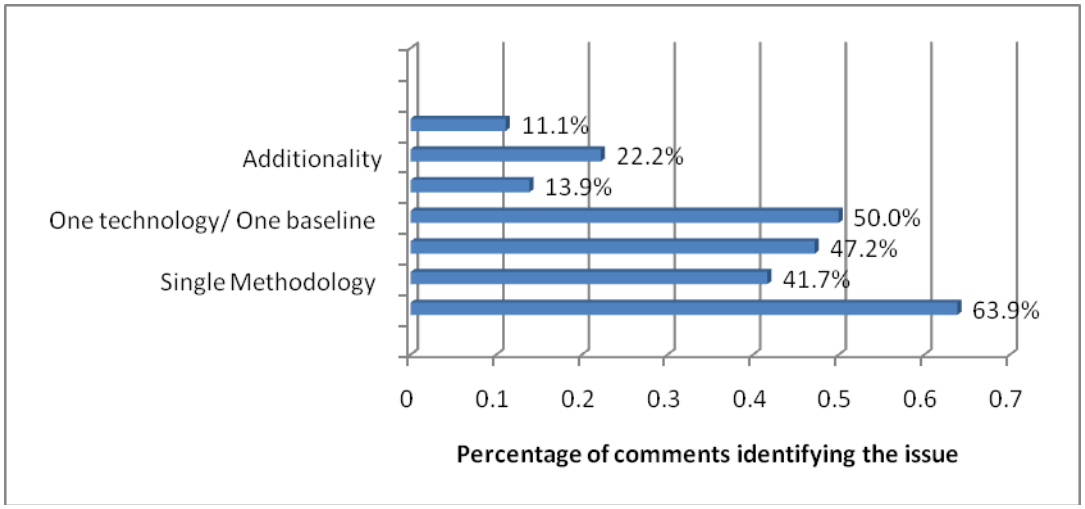



**Figure 2-4: Comments on CDM PoA**

[21] http://cdm.unfccc.int/public_inputs/2008/PoA/index.html

Some issues are deliberated here:

1. As shown in Fig. 2-5 and 2-6, CPAs added later in the lifetime of the CDM PoA might have lesser crediting years *i.e.* only for the remaining lifetime of the PoA.
2. Consequences of the exclusion (DOE liability issue): If the CPA that has been excluded can not be re-included in that or any other PoA, or qualify as a CDM project activity; the DOE that included the CPA, shall have to transfer the amount of CERs issued to the PoA as a result of inclusion of a disqualified CPA , to a cancellation account maintained in the CDM registry . The further inclusion of new CPAs and issuance of CERs to that PoA shall be put on hold and all CPAs already submitted shall be reviewed to determine if any other CPA disqualifies. This provision of refunding CERs may lead to less attractiveness of PoAs for DOEs[22].
3. A DOE accredited for the sectoral scope to which PoA belongs to, that has not performed validation, registration, inclusion or verification functions with regard to the PoA with erroneous inclusion, will conduct the review and submit a review report to the Board. This might create a gap as not adequate DOEs are accredited for performing these functions to all the sectoral scopes.
4. Single methodology and single technology: A PoA will use only single CDM baseline and monitoring methodology and single technology. Given the fact that most of the registered CDM project activities use more than one CDM methodologies, this is disadvantage which limits the potential of PoA as an instrument for low carbon growth.
5. As discussed earlier, if the approved methodology applied to a PoA is put on hold or withdrawn, no new CPAs is included to the PoA. If the methodology is subsequently revised the PoA has to be revised accordingly and the changes are validated by a DOE and approved by the CDM EB. This may bring an additional cost on the PoA managing entity for validating the changes and also may lead to monitoring changes at the user level.

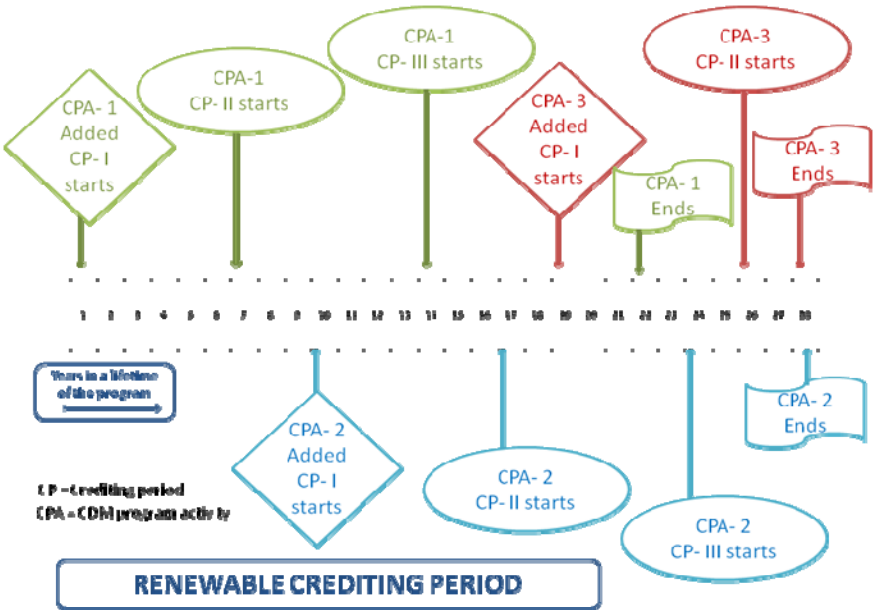



**Figure 2-5: Life of a PoA when renewable crediting period is opted**

[22] DOE forum meeting EB 39. Also, Public inputs on UNFCCC call.
http://cdm.unfccc.int/public_inputs/2008/PoA/cfi/C1PZOGI16ARACDN6W48WAEM9LH9DHM

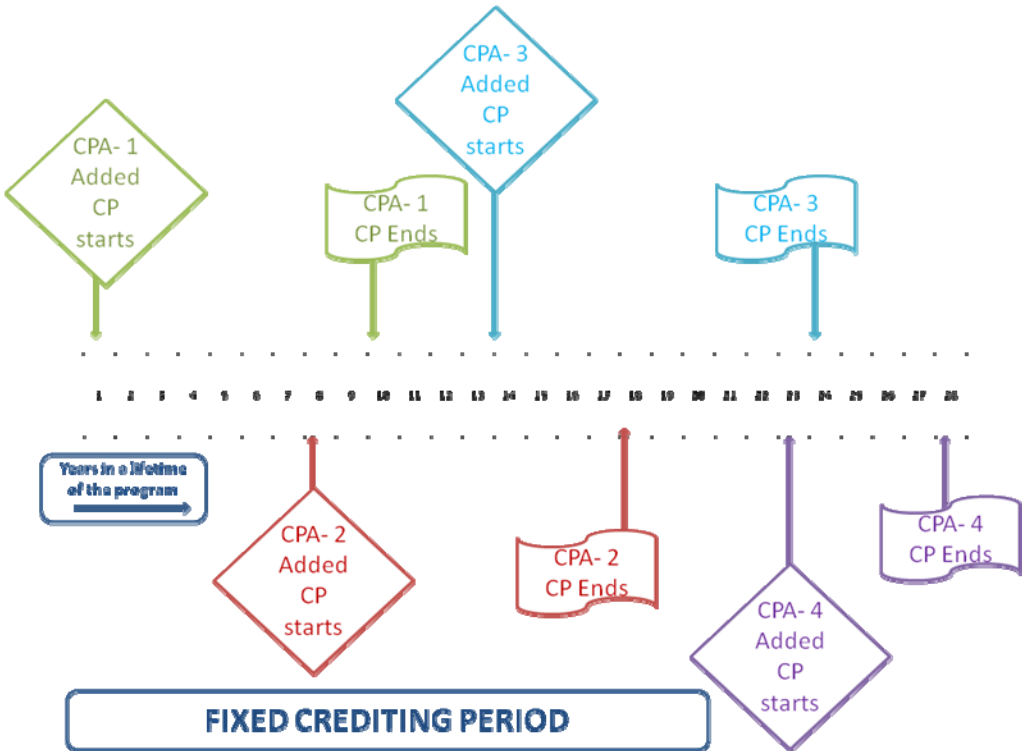



**Figure 2.6- Life of a PoA when fixed Crediting period is opted**

**Status of Proposed PoA**

There are currently eight programs of activities (PoAs) in validation stage but none of them registered yet. CDM PoAs currently under validation[23] are listed in the table 2.2.

**Table: 2-2: Proposed CDM PoAs**

| Project Title | Host Country | Methodology | Emission Reductions | Type | DOE |
|---|---|---|---|---|---|
| Installation of Solar Home Systems in Bangladesh | Bangladesh | AMS-I.A. ver. 12 | 34,854 | Solar PV | DNV |
| Methane capture and combustion from Animal Waste Management System (AWMS) of the 3S Program farms of the Sadia Institute | Brazil | AMS-III.D. ver. 13 | 3,894 | Biogas flaring | DNV |
| New Energies Commercial Solar Water Heating Programme in South Africa | South Africa | AMS-I.C. ver. 13 | 967 | Solar Water Heating | PWC |

[23] http://cdm.unfccc.int/ProgrammeOfActivities/Validation/index.html as on 16 February, 2009

| | | | | | |
|---|---|---|---|---|---|
| CUIDEMOS Mexico (Campana De Uso Intelegente De Energia Mexico) – Smart Use of Energy Mexico - Programme of Activities | Mexico | AMS-II.C. ver. 9 | 27,789 | Efficient light bulbs | DNV |
| Uganda Municipal Waste Compost Programme | Uganda | AMS-III.F. ver. 6 | 22,301 | Compost-ing | AENOR |
| Promotion of Energy-Efficient lighting using Compact Fluorescent Light Bulbs in rural areas in Senegal | Senegal | AMS-II.C. ver. 10 | 3,835 | Efficient light bulbs | AENOR |
| Masca Small Hydro Programme | Honduras | AMS-I.D. ver. 13 | 3,952 | RoR Hydro | TÜV-SÜD |
| Solar Water Heater Programme in Tunisia | Tunisia | AMS-I.C. ver. 13 | 9,539 | Solar Water Heating | TÜV-SÜD |

Figure 2-7 gives graphical representation of analysis of programmatic CDM projects currently under validation

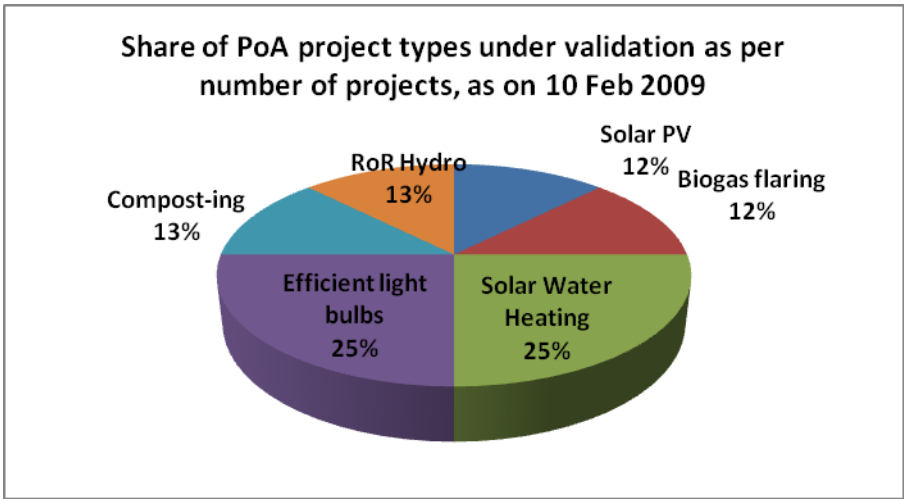



**Fig. 2-7: Share of different project types in proposed PoAs**

No PoAs have been webhosted from India till date, for validation. This can be attributed to the procedural which have impeded the development and registration of PoAs. Government of India has decided that all public sector PoAs will be implemented by the government in order to ensure alignment with public policy and goals[24]. Experts believe that this approach will be very appropriate in sectors like energy efficiency, transportation, fuel switch and renewable energy particularly in households, small enterprises

[24] http://www.figueresonline.com/publications/PoA%20paper%20for%20IETA.pdf

and rural areas. The reason for its appropriateness is that the activities in these areas are often dispersed, have high transaction costs and relatively low CER flows.

**Conclusion**

Program of activities under CDM is an extension of bundling of projects. It allows many CDM program activities (CPAs) to be included under a registered program of activities (PoA) at any time during its lifetime (28 years). PoA is a voluntarily coordinated action by a managing/coordinating entity. Set of voluntary/ mandatory policy driven measures under single technology can be taken up as a PoA provided proper CDM consideration is in place. A PoA employs only one approved CDM baseline and monitoring methodology. Eight PoAs are under validation for CDM registration. In India, a few PoAs have been proposed to National CDM Authority for host country approval.

# Chapter 3
# Implementation Framework

For programmatic approach to be successful and have desired impact, certain institutional reforms, reforms in management system, and capacity building at all levels is required. This is evident from the fact that there are not much successful programs that have been developed so far, the concept as such is relatively new and much more clarity is required. Also, this sector in general has limited availability of experts and limited financial resources. Besides, awareness level in implementation front is also low. Therefore institutional and management reforms should involve efforts in education, training and public awareness. However before possible frameworks are suggested, CDM PoA cycle and roles of various stakeholders involved in the process will be discussed.

**CDM PoA Cycle:**

In order to request validation of a PoA, the managing entity must submit three documents to the designated operational entity (DOE) :(i) PoA design document (PoA-DD), (ii) CPA design document (CPA-DD)–Generic and (iii)CPA design document (CPA-DD)-Specific.

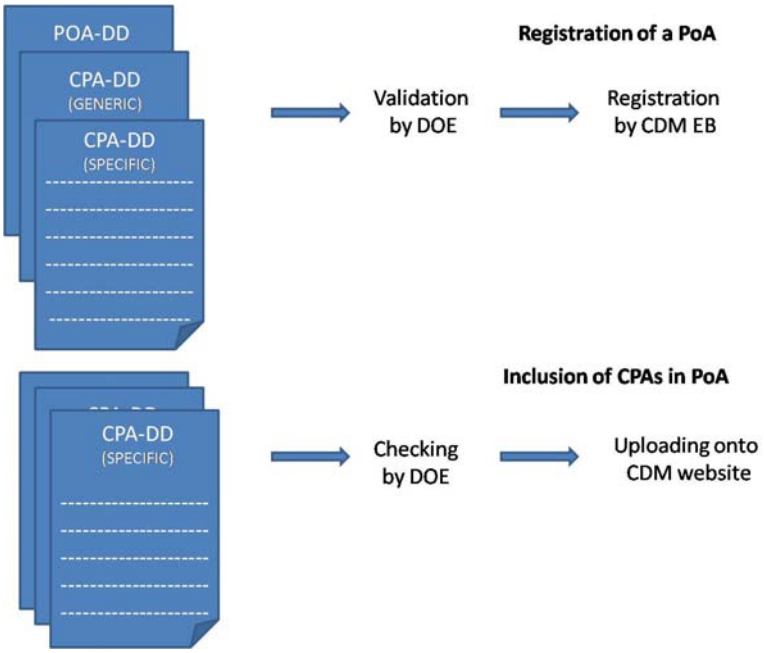



**Figure 3-1: Registering a CDM PoA and inclusion of CPAs**

The PoA design document (PoA-DD) identifies the managing entity, the boundary of the PoA, and the eligibility criteria for the CPAs, and demonstrates the additionality of the PoA at both the program and the CPA level. A CPA design document (CPA-DD)- typical, contains the generic information relevant to all CPAs of the PoA and is essentially the blueprint for all CPAs implemented under the PoA. The completed CPA-DD of the first CPA is called a CPA DD (specific) and is based on the blueprint CPA form, but containing all the information for the specific CPA which is to be implemented.

Once the DOE has validated the PoA-DD, the generic CPA-DD, and the specific CPA-DD, the three documents are sent to the EB for registration. All further CPAs do not need to be validated. Each subsequent CPA-DD will be checked by the DOE for consistency and then forwarded to the UNFCCC Secretariat for automatic uploading on the UNFCCC Web site.

*Verifying DOE should be different from validating DOE (both for large and small scale PoAs).

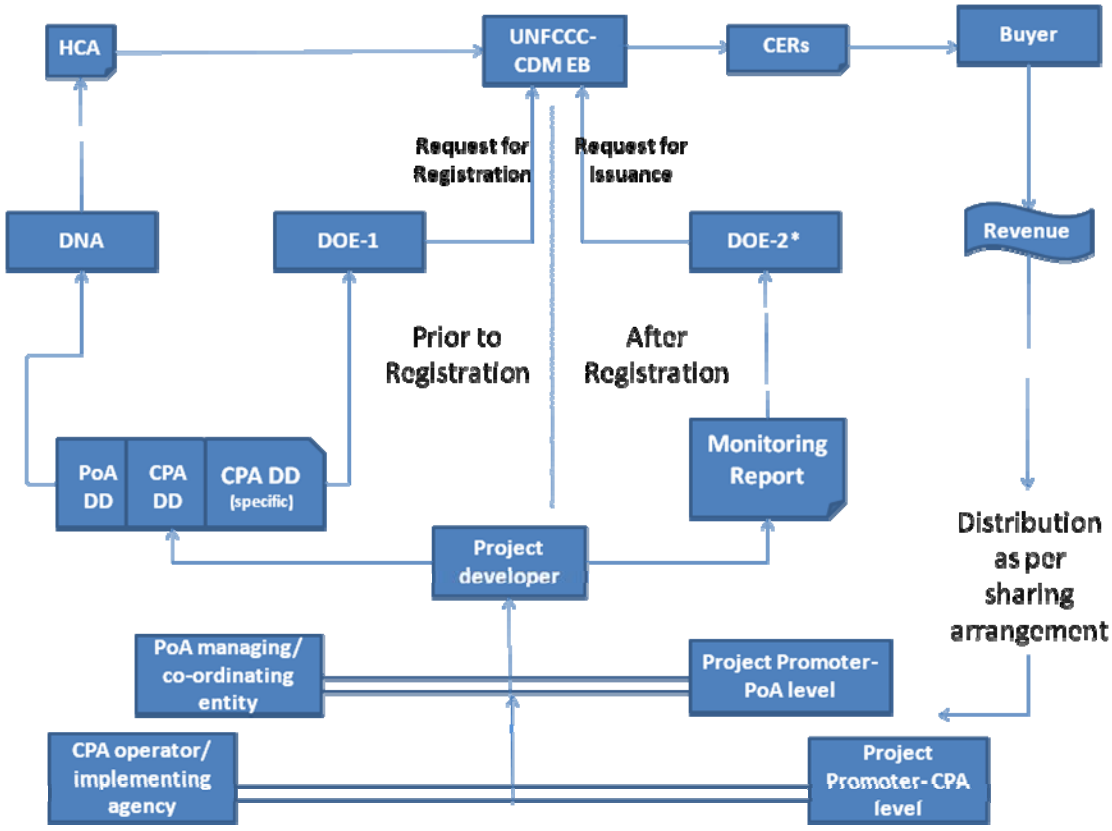



**Figure 3-2: A representation of PoA CDM Cycle**

Registration happens only when the project participants submit LoA from host country DNA. After a PoA is registered, emission reductions are monitored, monitoring report is prepared which is verified and certified by the DOE (for a large scale PoA, different from the one who has validated the program). CERs are then issued by CDM EB which can be sold to a buyer and revenue generated can be shared among the PPs as per a CER sharing agreement.

**Process Facilitators**

**Project Developers/ Consultants**

Project developers have to build capacity and have to assume a role responsibility. This responsibility could be launching programs themselves as a PoA coordinator as they have a good reach and base of technology suppliers, financial institutions and other stakeholders. They should also be proactive in providing support for capacity development, awareness generation and helping in resolution of issues with any relevant authorities.

**Designated Operating Entities**

DOEs should develop the ability to deal with project activities that have a broader scope than the current single site projects, DOE liability is one of the major issues with PoA (as discussed in previous chapter under erroneous inclusion of a CPA in a PoA[25]). The DOE forum has put this issue for consideration of the Executive Board[26] in February 2009. In general, DOEs must also pay attention to assessing the baseline, analyzing the rigor of the additionality tests and evaluating the suitability of the monitoring methodology. Besides this, DOE should assess sectoral or geographical baseline, analyze additionality at PoA as well as CPA level and develop possible sampling techniques using stratified samples, identifying control groups, and regression analysis techniques to extrapolate results. Verification would involve ensuring actual implementation and assessment of the impact of the program along with an estimation of free riders where appropriate. DOEs should also actively propose reforms and guidelines that make these processes simpler for DOEs and for the project participants. For a given sectoral scope enough DOEs may not be available in the region thereby increasing transaction costs.

**Designated National Authority**

India has an inter-ministerial body- National CDM Authority (NCDMA) under the chairmanship of the Secretary- MoEF to ensure sustainable development and voluntary participation of the host country in a CDM project activity. NCDMA releases Host Country Approval which is a Letter of Approval (LoA) for a proposed CDM project (under the scope of this report- a PoA). This LoA is necessary for successful registration of a PoA. As PoA is supposed to provide a much required impetus to sustainable growth, DNA's role is of high importance in guiding ministries and other departments and pushing reforms through all levels.

**UNFCCC secretariat and CDM Executive Board**

In CMP-4, The UNFCCC secretariat encouraged project participants to prepare and submit programs of activities. The secretariat also requested the Executive Board to work on the provision of guidance on programs of activities on urgent basis. The secretariat also encouraged the CDM Executive Board to expand the applicability of methodologies for programs of activities by allowing a combination of small-

[2525] Chapter 2, Under: Issues in PoA approach

[26] EB 45 Report. Para 82.

scale methodologies[27]. The CDM EB encourages submissions of new methodologies as well as revision of approved methodologies such that they are adapted to meet the broader scope of programmatic activities. Also, much further clarity can be achieved with PoA specific guidelines based on addressing the issues that have been raised so far.

**Stakeholders and their Role:**

**Project Promoters/ corporates**

Project promoter is an investor or a facilitator who promotes the PoAs/CPAs with the means of finance and other resources. Corporate sector could become project promoter with the aim of business or Corporate Social Responsibility (CSR).

**Technology Supplier**

Role of technology supplier could be to act as PoA manager/coordinator or as CPA operator/ implementing agency. Technology suppliers may also help in O&M of technology installed/sold by them. They can also act as bridge between financial institution and end user to facilitate successful implementation of the programs. As a managing/coordinating entity of a program technology supplier can act as an aggregator. Registered business model can be easily sailed by a company managing the programme. Once the PoA is registered, the managing entity may like to sail the project concept and specific guidelines to the bodies who want to operate/implement CPAs under the umbrella of the registered programme.

**Financial Institutions and Industry Associations**

PoAs are anticipated to open the CDM market to replicable but physically scattered projects that would have been difficult and time-consuming to develop under the ordinary CDM structure. Programmatic CDM is also anticipated to be well suited to renewable energy projects and in private households, small enterprises sector[28].

Financial institutions like rural credit and small cluster credit banks are now engaged in the fast growing markets like low carbon technology. In this context, programmatic approach can become an interesting opportunity wherein financial institutions can design attractive financial products to support low carbon projects. In such a scheme, financial institutions like MFIs, SMEs, and Associations can enter into contracts with small enterprises or households participating in the program and offer attractive loan products in return of which the participating SMEs or households can transfer their property rights of the achieved emission reductions to the concerned financial institutions. Microfinance institutions are typically suited in the rural set up as they already have loan products and penetration among the rural community which can be modified in these lines. Also, associations like CII, FICCI, ASSOCHAM have good rapport and capacities to play an active role in linking financial institutions and the activity owner. They can be instrumental in capacity building of the end users and also for developing the financial products in association with financial institutions.

[27] Decision-/CMP-4. Further guidance relating to the clean development mechanism

[28] Francisco Avendaño (2008). Scaling Up Ghg Emission Reductions Through Replicable Business Models. A Reformed CDM – including new Mechanisms for Sustainable Development. UNEP Risø Centre. P.166.

**Central Government Bodies:**

Given the social dynamics of the intended sector, a PoA approach can pick up really well if a **bottom up approach** is followed where in the role of community/people increases. This can be practiced in public sector project activities related to policy changes/reforms with a local public entity as the implementing agency. The relevant government agency would then be responsible for defining and documenting the baseline, and in suggesting a suitable monitoring methodology/mechanism for the program. Also, central government bodies can do a lot to increase awareness at all levels in a **top down approach**, in particular, end users of technology. One method to do this would be to document successful case studies of activities which have been taken up and projected as a larger national programme.

**State Level Govt. Bodies**

State level govt. bodies and nodal agencies like SNAs, KVICs etc. have been running various forms of extension services for the priority sectors. Some of them have been able to increase the awareness level manifold but some of these services also could not gain enough momentum due to lack of funds. At the same time, as these agencies have been closely involved with the priority sector and have good levels of penetration and acceptance they become ideal to get involved in a programme. They can make a framework of possible localized programme which is focused on the region and educates the end user about the advantages of using best low carbon/no carbon practices for leading a viable and self-more sustainable lifestyle.

**Non Governmental Bodies**

Non governmental bodies like NGOs, Self Help Groups (SHGs) and Social Ventures can act as managing/coordinating entity for PoA and/or as CPA implementer. More precisely roles for large NGOs could be to manage/co-ordinate PoA and implement CPAs. Capacity building role can also be played by them. SHGs are end users groups that can be involved in O&M, Monitoring and verification activities. Social Ventures are promoted by Private players to induce sustainable development and can act as CPA implementer.

**Academic Institutions**

Academic institutions like Universities and Research Institutes can play important role of capacity building, creating awareness, training and research on PoAs.

**CER Buyers**

Programmatic CDM may face higher delivery risks than conventional CDM which is of concern from a buyer's perspective. A PoA has to be revalidated every time there is revision in the methodology used. Hence this may result in increase or decrease in the number of CERs generated which is a concern for the buyer because of the shortage of credits from the earlier numbers. This may result in higher risks and thus PoA CERs may command lesser prices as compared to a standard CDM project activity[29]. Moreover, the investment per CER generated would be higher as compared to normal CDM project activity. However, it has certain advantages as Programmatic CDM faces less regulatory risks (see: Chapter 2) than bundled CDM project activities. Hence, successful implementation and registration of PoAs would only give a clear picture of the preference of buyers and CER prices the PoAs command.

The Community Development Carbon Fund of the World Bank can be a potential buyer for CERs from CDM PoAs in renewable energy area. This fund targets small projects in least developed countries (LDCs)

[29] http://cdm.unfccc.int/public_inputs/2008/PoA/cfi/TN4T6XKB6BWBSFAG1ALHPH058FRN7B

and rural areas of all developing countries. This fund aims to catalyze private capital to the poorest of the poor. Projects funded under the CDCF need to pay particular attention on the real, measurable and long term benefits of the project to the local community.

**Model Framework for the PoA**

This section presents a model framework for taking up CDM PoA in all identified sectors of renewable energy project development can be based on the pros & cons of the model and the needs of the sector and region of implementation.

**Basic Principles:**

- End User pays a nominal amount upfront. This would help to develop a sense of ownership and responsibility.
- End Users are involved in Operation & Maintenance, Monitoring &Verification. This would help in better functionality and employment generation.
- Incentive based approach rather than being a subsidy based approach because subsidies depend on grants and not all/ enough programs can be promoted through subsidies.

**Classification of the models on the basis of Coordinating/Managing Entity and CPA Operator/ implementing agency**

Models are primarily categorized based on the nature of coordinating/managing entity and CPA operator/implementer.

| Co-ordinating/ Managing Entity / Implementing agency/ CPA operator | *Government* | *Private* |
|---|---|---|
| *Government* | GG Model | PG Model |
| *Private* | GP Model | PP Model |

**Figure 3-3: Model categorization**

**GG Models**

A Government-Government Model is one in which government agencies work both at PoA and at CPA level. This model can be further categorized into several types based on level of agency deploying the activities.

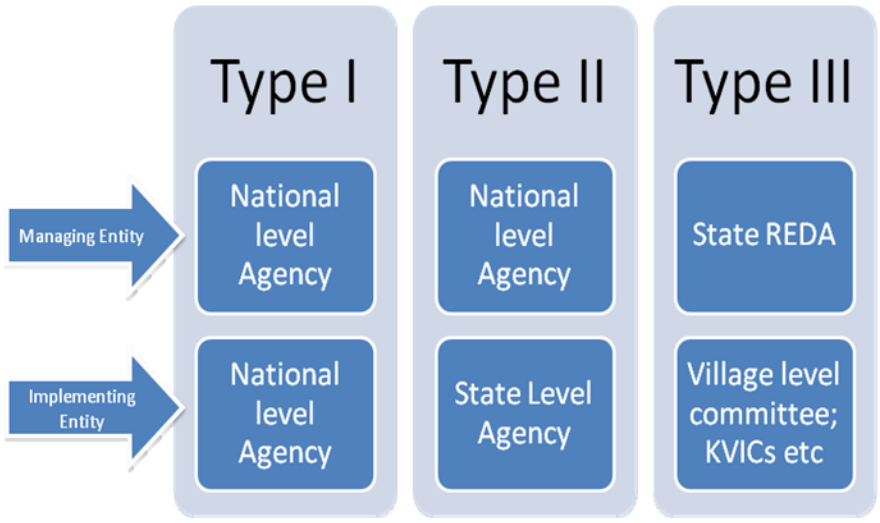



**Figure 3-4: GG Models**

**PG Models**

In a Private-Government model, a corporate, a technology supplier or financial institution or an NGO joins hands with government to implement the CPAs.

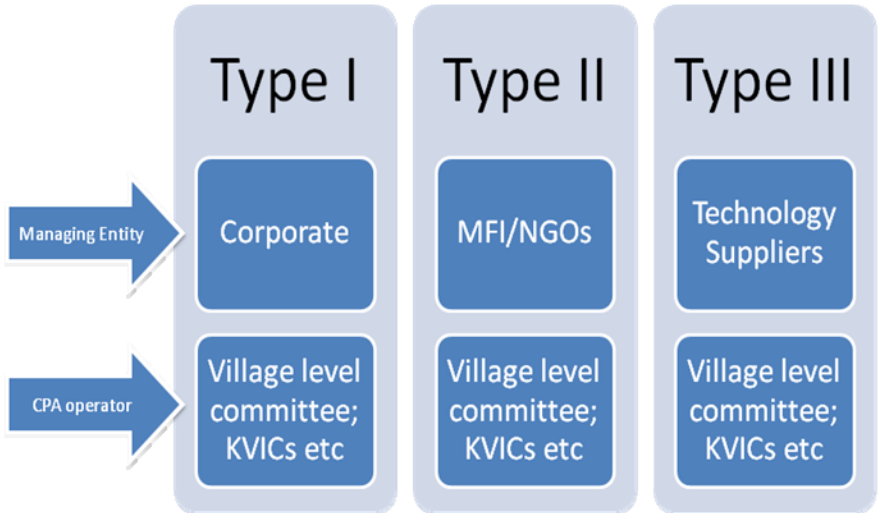



**Figure 3-5: PG models**

**GP Models**

A Government-Public model is defined as the one where government bodies act as a managing/coordinating entity whereas CPAs are implemented and operated by private parties.

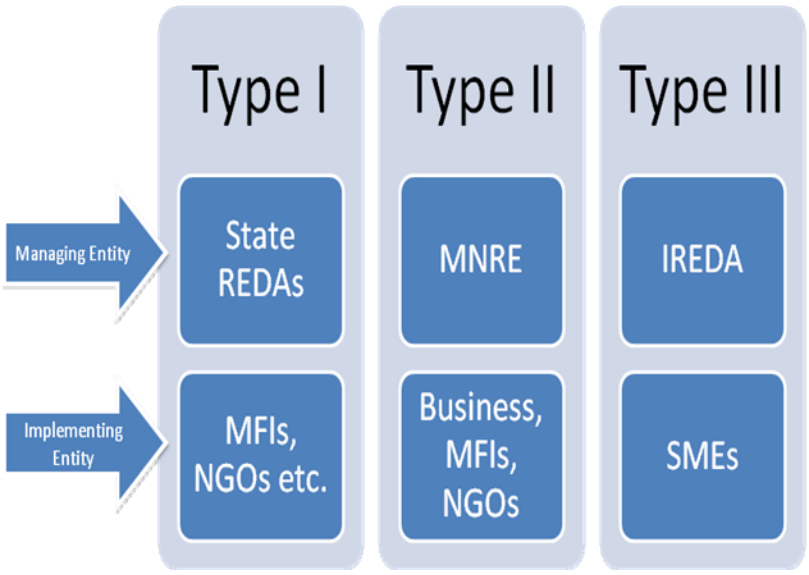



**Figure 3-6: GP models**

**PP Models**

Private institutions like corporate/ entrepreneur, financial institution, rural bank, co-operatives, NGOs may tie up to manage a PoA and implement CPAs therein to form a PP model.

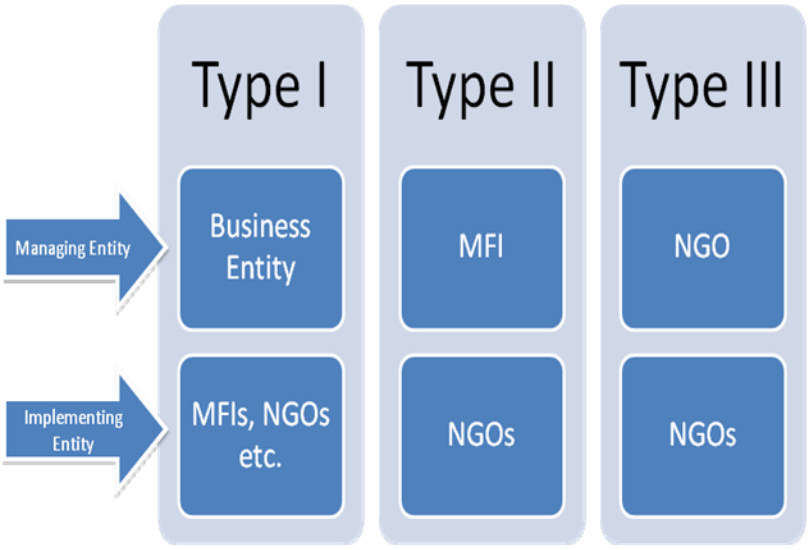



**Figure 3-7: PP models**

**Suggested Models**

Under aforesaid categorizations several models can be created. These models will be based on the principles stated above. Figure 3.8 shows that present model of renewable energy programs is subsidy based and is undertaken without CDM. Through changes in policy these programs can be retrofitted in a PoA framework. These changes in policy should clearly mention that CDM is integral part of the program implementation.

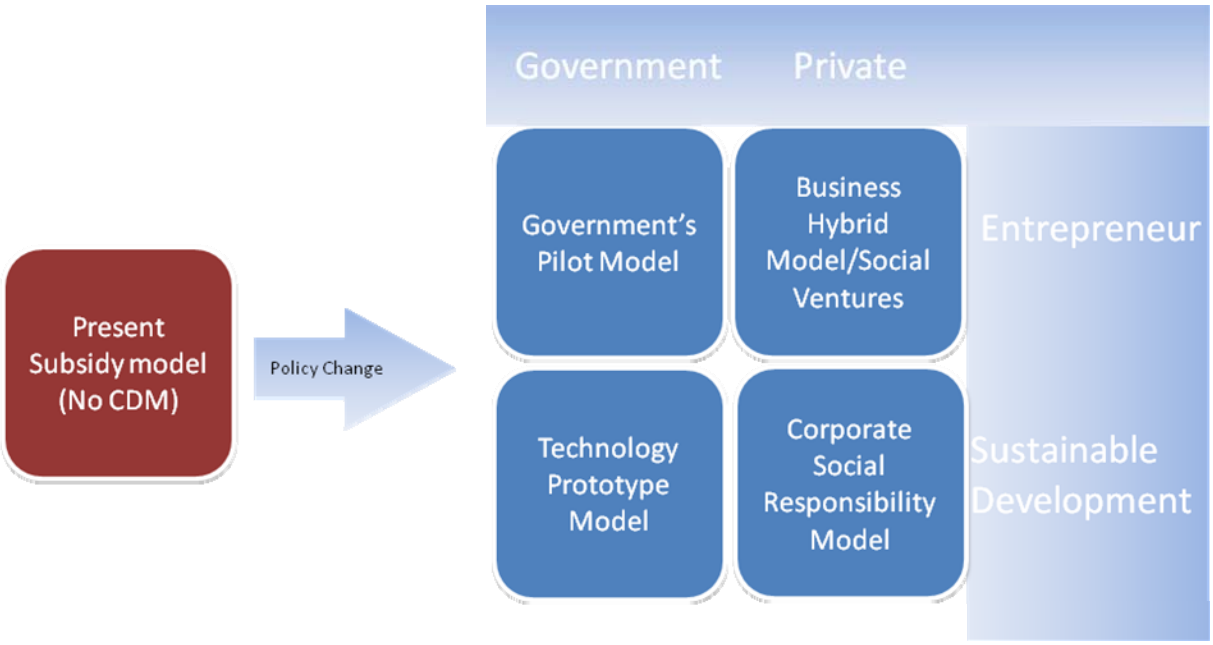



**Figure 3-8: Some Models for PoA implementation**

Apart from the models listed above, a number of other models are also possible. Some of there models are described here.

**Government's Pilot Model**

***Classification:*** This model could be either a GG model or a GP model.

***Applicability:*** This model would be applicable in following conditions:

1. Government entity acts as a managing co-ordinating entity.
2. Government entity launches a program through policy initiative/scheme considering CDM as its integral part.
3. Initial finance is available with the managing/coordinating entity to start off the program.
4. Implementing agency (CPA operator) can be a government body or a private agency.
5. Government may offload its work as a managing/co-ordinating entity to a partner NGO without scarifying CER rights and ownership of the program.

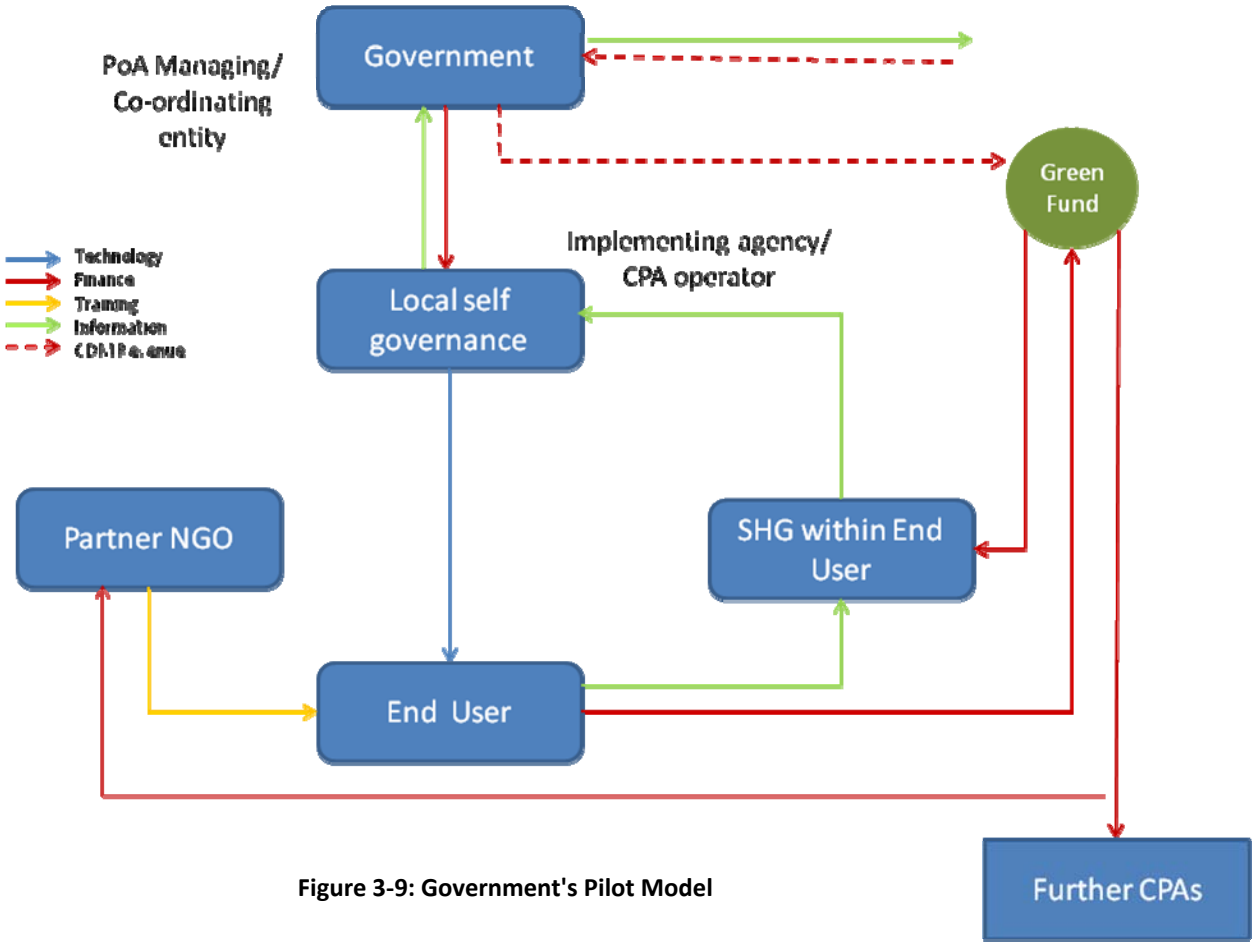



**Figure 3-9: Government's Pilot Model**

***Example:***

- Under GG structure, a relevant government agency launches a PoA through relevant policy change. It acts as managing/co-ordinating entity of the program. It sets up few pilot CPAs (that may be taken up through subsidy in the baseline) which are implemented by cluster of local self governance bodies *i.e. Panchayats*. Formation of these clusters will be initiated by the managing/co-ordinating entity and will be through MoUs between the *panchayats*. CDM revenues used to replicate CPAs and end users pay for O&M, M&V of present CPAs. Capacity building and awareness generation can be done by academic institutions to increase participation level.
- Under a GP structure, relevant government agency launches a PoA and becomes the managing/co-ordinating entity itself to expand its present policies and programs. It coordinates with UNFCCC to get the program registered and issuance of CERs. It chooses its partners from NGOs with national reach. While government gives the technology (directly or indirectly by means of finance with interventions of a supplier), partner NGO implements CPAs and performs capacity building activities. Inclusion of CPA can be closely monitored and self validated by the partner NGO. The CPAs would act as a pilot or demonstration projects. Associations, groups can

approach the coordinating/managing entity for addition of CPA. The CDM revenue from the PoA can be utilized for O&M, M&V, training and capacity building. Part of the CDM revenue may also add to a *Green Energy Fund*. The end user pays a nominal cost for the facility which goes in this fund to shear the cost of technology for further CPAs. This fund can be managed by the managing/coordinating entity and will be used for implementing similar activities as further CPAs to be added and for compensation to SHGs responsible for the O&M, M&V etc.

***Limitations:***

1. This model is novel in structure. No PoAs applied so far have gone for such model.
2. Management of Green energy fund may be seen as a constrain and will involve additional efforts.

**Technology Prototype Model**

***Classification:*** This could be a GG or GP type of model.

***Applicability:*** This model is applicable in following conditions:

1. A government entity launches a program and acts as managing/co-ordinating entity.
2. A novel clean technology/concept is promoted through the program for large scale dissemination.
3. Technology is less costly and can sustain itself on locally available resources.
4. Technology faces prevailing practice barriers particularly related to behavioral change and mass acceptance.
5. Managing/coordinating entity can provide technology to CPA implementing agencies on credit which will be repaid through CDM revenue.

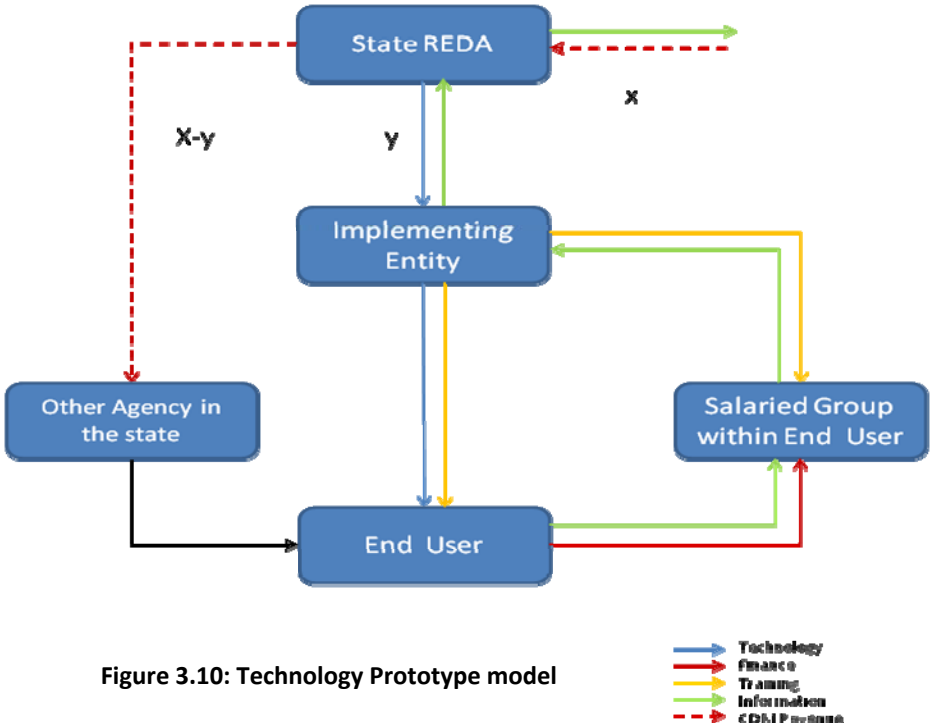



**Figure 3.10: Technology Prototype model**



*Implementation Framework*

***Example:***
State Nodal agency (State Renewable Energy Development Agency) launches a PoA. It gives technology on loan to the implementing agency, which can be local government- cluster of *panchayats* at appropriate level (GG type) or NGO (GP type). The implementing agency is responsible for training the end users to use the technology and also training the group that will be responsible for O&M, M&V. End users pay nominal charges that can be used for expenses of the group. This group is also capable of solving basic problems related to disfunctionality, hence local solutions are available. The M&V information flows from the group to Implementing agency where it is checked and compiled and sent to State REDA. The State REDA looks after issuance of CERs. The revenues help to offset some part of the initial loan, part of the revenue can be spent in promoting sustainable development by other relevant agency (if not by the implementing agency).

***Limitations:***

1. This model is limited by narrow applicability conditions.
2. This is a new model in Programmatic CDM, no precedents are available.

**Business Hybrid Model**

***Classification:*** This can be a PP type or PG type of model.

***Applicability:*** This model is applicable to:

1. The programs where business entity (like technology supplier) takes initiative of launching a program.
2. A microfinance institution is involved to grant soft loans for implementation of the program.
3. MFI can also act as CPA operator or outsources it to a relevant entity like local government (PG type) or a local NGO (PP type).

***Example:***
A business entity for example a technology supplier launches a Program. MFI is interested in the clean energy technology and buys it from the supplier. MFI gives this technology to the end user on loan, which shall be remitted in installments (similar to normal lending process). The end user enjoys the benefits without paying huge capital cost initially. The MFI also gives training to use the technology. A group is appointed and trained for O&M and M&V. MFI bears the related expenses. The CDM revenue is shared by the technology supplier and the MFI. The technology supplier invests in further R&D. The MFIs also provide vocational training to the end users for their development either directly or through.

***Limitations:***

1. Finding appropriate MFI that not only finances but also acts as CPA operator may be a problem.
2. Surveillance on functioning and payments to SHGs is required by the implementing agency.

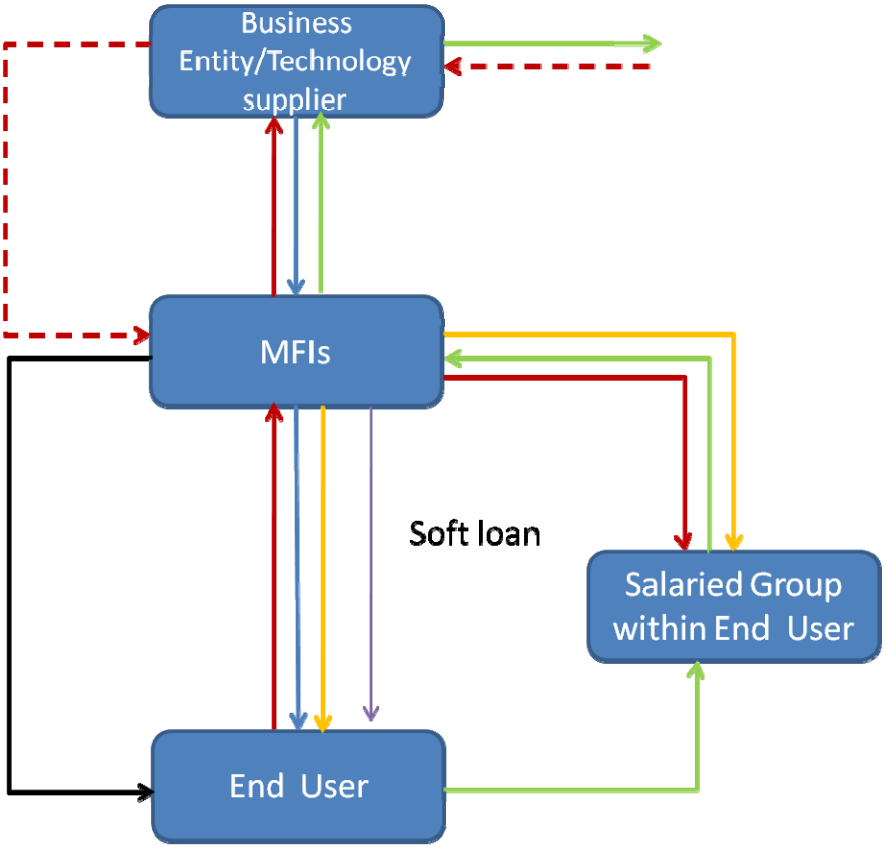



**Figure 3.11: Business Hybrid model**

**Social venture Model**

***Classification:*** This is a PP model.

***Applicability:*** This model is applicable when:

1. A business entity launches a PoA as its CSR initiative without any direct profit interests.
2. Program is implemented by an appropriate NGO.
3. The program is managed through a green fund, created by the PoA managing /coordinating entity.

***Example:***

A business entity launches a Program as its CSR initiatives. Technology is provided by the business entity which is also the Managing entity. Small NGOs come up with CPAs. These NGOs give training to the end



***Implementation Framework***

users and are closely involved with O&M and M&V. Training to the trainers is given by the business entity personals. The CDM revenue goes to the Green fund of the corporate which is partly used for payment to partner NGO towards O&M, M&V and sustainable development initiatives such as building school, community centre etc. Local people are involved in these activities to generate employment/livelihood opportunities and may get payment through the fund. The end users also pay a nominal charge to the NGO to meet its expenses. This model is self sustainable and revenue from green fund may be used to replicate the CPAs at larger scale.

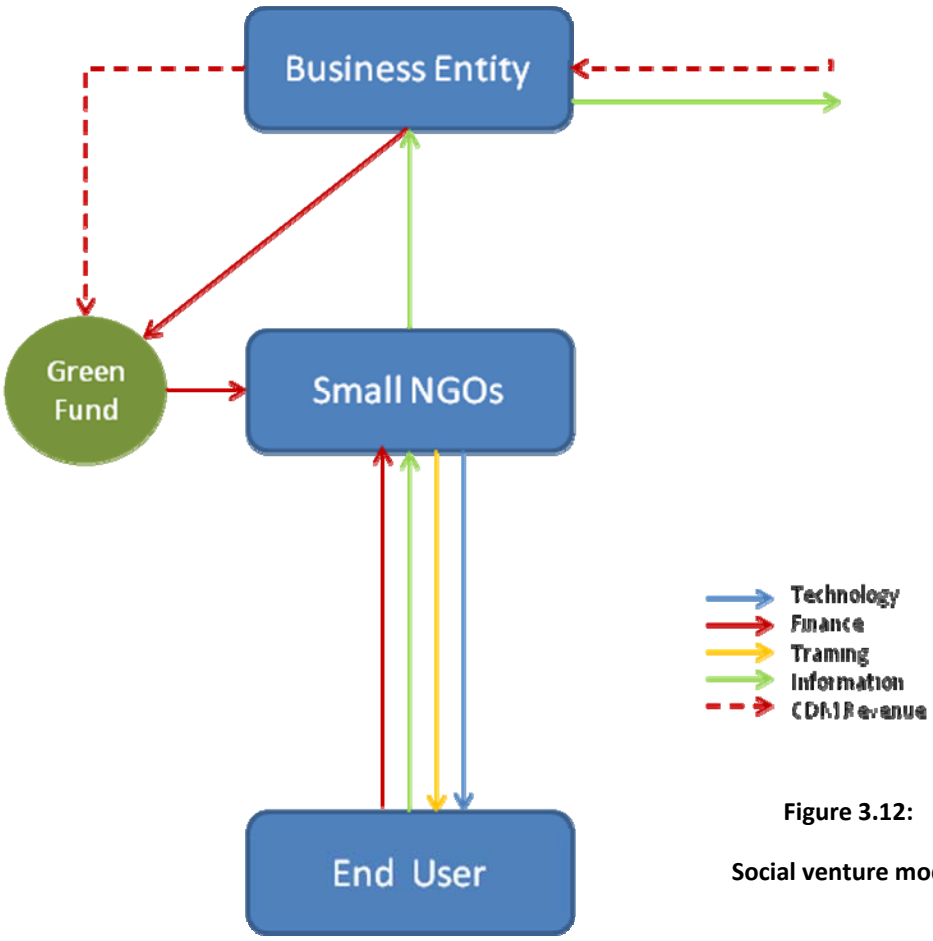



**Figure 3.12:**

**Social venture model**

***Limitations:***

1. Business entity will have to be dependent on the NGO for successful implementation of CPAs.
2. There is no direct motive for the business entity that drives them to launch such program.
3. As other models this is also a new kind of model which has not been attempted in CDM PoA.

**Co-operative Model:**

***Classification:*** This is a fabric model which is basically a variant of PP type.

***Applicability:*** This model is applicable for the conditions such as:

1. High initial cost of technology is involved and it is not possible to disseminate the program at large scale without interventions of multiple parties.

2. Multiple parties including government and private players are ready to be involved to form a accredited project vehicle (APV).

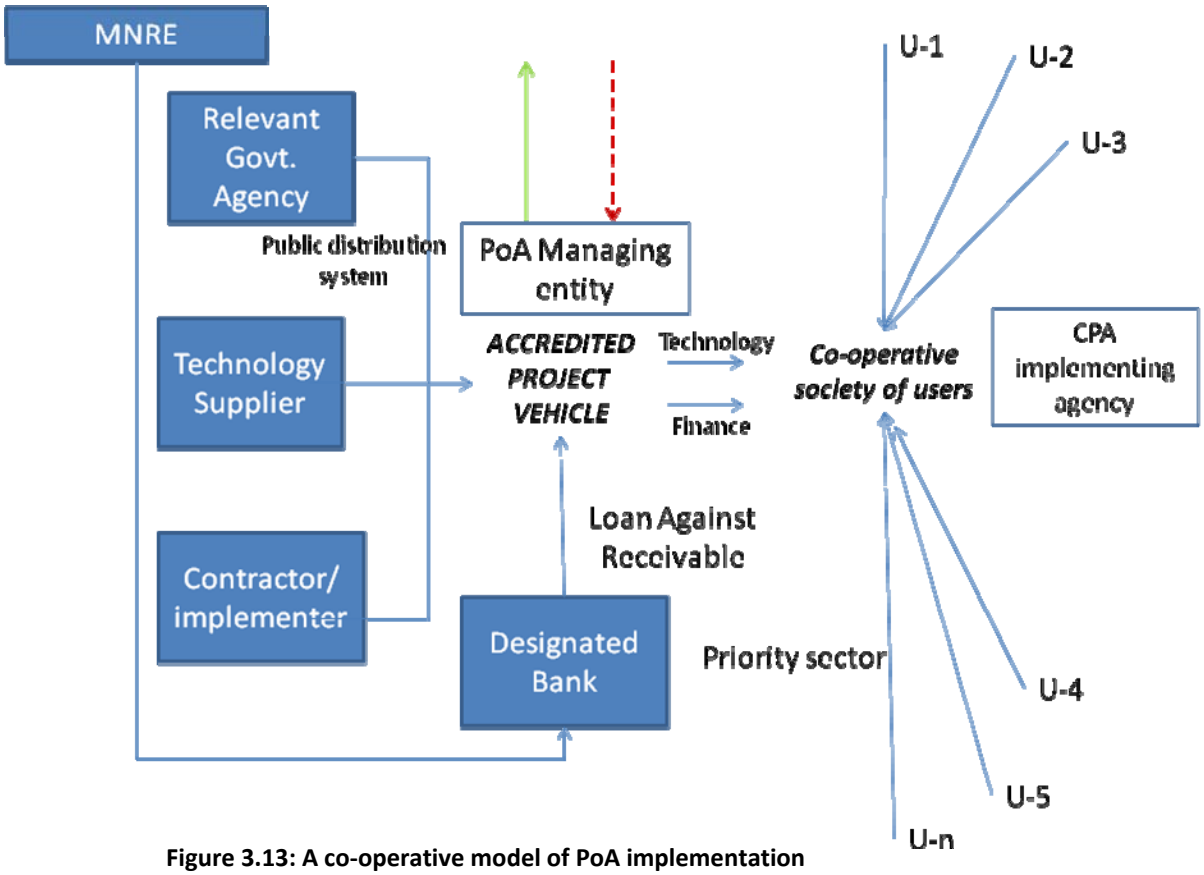



**Figure 3.13: A co-operative model of PoA implementation**

***Example:***

A clustered approach may be taken up where co-operatives of households can be formed with the interventions of local self governing body. These co-operatives may act as CPA operator/implementing agency. These societies are supplied technology and finance by an Accredited Project Vehicle (APV) which also act as the PoA managing/co-ordinating entity. A project vehicle is an association of relevant government agency, a technology supplier and a contractor (a service company). Government agency distributes the technology provided by technology supplier with the help of contractor. MNRE may approach RBI to declare loans against receivables (LARs) from a designated bank to implement the

program as a priority sector loan. MNRE may accredit the project vehicles to manage and coordinate PoAs.

***Limitations:***

1. This model involves many entities.
2. Willingness of users to join a cooperative may vary.
3. Program may diminish its vigor over time.

**Project Developer/ESCO Model**

***Classification:*** This is a PP or a PG type model.

***Applicability:*** This model is applicable when:

1. A project developer (a consultant/advisor) launches a program in understanding with various clients.
2. An energy service company acts as a CPA operator.
3. Government at municipal or panchayat/block level helps program dissemination.

***Example:***

- Under this model, a project developer acts as an aggregator. A project developer launches a program with the help of technology supplier and/or investors. Role of project developer will be ensuring CDM PoA management/coordination, registration, inclusion of new CPAs, monitoring, verification and issuance of CERs. Energy service companies (ESCOs) can voluntarily participate to implement CPAs. The will operate CPAs at the end user level with the help of local government body (municipal corporation/panchayat) and will share CERs with this body. Local government will support the program by awareness generation and training etc.

The operating and implementing framework of the PoA is depicted in the flowchart given in the figure 3.14.

- Project developer as a Co-ordinating and Managing Entity for the Program of Activities will be responsible for managing the entire program and communications with the Executive Board. The technical inputs required for the implementation and successful operation of the program activities would be brought by project developers. The municipalities could implement and operate renewable energy project themselves or contract it to various parties in ESCO mode. These project activities would be financed through internal funds, external borrowings or through ESCO[30] models. The municipalities may get into performance sharing agreements (CERs) with various funding agencies in lieu of the investments received for various renewable energy projects.

[30] ESCO: Energy Saving Company is an organization engaged in a performance based contract with a client firm to undertake energy assessment/ audit and/ implementation of various energy efficiency measures

***Limitations:***

1. Project developers may not be interested in bearing cost of project development and transaction costs upfront.

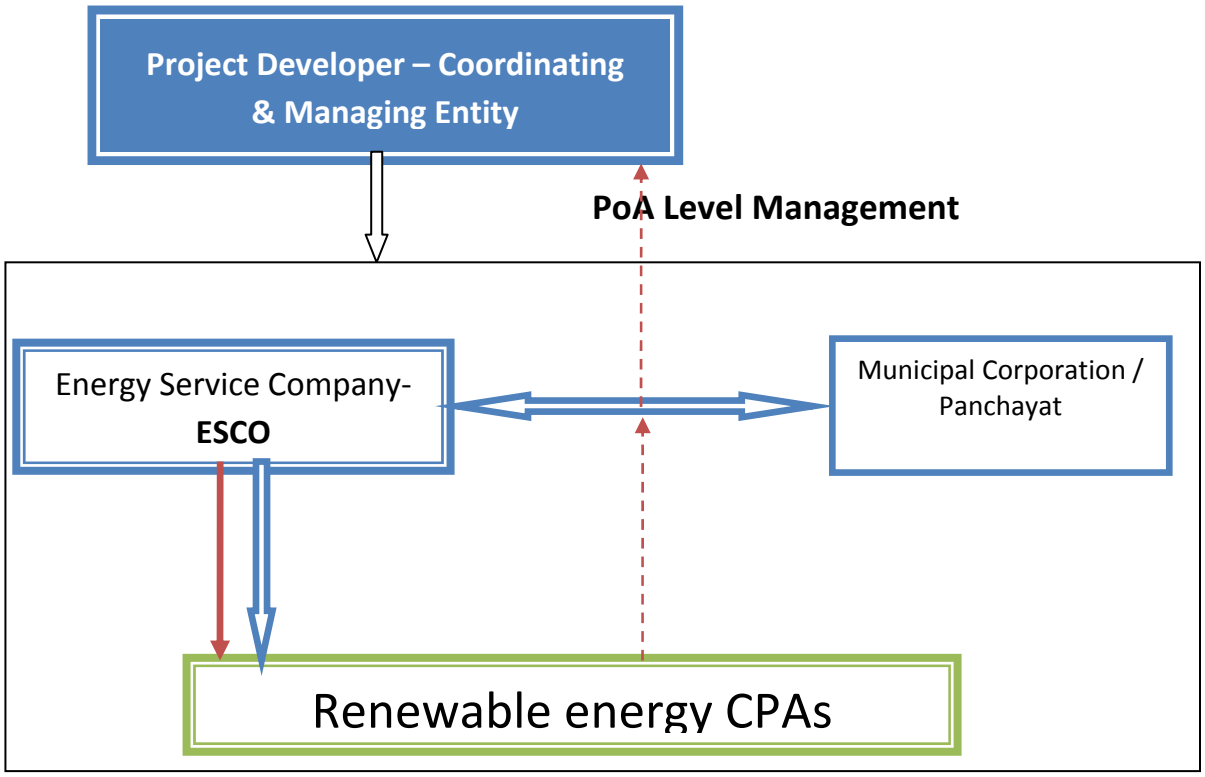



**Figure 3.14: Project Developer/ESCO Model**

**Consortium Model:**

***Classification:*** This is a PP type or PG type model.

**Applicability:** Following conditions relate to apply this model:

1. Small entrepreneurs make a consortium and look for launching a CDM PoA.
2. Any private/government entity can act as PoA managing/co-ordinating entity.

***Example:***

This model follows bottom up approach. Small entrepreneur wish to go for a CDM project activity but do not have an appropriate size. Two or more such entrepreneurs form a consortium and approach a relevant

government/private agency for launching a program. This agency may itself launch a PoA or can suggest some other party to launch a program. After identification of an appropriate agency for launching a program is done there will be an agreement between consortium and the agency. In this agreement agency will be defined as managing/ coordinating entity and the individual entrepreneur (member of the consortium) as CPA operators (implementing agency). Further inclusion of entrepreneur is possible in the consortium and thus in the PoA. O&M and M&V shall be the responsibility of CPA operator.

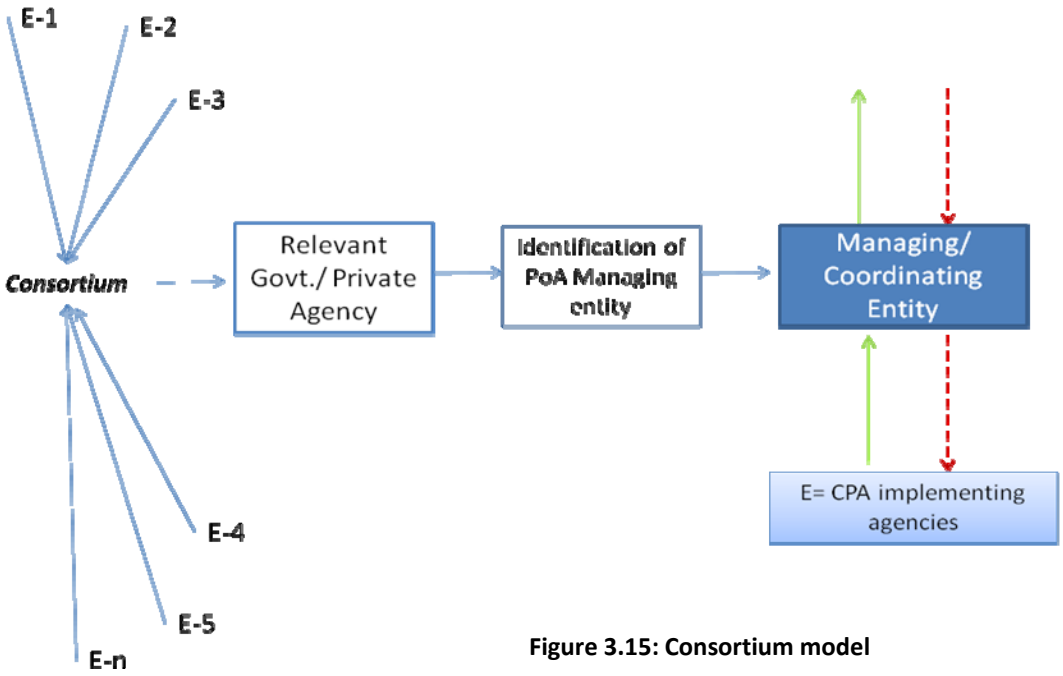



**Figure 3.15: Consortium model**

CERs shall be shared between the parties as per agreement b/w them. CER sharing agreement will be between- PoA managing/co-ordinating entity and the consortium and between the members of the consortium.

***Limitations:***

1. Initiative may not take shape as an appropriate entity to launch a program may not be identified.

**Conclusion**

CDM PoA cycle includes a number of stakeholders and process facilitators. Role of each of them has unique importance for successful management and operation of a PoA and CPAs therein. Various models can be framed based on a number of criteria, including who takes risk in a PoA. A few models have been suggested in this chapter, including government's pilot model, technology prototype model, business hybrid model, co-operative model, social ventures model, consortium model etc. These models are not the only possible ones. Other models can also be created and many variants can be prepared based on local and regional needs. Following chart summarizes the basic features of models framed.

**Table 3.2: Suggested model frameworks**

| ***Models*** and *features* | ***Government's Pilot Model*** | ***Technology Prototype Model*** | ***Business Hybrid Model*** | ***Social venture Model*** | ***Co-operative Model*** | ***Project Developer/ ESCO Model*** | ***Consortium Model*** |
|---|---|---|---|---|---|---|---|
| *Managing/ coordinating entity* | A government body | A government body/ technology supplier | Business entity/technology supplier | Business entity | Accredited Project Vehicle (JV) | Project Developer (consultant/ advisor) | Small entrepreneurs |
| *Implementing agency (CPA operator)* | A government body or a private entity | A Private entity/ a government body | MFIs/ Government/NGO | NGO | Co-operative society | ESCO | Any private/government entity |
| *Other parties involved (optional)* | NGOs/SHGs | NGOs/SHGs | NGOs/SHGs | NGOs/SHGs | Bank/tech. supplier, government | Government at municipal or panchayat/ block level | |
| *Initial finance* | By government | By government/ technology supplier | Business entity/technology supplier/MFI | Business entity | Bank | ESCO | Small entrepreneurs |
| *Fund* | Green energy Fund | | | Green fund | | | |
| *Technology type* | A less penetrated technology | A novel clean technology/ concept | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Cost of technology* | | Less, can sustain itself on locally available resources | High initial/operating cost | | High initial cost | | |
| *Other technology specification* | | Technology faces prevailing practice barriers | | Strong SD benefits | Large scale dissemination not possible without interventions of many parties | | |
| *Loan* | | Managing/coordinating entity | MFIs | | | | |
| *Other features* | | | | CSR | | | |

Almost all renewable energy technologies covered in this study are established and proven. These technologies and concepts have already been used in the past under different schemes with varied degree of success. Reasons of partial success and limited penetration of some technologies include barriers of high upfront cost, absence of sufficient revenue streams, behavioral barriers etc. PoA will be helpful in removing these barriers and thereby increasing the extent of implementation of these technologies. Every model would not suit for all technological ventures in a PoA. Hence selection of a particular model is dependent on the renewable energy technology and the region that is being focused. Thus, for each renewable technology, a separate model shall be designed and the roles of various stakeholders can be decided according to the challenges of region, time scale and technology used in the PoA.

# Chapter 4
# Family type biogas plants program

Biogas is an alternative source of energy, derived from organic wastes. The feed materials for production of biogas such as animal and agricultural wastes are abundantly available in rural and semi-urban areas of India. Biogas, primarily a mix of $CH_4$ (methane) and $CO_2$ (carbon dioxide) is generated in the process of biodegradation of organic materials under anaerobic conditions. Biogas technology is not new to India and Ministry of New and Renewable Energy (MNRE) has over the years through various programs facilitated the availability of standardized models of biogas plants which are suitable for individual households and communities. At the household level, the cumulative number of biogas plants built from 1982 to 2006 is estimated to be 3.83 million[31] against apotentialof12–17 million[32].

**Scope- eligible activities**

Biogas technology is not tapped for useful applications to the maximum extent as part of the effort to reduce greenhouse gas emissions. Biogas technology, besides supplying energy and manure, provides an excellent opportunity for mitigation of greenhouse gas (GHG) emission and reducing global warming through substituting firewood for cooking, kerosene for lighting and cooking and chemical fertilizers. Benefits from biogas technology is categorised as follows;

- **Biogas consumption as a cooking fuel:**
  Biogas produced from family type biogas plants can replace non renewable biomass, kerosene and LPG or a combination of above in household cooking.

- **Biogas for lighting purpose:**
  Electricity generation or biogas lamp application can replace grid and/or kerosene or other fossil fuels.

- **Biogas for transport applications:**
  Biogas can be compressed after enrichment to form bio-CNG that can be used as a substitute of transport fuel like CNG.

- **Avoidance of methane emission from anaerobic degradation of waste:**
  Biogas capture and use can avoid the emission of methane that would have otherwise been released under anaerobic condition in waste storage pits or heaps.

- **Switch from chemical fertilizer to organic manure in fields:**
  Organic manure produced from anaerobic digestion of animal waste, human excreta and agro residues can be used as replacement of chemical/synthetic fertilizer in the crop-fields. This will reduce GHG emissions associated with production and application of synthetic fertilizers like Urea, DAP etc.

[31] Ministry of New and Renewable Energy (MNRE). New Delhi: Government of India; 2007 /http://mnes.nic.in/S.
[32] Ravindranath N H, Balachandra P. Sustainable bioenergy for India: Technical, economic and policy analysis. Energy (2009),doi:10.1016/j.energy.2008.12.012

**Table 4.1: Appropriateness of PoA**

| Elements | Family Type Biogas Plants |
|---|---|
| Sites | Multiple, dispersed |
| Possibility of adding new devices over time | High |
| CER potential per unit device per year | Low |
| Size of device | Small |
| *Ex-ante* identification of project sites | Difficult |
| Project developers/promoters | Many |
| Degree of Replicability of projects | High |

Thus it can be concluded that programmatic route will be appropriate to undertake family type biogas plants program.

**Baseline Scenarios**

Baseline scenarios should be determined through project specific baseline surveys in the region where CPAs are to be operated/ implemented. A brief discussion on fuel consumption pattern at household level, which will be required for identification of baseline, is given below.

***Biogas consumption as a cooking fuel***

The household sector in India, consisting of about 200 million households, is responsible for about 40 % of the country's total energy consumption[33]. Cooking is the predominant end-use, followed by water-heating and lighting. For cooking households generally use a combination of two sources from among bio-fuels (wood, crop residues and cowdung), kerosene and liquefied petroleum gas (LPG). In rural areas, 75% of households use fuel-wood while the rest depend on dung cake, LPG and kerosene[34]. In urban areas as well, about 22% households relied mainly on firewood/chips and 10% relied on kerosene as primary source of energy for their cooking. Only 5% of the households in rural areas and 44% in urban areas used LPG. Other primary sources of cooking energy used by urban and rural households include coke, charcoal, Gobar gas (Biogas), electricity and other fuels. Therefore fuel mix dominated by fuel wood followed by the kerosene and LPG would be most plausible baseline for cooking.

***Biogas for lighting purpose:***

In the case of lighting, different primary sources of energy are kerosene, gas, candle, electricity, other oil, etc by the households in India. Among these, kerosene and electricity are commonly used. At national level, these two accounted for 99% of the households in both rural and urban areas. The use of kerosene as primary source of lighting is still much in vogue, in rural areas (44%) compared to urban areas (7%)[4]. The energy consumption pattern for lighting also depends on the region (rural/urban/semi urban) and the socioeconomic conditions of the population. Kerosene lamps and/or grid could be baseline option.

***Avoidance of methane emission from anaerobic degradation of waste:***

In India, majority of cases the livestock waste, waste from the cattle shed – cow dung, straw, green fodder and urine are removed and dumped in pits nearby cattle sheds or household. The

[33] Reddy, S.B. and Balchandra P., 2006; Climate change mitigation and business opportunities – the case of the household sector in India, Energy for Sustainable Development, Vol X No.4.

34 Energy Sources of Indian Household for Cooking and Lighting, 2004-05 (Report No. 511 (61/1.0/4). NSS 61st Round Survey (July 2004-05). National Sample Survey Organisation,Ministry of Statistics and Programme Implementation Government of India, April 2007.

pits are cleaned out once a year and the material is used subsequently in the fields as an organic fertilizer. All dung produced by cattle is difficult o collect and use. In India, the cattle are also allowed to graze in open fields and hence cannot be collected. Therefore the dung collection would be mostly from the droppings at the cattle shed. About 30-40% of the dung collected is used as fuel in cook-stoves and rest is dumped or stored in pits/heaps for further use as fertilizer. This is the most common and plausible baseline for livestock waste disposal.

***Switch from chemical fertilizer to organic manure in fields:***

Biogas slurry, a by-product of biogas plant, is applied as manure to substitute chemical fertilizer. Biogas spent slurry containing 1.4% N, 0.5% P and 0.8% K on dry weight basis[35,36]. Substitution of chemical fertilizer with spent slurry reduces CO2 emission, which would emit for production of fertilizer.

***CERs Potential***

**Biogas consumption as a cooking fuel:**

**Table 4.2: CER generation**

| Equivalent to 1 $m^3$ of Biogas | | | | | |
|---|---|---|---|---|---|
| **Name of the fuel** | **Kerosene** | **Firewood** | **Dung cakes** | **Charcoal** | **FO** |
| NCV TJ/Gg | 43.8 | 15.6 | 11.6 | 29.5 | 40.4 |
| CO2 EF t/TJ | 71.9 | 111.8 | 100.1 | 111.8 | 77.4 |
| Gg of fuel | 0.0014 | 0.0040 | 0.0053 | 0.0021 | 0.0015 |
| t CO2/m3 of biogas | 0.0044 | 0.0069 | 0.0062 | 0.0069 | 0.0048 |
| t CO2/ year (Gas production@ 0.4 m3/m3 installed cap/yr) | 0.65 | 1.01 | 0.90 | 1.01 | 0.70 |

**Methane avoidance**

| | |
|---|---|
| Digester Size | 2 $m^3$ Biogas Plant |
| Livestock per household | 3 (1 Cow & 2 Buffalo) |
| CER/digester | 2.6 |

**Additionality Analysis:**

The additionality of family size biogas plants included in PoA can be justified (but not limited to) as discussed below;

***Investment barriers***

Although an essential feature of biogas power is that the target sector is rural, semi-urban areas with low income therefore beyond the reach of the majority of households.

35 Tandon, H. L. S.,&Roy, R. N. (2004). In integrated nutrient management — A glossary of terms. New Delhi: Food and Agriculture Organization of the United Nations, Rome and Fertiliser Development and Consultation Organization.
36 Subrian, P., Annadurai, K., & Palaniappan, S. P. (2000). Agriculture: facts and figures (pp. 133–134). New Delhi: Kalyani.

Depending on size and location the cost of biogas plant varies as given in table below.

**Table 3.3: Economics of family size biogas plants**

| Economics of KVIC model of biogas plant | | | | | | |
|---|---|---|---|---|---|---|
| Name of component | For biogas plant of capacity | | | | | |
| | 1m³ | 2m³ | 3m³ | 4m³ | 5m³ | 6m³ |
| Installation cost (Rs.) | 10,558 | 13,135 | 15,722 | 17,935 | 19,798 | 21,653 |
| Annual operational cost (Rs.) | 2110 | 3557 | 5008 | 6432 | 7814 | 9202 |
| **Economics of Janta model of biogas plant** | | | | | | |
| Name of component | For biogas plant of capacity | | | | | |
| | 1m³ | 2m³ | 3m³ | 4m³ | 5m³ | 6m³ |
| Installation cost (Rs.) | 8132 | 11,050 | 14,136 | 17,296 | 18,858 | 20,270 |
| Annual operational cost | 1787 | 3205 | 4635 | 6069 | 7406 | 8735 |
| **Economics of Deenbandhu model of biogas plant** | | | | | | |
| Name of component | For biogas plant of capacity | | | | | |
| | 1m³ | 2m³ | 3m³ | 4m³ | 5m³ | 6m³ |
| Installation cost (Rs.) | 4367 | 5704 | 7302 | 8394 | 9888 | 11067 |
| Annual operational cost (Rs.) | 1577 | 2904 | 4245 | 5571 | 6905 | 8223 |

The high up-front investment cost of a biogas plant inhibits from adopting the technology, making the subsidy provided under the various Government and Non Governmental Schemes an essential economic incentive for farmers deciding to purchase a biogas plant. Due to the institutional structure of the National Programme on Biogas Dissemination, the biogas programme is dependent on an annual budget allocation. The availability of government subsidies has reduced dramatically in recent years from equating to at best only tens of biogas units per district and an even smaller number at block level.

Similarly, Non Governmental or donor financing has contributed to biogas units in the past but such financing is not able to cover the need for improving the energy supply to rural households in India. Therefore the installation costs are too high for the majority of households to afford. In addition, there are no tangible monetary savings on the invested capital if the biogas is used for cooking and or lighting only.

***Technological barriers***

The existing practice of using earthen *chulha/angithi* for cooking and kerosene lamps for lighting requires no technical expertise.

While biogas plant involves complex technology that requires trained manpower for supervision and experts for maintenance. Events of breakdown and disrepair may become may lead to plant outages. Despite several initiatives of the MNES to impart training, technically qualified manpower and servicing agents who can provide quick, efficient and cost-effective operation and maintenance services for bio-energy devices are not available in sufficient numbers, particularly in the rural areas.

Other, well-known barrier for the dissemination of biogas digesters worldwide is the poor quality of biogas systems. In the absence of a proper quality control program, suppliers of biogas plants would compete solely on price. The dissemination of low-quality biogas plants would lead to lack



***Family type biogas plants program***

of trust in the technology, resulting in a vicious circle with less demand, fewer margins on biogas digesters sales.

***Operational Barriers***

Discontinuation in the use of biogas plants due to operational and structural problems is common. Operational problems include: accumulation of water in the pipeline; scum formation in the digester; clogging of the inlet and outlet; leakage of gas from the gas holder, etc. Structural problems usually relate to constructional imperfections. For example fixed dome plants require good engineering skills to build and a defective plant could crack easily because of gas leakage. Therefore technical expertise is required for design, manufacture and operation and maintenance services of these systems.

Poor extension services and inadequate after-installation services have discouraged potential users in the past. In developing countries, it is also difficult to get skilled manpower for repairing the plants. Lack of infrastructure also poses serious obstacles in its large scale acceptance of this technology.

***Prevailing practice Barriers***

In absence of a proposed PoA activity, the other baseline options may be cheaper and readily available. Kerosene is used primarily for enhancing the burning of fuel wood and for lighting. A small amount of kerosene is subsidised by the government at a cost of 10 Rupees per litre. In addition, kerosene is available on the market at a cost of 20-25 Rupees per litre and some families, who can afford it, buy some kerosene to supplement the subsidised amount. It is not generally used as an alternative primary fuel as most families cannot afford to buy enough kerosene for all their cooking needs and will continue using free fuel wood as their primary cooking fuel in the absence of the project activity.

The biogas will displace GHG emissions from kerosene and fuel wood that are currently used for cooking. The biogas produced from cattle manure is a renewable source of energy as the CO2 that is absorbed during the growth of the organic matter in the dung equals the CO2 emitted when the biogas is burnt.

Being biomass, fuel wood or wood waste is also generally regarded as renewable source of energy. Significant part of the fuel-wood consumed comes from unsustainable extraction leading to GHG. But, in reality, fuel wood (or forest biomass) is partly renewable. Activities with non renewable biomass as the baseline can be included as CPAs in a CDM PoA.

**Applicable baseline and monitoring methodologies-**

**Table 4.4: Applicable Approved CDM methodologies**

| Activity | Methodology |
|---|---|
| Biogas consumption as a cooking fuel | AMS I.C |
| Switch from non-renewable biomass for thermal applications by the user | AMS I.E |
| Biogas for lighting purpose | AMS I.C |
| Avoidance of methane from anaerobic degradation of waste | ACM0010, AMS III.D, AMS III.R |
| Switch from chemical fertilizer to organic manure in fields | New methodology required |



***Family type biogas plants program***

***Methodology AMS I.C. -*** *Thermal energy for the user with or without electricity*
***Applicability:***

Under this methodology, the family type biogas plants which limit to the following criteria are considered as a CPA:

1. Biogas plants that supply individual households or users, thermal energy that displaces fossil fuels.

2. Where thermal generation capacity is specified by the manufacturer, it shall be less than 45 MW.

***Monitoring requirements:***

Monitoring shall consist of:

a. Metering the energy produced by a sample of the biogas plants

b. If the emissions reduction per biogas plant is less than 5 tonnes of $CO_{2e}$ a year:

   i. Recording annually the number of biogas plants operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute);

   ii. Estimating the annual hours of operation of an average system, using survey methods. Annual hours of operation can be estimated from total output (e.g., $m^3$ of biogas generated) and output per hour.

***AMS III.R-*** *Methane recovery in agricultural activities at household/small farm level*

***Applicability:***

In case of household biogas plants with request for the addition of recovery and destruction of methane from manure and wastes from agricultural activities that would be decaying anaerobically emitting methane to the atmosphere in the absence of the project activity, methane emissions should be prevented by:

1. Installing methane recovery and combustion system to an existing source of methane emissions, or
2. Changing the management practice of a biogenic waste or raw material in order to achieve the controlled anaerobic digestion equipped with methane recovery and combustion system.

However, this category is limited to measures at individual households or small farms (e.g. installation of a family type biogas digester). Methane recovery systems that achieve an annual emission reduction of less than or equal to 5 tonnes of $CO_{2e}$ per system are included in this category. Systems with annual emission reduction higher than 5 tonnes of $CO_{2e}$ are eligible under AMS III.D. This methodology is only applicable in combination with AMS I.C.

***Monitoring requirements:***

Monitoring shall consist of:

(a) Recording annually the number of systems operating using survey methods;

(b) Estimating the average annual hours of operation of a system using survey methods;

(c) Survey methods are used to determine the annual average animal population (NLT), the amount of waste/animal manure generated on the farm and the amount of waste/animal manure fed into the system e.g. biogas digester;

(d) The proper soil application (not resulting in methane emissions) of the final sludge verified on a sampling basis.

***AMS.III.D-*** *Methane recovery in animal manure management systems*

***Applicability:***

This methodology is only applicable under the following conditions:

1. The livestock population in the farm is managed under confined conditions;
2. The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C
3. In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than 1 month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m
4. No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.
5. The final sludge must be handled aerobically. In case of soil application of the final sludge the proper conditions and procedures (not resulting in methane emissions) must be ensured.
6. Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared.

***Monitoring requirements:***

The emission reductions achieved by the project activity will be determined ex-post through direct measurement of the amount of methane fuelled, flared or gainfully used. The emission reductions achieved by the project activity is limited to the ex-post calculated baseline emissions minus project emissions using the actual monitored data for the project activity. Specifically following parameters should be measured in project activity;

a. Continuous measurement of the amount of biogas captured at the biogas recovery system using flow meters of the animal manure waste management system. The fraction of methane in the biogas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 95% confidence level.

b. Temperature and pressure of the biogas are required to determine the density of methane combusted.

c. The CPA shall describe the system used for monitoring the fraction of the manure handled in the manure management system, the average weight of the livestock and the livestock population taking into account the average number of days the animals are alive in the farm in a specific year.

d. In addition, other parameters required for emission estimation should also be measured according the approved methodology IIID.

***ACM0010:*** *Consolidated baseline methodology for GHG emission reductions from manure management systems.*

***Applicability:***

Applicability conditions of this methodology are similar to those of AMS III.D. This methodology is applicable to large scale manure management CPAs. The AWMS/process in the project case should ensure that no leakage of manure waste into ground water takes place, e.g., the lagoon should have a non-permeable layer at the lagoon bottom.

***Monitoring requirements:***

Parameters like methane conversion factor, maximum methane producing potential for animal type, livestock populations by different livestock types and the average animal weight in each population, biogas generation, biogas composition and other parameters required for estimating the emission reduction as defined in approved methodology ACM 0010. In addition, fuel consumption for generation of heat used in the project case. Calculated following the latest version of "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".

**Framework for CDM PoA**

A Co-operative model can be appropriate for family type biogas plants. This is a fabric model which is basically a variant of PP type. Biogas plants have high initial cost and it is not possible to disseminate the program at large scale without interventions of multiple parties. Multiple parties including government and private players should be ready for being involved to form an accredited project vehicle (APV).

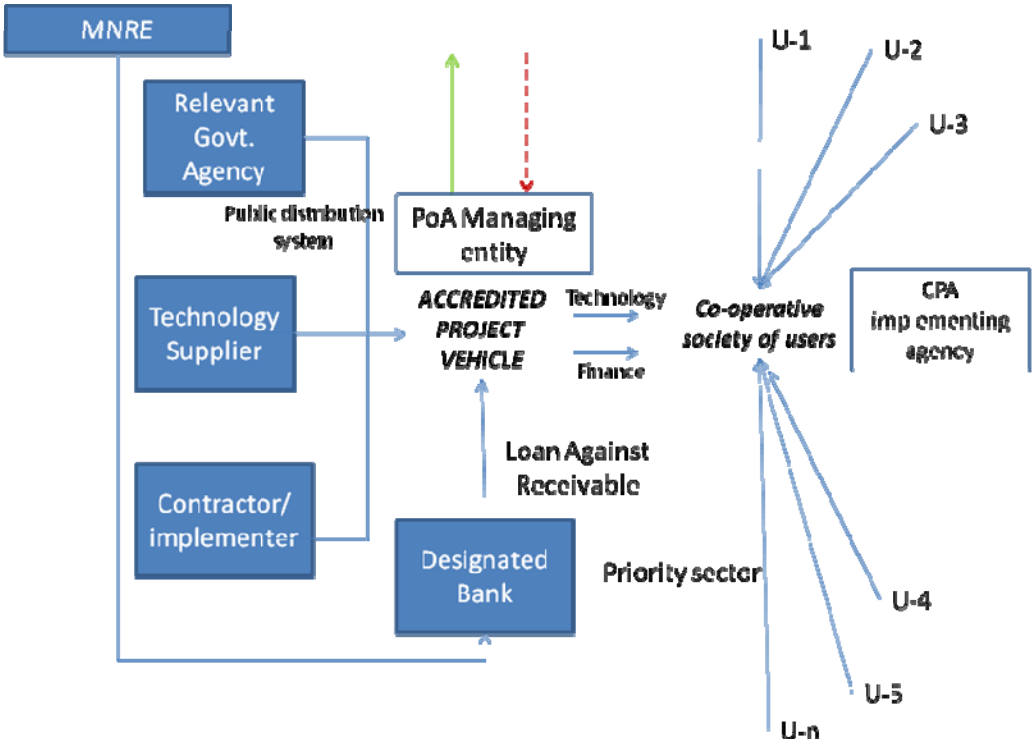



**Figure 4-0-1: Co-operative model**



***Family type biogas plants program***

A clustered approach may be taken up where co-operatives of households can be formed with the interventions of local self governing body (*gram sabha/panchayat*). These co-operatives may act as CPA operator/implementing agency. These societies are supplied biogas plants and finance by an Accredited Project Vehicle (APV) which also act as the PoA managing/co-ordinating entity. A project vehicle is an association of relevant government agency, a technology supplier and a contractor (a service company). Government agency can distribute the biogas plants provided by the supplier with the help of contractor through public distribution system. MNRE may approach RBI to declare loans against receivables (LARs) from a designated bank to implement the program as a priority sector loan. MNRE may accredit the project vehicles to manage and coordinate PoAs.

**Conclusion**

Large scale dissemination of Family type biogas plants program is possible by means of CDM PoA. Additional cost of monitoring the verification and the part cost of putting up new biogas plants can be recovered with this approach. This will also help in training of service and maintenance crews in the villages to ensure smooth running of the plants. Approved CDM methodologies are applicable for methane avoidance and energy use of biogas however; new CDM methodology development is required for use of organic manure as a replacement of synthetic fertilizers. A variant of co-operative model is suggested in this chapter for implementation of PoA. This model involves many entities including an accredited project vehicle, designated banks and cooperative societies. This model may face certain barriers in implementation like degree of willingness to join a cooperative may vary from user to user. This will be overcome with the help of capacity building through relevant agencies.

# Chapter 5
# Medium and Large Size Biogas Plants programme

Apart from the opportunities that exist in family type biogas plants, medium and large size biogas plants have additional benefits. These plants are popularly known as community and industry type biogas plants. Plants ranging from size 1 $m^3$ to 10 $m^3$ are classified as family-size plants and plants ranging from 15 $m^3$ to 140 $m^3$ are categorized as large size plants[37] which can cater to the need of institutions/community centers etc. Biogas which can be used for cooking and electricity generation and the slurry from the biogas plants can be used as fertilizer.

In order to assist the underprivileged and the people in need, specially who can not own and operate family type biogas plants, the programme for promoting large biogas plants at the community level was taken up in 1982-83. Evaluation Study of The National Project on Biogas Development in 2002 concluded that potential has to be realized through Community Biogas Plants (CBPs) of large capacities[38].

**Scope- Eligible activities**

As discussed in Chapter 4, biogas produced can replace non renewable biomass, kerosene and LPG or a combination of above in household cooking, lighting. In addition, the medium/large biogas plant can also generate enough biogas to produce power. Therefore, benefits from the medium/large biogas plant can be categorised as follows:

1. Biogas consumption as a cooking fuel
2. Biogas consumption for lighting lamps
3. Biogas consumption for electricity generation
4. Methane avoidance from manure management
5. Switch from chemical fertilizer to organic manure in fields

Biogas can also be converted in bio-CNG after enrichment and bottling. There are a number of Goshalas, dairies, village communities having large number of cattle which have potential of installing biogas enrichment and bottling system. In urban areas, large quantity of biogas can be produced in sewage treatment plants from anaerobic digestion.

[37] http://update.kvic.org.in/activities_biotechnology.htm
[38] http://planningcommission.nic.in/reports/peoreport/cmpdmpeo/volume1/185.pdf

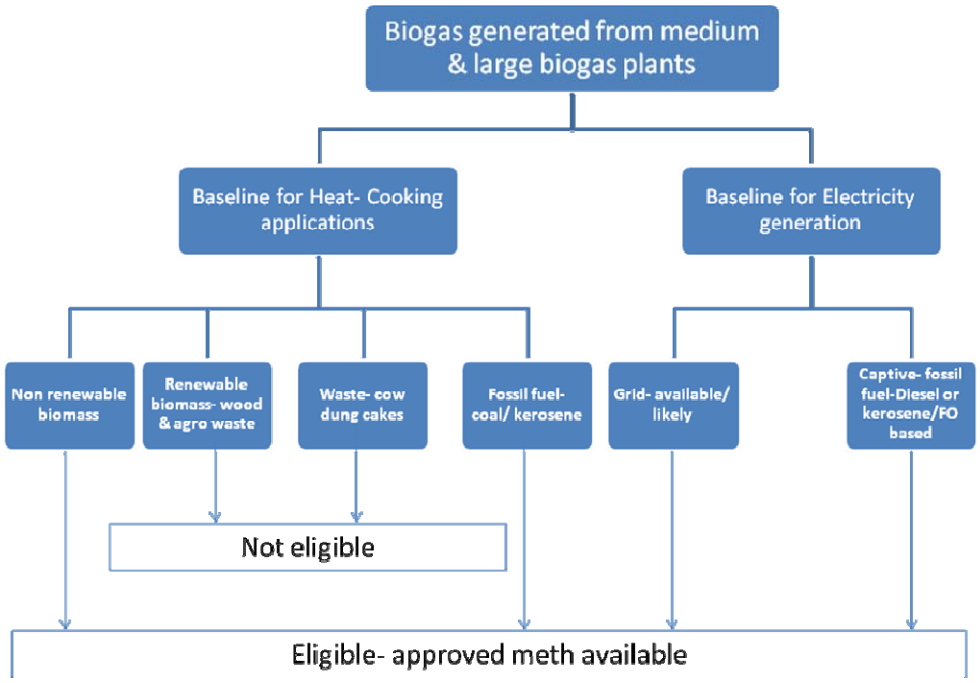



**Fig. 5-1: Baseline for biogas application and eligibility under CDM**

## Baseline Scenario:

Baseline scenarios could be determined through CPA specific baseline surveys in the region.

### *Biogas consumption as a cooking fuel*

Biogas produced from medium and large biogas plants replaces non renewable biomass, kerosene and LPG or a combination of above in household/community cooking in rural India. A detailed description is given in chapter 4.

Recent surveys show that of total domestic fuel needs in India, around 75% in rural areas and 21% in urban areas are met from fuel wood/wood waste/agro-residues as fuel. Being biomass, fuel wood is generally regarded as renewable source of energy. It is also said to be GHG neutral. But, in reality, fuel wood (or forest biomass) is partly renewable. Activities with non renewable biomass as the baseline can be included as CPAs in a CDM PoA.

The prevailing practice by the public sector in India has been to make kerosene as cooking fuel available to families below the poverty line through the public distribution system at the market price or below it. In rural India use of kerosene for cooking is increasing. The government policy of providing subsidies on kerosene price also encouraged the kerosene consumption[39].
The public distribution system for subsidized fossil fuel in the cooking fuel sector (including LPG) is working very well, and expanding rapidly. Government programme for providing biogas plants for the poor, which is an E- policy (that induces decrease in emissions), has been reduced at the State level in all the states, and thus the capital shortfall prevents the continued expansion of the

[39] Ravindarnath, N.H., Balachandra, P., Dasapa S., Rao Usha, K., Bioenergy Technologies for Carbon Abatement, Biomass and Bioenergy 30 (2006) 826-837.

biogas programme in India. Thus a fossil-fuel based least cost approach has come to dominate National and State level cooking fuel policy.
In cities and rural municipalities with some level of income, LPG is the preferred cooking fuel of all the classes, upper, middle and lower middle class and working class. To some extent this technology is also slowly penetrating the villages. Taking all this information into account, it is very unlikely that any of the new users who will be installing biogas plants under CDM PoA will be able to afford a biogas plant otherwise.

***Biogas consumption for lighting lamps***
Biogas produced from medium and large biogas plants can be used in glow lamps and replaces fossil fuel based lighting or grid or a combination of both. This may be applicable in households/ street lighting/ lighting in commercial spaces etc. The key and most widely used sources for lighting are (i) electricity, (ii) kerosene, (iii) gas, and (iv) candle.

***Biogas for power generation***
Biogas produced from medium and large biogas plants replaces fossil fuel based captive power generation or grid or a combination of both at community and SME level. Diesel engines have wide application in rural areas including irrigation and other stationary operations; these engines can be retrofitted to dual fuel fired for biogas combustion.

***Switch from chemical fertilizer to organic manure in fields***
Synthetic fertilizers emit GHGs in their production and application processes. Emission from fertilizer production can be calculated based on- Amount of synthetic fertilizer used in field and $CO_2$ Emission factor for fertilizer production. Additionality can be built on investment and other barriers. Yields have been found lowered on use of organic fertilizers.

Baseline scenarios could be determined through project specific baseline surveys in the region. Plausible baseline scenarios include use of nitrogenous synthetic fertilizers like urea. The chosen baseline scenario has to represent the reality after conducting the PoA region specific surveys.

## CER potential

**Table 5.5: CER potential from Biogas**

| Animal | No. of Animals | Biogas production m3/day | CERs/Yr Methane Avoidance | CERs/yr-Power gen Baseline-grid | CERs/yr-Fuel switch- Baseline-Coal | CERs/yr-Fuel switch- Baseline-kerosene | CERs/yr-Fuel switch- Baseline- NR Biomass |
|---|---|---|---|---|---|---|---|
| Cow/Buffalo | 1000 | 400 | 70 | 246 | 280 | 209 | 327 |
| Pig | 1000 | 96 | 17 | 59 | 67 | 50 | 78 |
| Human | 1000 | 10 | 2 | 6 | 7 | 5 | 8 |

**Additionality Analysis**
The additionality of medium/large size biogas plants included in PoA can be justified (but not limited to) as discussed below.
Medium/Large size biogas plants have high installation cost which can be used for establishing additionality.

Use of biogas at a larger scale and realization of its potential may not be possible in an E+ policy environment where more emitting alternative fuels, such as electricity, kerosene, diesel and LPG are subsidized and where fuel wood can be collected without much cost to the households. If such policy distortions can not be corrected because of socio-political obligation the expansion of biogas program will be possible only through extension of similar fiscal incentives to it, this incentive might come from PoA CDM based revenue.

**Applicable Baseline and Monitoring Methodologies**

Following methodologies are applicable for identified project activities;

**Table 5.6: Applicable CDM baseline and monitoring methodologies**

| Activity | Methodology |
|---|---|
| Cooking | AMS I.C |
| Lighting- lamps | AMS I.C |
| Electricity | AMS I.C, AMS I.A |
| Mechanical energy | AMS I.B |
| Methane avoidance | AM0053, AM0069, ACM0010, AMS III.D, AMS III.R |
| Fertilizer switch | New methodology required |

For description of above listed methodologies AMS I.C, AMS III. A, AMS III. D, AMS III. R, and ACM0010, please refer to chapter 4. The applicability criteria for AMS I.A, AMS I.B, AM0053, AM0069 is discussed below.

***AMS I.A. –*** *Electricity generation by the User*

***Applicability:***

Biogas is used for generation units that supply individual households or users or groups of households or users with electricity. The applicability is limited to households and users that do not have a grid connection except when;

(a) A group of households or users are supplied electricity through an isolated minigrid, where the capacity of the generating units does not exceed 15 MW; or

(b) The emissions reduction per renewable energy based lighting system is less than 5 tonnes of CO2e a year and where it can be shown that fossil fuel would have been used in the absence of the project activity.

***Monitoring:***

Monitoring shall consist of:

(a) An annual check of all systems or a sample thereof to ensure that they are still operating (other evidence of continuing operation, such as on-going rental/lease payments could be a substitute).

(a) Metering the electricity generated by all systems in a sample thereof.

***AMS I.B*** *Mechanical energy for the user with or without electrical energy*

***Applicability:***

1. This category comprises renewable energy generation units that supply individual households or users or groups of households or users with mechanical energy who otherwise would have been supplied with fossil fuel based energy.
2. Where generation capacity is specified, it shall be less than 15MW.

***Monitoring:***

Monitoring shall consist of:

(a) Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute); and

(b) Estimating the annual hours of operation for the equipment that uses the mechanical energy produced, if necessary using sampling methods. Annual hours of operation can be estimated from total output (tonnes of grain milled) and output per hour if an accurate value of output per hour is available.

**Approach for CDM Programme of Activities**

Suggested Framework is based on co-operative model and a consortium model. In a top down approach, co-operative model will be used whereas in bottom up approach consortium model will be used. State Nodal Agency, KVIC, NGOs, Private bodies and micro finance institutions etc can as coordinating entity. At CPA level Village Energy Security Committee, Panchayat etc can act as implementing agency (CPA operator). The proposed model assumes that the initial investment is done by the Coordinating entity and so they should be entitled to get CDM benefits. Community will get the benefit of using the biogas plants with an ability to utilize the cow dung to feed the digester for the production of biogas for cooking and would replace the commonly used inefficient wood/ dung/ coal/kerosene fired mud stoves technology, with clean, sustainable and efficient biogas. The benefits so earned through the CDM project should thus go to the Coordinating entity to recover the initial capital costs incurred in setting up of Biogas plants and monitoring system and maintenance. However, the coordinating entity can also give certain share from the revenue towards community development projects.

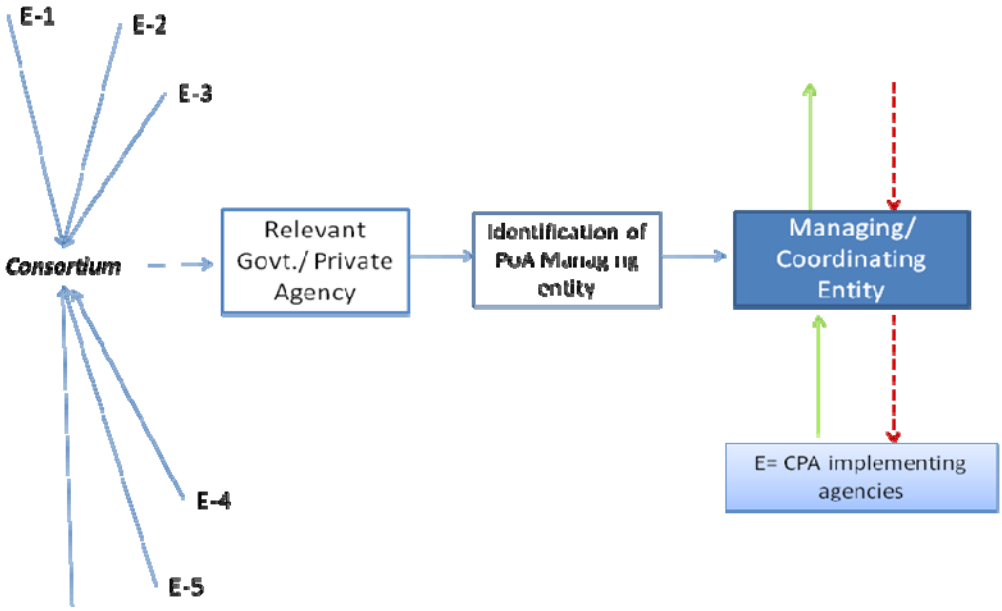



**Figure 5-2: Consortium model**

**Conclusion:**

Medium and large size biogas plants can be potential GHG reducer in domestic as well as in small industry sector. CDM PoA can be used for large scale dissemination of program through appropriate model. A variant of co-operatives model or a consortium model can be applied. CERs shall be shared between the parties as per the understanding between them. CER sharing agreement will be between- PoA managing/co-ordinating entity and the consortium (or co-operative) and between the members of the consortium (or co-operative). Finding an appropriate entity to launch a program will be crucial part in CDM PoA process.

# Chapter 6
# Solar Cooking

Solar energy is renewable and clean form of energy and is directly drawn from the ultimate source of energy on earth, the Sun. Since most of the Indian landmass lies between the Tropic of Cancer and the Equator, India has an average annual temperature that ranges from 25°C – 27.5 °C. This leads to huge solar energy potential. Cooking at low temperatures is a major part of cooking energy requirement. Solar cookers are heat exchangers designed to use solar energy in the process of cooking. Solar cookers are ideal for meeting such thermal energy requirement.

Solar cooker can be effectively used to cook food. Solar cooking may not fully replace conventional cooking fuels but plays an important role in reducing their consumption. For household cooking, box type solar cookers are used whereas concentrator type solar cookers (also called Scheffler's model) are used for community cooking. Ministry of New and Renewable Energy has been implementing Solar Thermal Energy Demonstration Programme having solar cooking as one of its components. The Ministry provides financial support for procuring concentrating solar cookers and the promotional incentives for box type solar cookers. In India as of 31 January 2007, about 6.03 million solar cookers had been sold[40].

**Scope- eligible activities**

Being renewable and GHG free energy convertors, solar cookers have Climate Change mitigation opportunities. Solar cookers can contribute in mitigating climate change by replacing non renewable biomass, kerosene, coal and LPG or a combination of above in household and community cooking applications in rural and urban areas. This should be noted that solar cooking will not generate any real, measurable and long term emission reductions when replaces renewable biomass and waste (dung-cake) or biogas. In table 6.1 relative parameters based on general observations and qualitative assessments of solar cooking technology have been given. Some of these parameters can be further quantified as well.

**Table 6.1: Appropriateness of PoA**

| Elements | Solar Cooking |
|---|---|
| Sites | Multiple, dispersed |
| Possibility of adding new devices over time | High |
| CER potential per unit device per year | Low |
| Size of device | Small/Large |
| *Ex-ante* identification of project sites | Difficult |
| Project developers/promoters | Less |
| Degree of Replicability of projects | High |

Programmatic route will be appropriate to undertake solar cooking program.

[40] TEDDY 2006/07 P. 216.

**Baseline Scenario for solar cooking**

Baseline scenarios can be determined through project specific baseline surveys in the region where solar cooker program is being implemented. Possible baseline scenarios could be stand alone or mix of cooking energy sources like cooking coal, kerosene, LPG, non-renewable or renewable fuel wood/wood waste, sustainable and/or unsustainable agro-residues and cow dung cakes. Real baseline scenario can only be determined by conducting surveys in PoA implementation region. A percent distribution of households by primary energy source of cooking is given in figure 6.1.

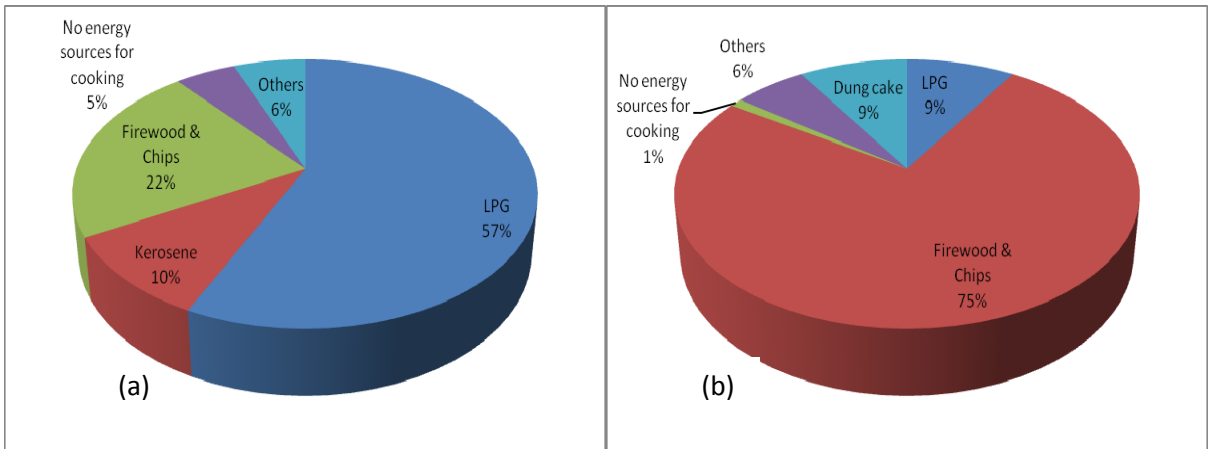



**Figure 6 -1 Distribution of households by primary source of energy used for cooking in (a) urban and (b) rural India**

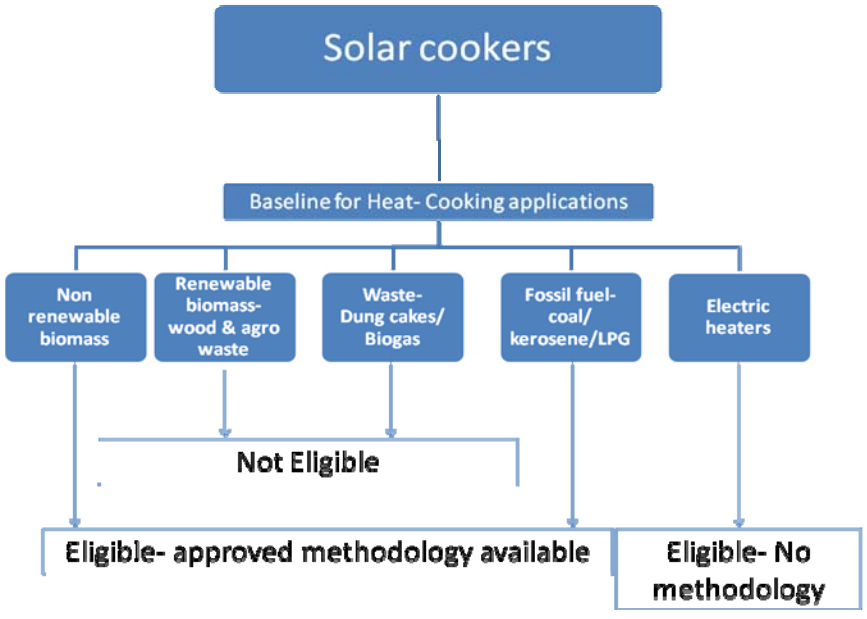



**Figure 6-2: Baseline alternatives for solar cooking**

Potential baseline scenarios have been categorized in the figure 6.2.

**Emission Reduction Potential**

Table 6.2 provides a general estimation of emission reduction per cooker per year for the four solar cooker types- Box type, SK14, Scheffler (domestic and community type). These estimates are based on IPCC default values for NCV and CO2 emission factor of alternative fuels[41].

**Table 6.2: Emission reduction potential in solar cooking**

| Baseline option → | | Traditional chulha | Improved chulha | Kerosene stove | LPG stove |
|---|---|---|---|---|---|
| **Fuel** | Name | NR Biomass | NR Biomass | Kerosene | LPG |
| **NCV** | TJ/kt | 15.6 | 15.6 | 43.8 | 47.3 |
| **CO2 EF** | t/ TJ | 112 | 112 | 71.9 | 63.1 |
| **BOX type** | CER/yr/cooker | 1.1 | 0.6 | 0.2 | 0.1 |
| **SK14** | CER/yr/cooker | 3.6 | 1.8 | 0.8 | 0.3 |
| **Scheffler domestic** | CER/yr/cooker | 4.8 | 2.4 | 1.0 | 0.4 |
| **Scheffler Community** | CER/yr/cooker | 12.1 | 6.0 | 2.6 | 1.0 |

*NR- Non renewable*

This should be noted that emission reduction potentials shown above are indicative only and will depend on solar cooker specification, days of operation and baseline fuel consumption.

**Additionality Analysis**

Additionality shall be established at PoA and CPA level through barrier analysis/investment analysis. A generalized *Barrier Analysis* for solar cooker program in India has been done here.

Solar cookers have numerous environmental advantages like they do not pose any positive radiative forcing to the atmosphere since they don't require fossil fuel. Solar cookers don't produce smoke and do not cause indoor air pollution. Also, these are durable systems and keep utensils clean. But, solar cookers still do not have attractiveness in India[42] because:

1. Solar cooking takes more time in cooking as compared to other cooking arrangements like Chulha, kerosene/LPG stoves etc. Box solar cooking takes 2 to4 hors which is 3 to 4 times longer on a gas burner. It implies changes in daily routine of the family, which, in practice, may not be easy for many.
2. It requires more and open rooftop space which may not be readily available. It may be hard to climb up and down the stairs for cooking.

[41] IPCC Guidance for National GHG Inventories Program. Table 1.2 and 1.4

[42] Ahmad, Bashir (2000). Users and disusers of box solar cookers in urban India- Implications for solar cooking projects. Solar Energy Vol. 69(Suppl.), Nos. 1–6, pp. 209–215.

3. Solar cooker needs solar tracking arrangement so that the solar reflection is concentrated on the same point.
4. Initial cost of solar cooker (around Rs. 1200-2000) is quite high as compared to Chulha (Rs. 25) or Kerosene stove (Rs. 125) and is at par with the LPG stoves. Maintenance of solar cookers also requires cost.
5. There is always needed a back up cooking system to deal with problems of cloudy days.
6. User needs to be trained to use the solar cooking systems.

Table 6.3 shows a benefit matrix[43] of comparison between different alternatives of solar cooking. The criteria like fuel consumption, cooking time, size/weight/space needs, various costs involved, pollution hazards, human drudgery and need for additional cooking system are desired to be minimized and are indicated by negative sign in the benefit matrix. The pay-off values are indicating quantity of fuel consumption in kg per family per day, cooking time in seconds, durability in years, various costs in rupees. Size/weight/space need is indicating the overall bulk in kilograms whereas rate of interest on loan is indicated in percent. It can be concluded from the matrix that based on major criterion the user would prefer to go for other alternatives.

[43] Pohekar S.D. M. Ramachandran (2004). Multi-criteria evaluation of cooking energy alternatives for promoting parabolic solar cooker in India. Renewable Energy 29 (2004) pp. 1449–1460.

**Table 6.3: Benefits matrix of cooking options[3]**

| **Alternative (no.)**<br>**Criteria** (*Quantitative criteria ) | **Chulha (1)** | **Improved chulha (2)** | **Kerosene stove (3)** | **Biogas stove (4)** | **LPG stove (5)** | **Micro-wave oven (6)** | **Electric oven (7)** | **Solar box cooker (8)** | **PSC (9)** |
|---|---|---|---|---|---|---|---|---|---|
| Fuel consumption* (kg/family/yr) | -2 | -1 | -0.5 | 0 | -0.25 | -2 | -2 | 0 | 0 |
| Cooking time* (min) | -60 | -60 | -30 | -15 | -15 | -5 | -30 | -180 | -20 |
| Durability* (yrs) | 1 | 4 | 15 | 5 | 20 | 5 | 5 | 10 | 20 |
| Size/weight/space needs* (m2) | -2 | -1 | -2 | -50 | -10 | -5 | -3 | -5 | -15 |
| Continuity of use | 10 | 10 | 10 | 4 | 10 | 10 | 10 | 4 | 2 |
| Need for tracking | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -4 | -10 |
| Nutrition value of food | 6 | 6 | 6 | 6 | 6 | 2 | 2 | 10 | 8 |
| Initial cost* (Rs.) | -10 | -50 | -200 | -5000 | -4000 | -8000 | -5000 | -2000 | -7000 |
| Fuel cost per month* (Rs.) | -20 | -10 | -100 | 0 | -250 | -200 | -400 | 0 | 0 |
| Maintenance cost* (Rs.) | 0 | 0 | -50 | -200 | -50 | -200 | -200 | -50 | -20 |
| Available subsidy* (Rs.) | 0 | 50 | 0 | 2000 | 0 | 0 | 0 | 500 | 2000 |
| Rate of interest on loan* (%) | 0 | 0 | 0 | 0 | -13 | -13 | -13 | -3 | -3 |
| Pollution hazards | -10 | -10 | -8 | -2 | -4 | -10 | -10 | 0 | 0 |
| Human drudgery | -10 | -10 | -6 | -6 | -2 | -2 | -2 | -2 | -2 |
| Aesthetics | 2 | 2 | 4 | 4 | 10 | 10 | 8 | 8 | 8 |
| Taste of food | 6 | 6 | 2 | 6 | 6 | 2 | 10 | 10 | 10 |
| Cleanliness of utensils | 2 | 2 | 2 | 8 | 10 | 10 | 10 | 10 | 10 |
| Ease of operation | 10 | 10 | 10 | 4 | 8 | 4 | 4 | 6 | 4 |
| Type of dishes cooked | 10 | 10 | 10 | 10 | 10 | 2 | 2 | 2 | 4 |
| Need for additional cooking system | -2 | -2 | -4 | -4 | -6 | -8 | -10 | -10 | -10 |
| Spares & after sales service | 10 | 10 | 10 | 4 | 10 | 6 | 4 | 4 | 2 |
| Distribution network | 10 | 6 | 6 | 6 | 2 | 6 | 2 | 2 | 2 |
| Need for user training | -2 | -2 | -4 | -8 | -4 | -10 | -6 | -6 | -8 |



***Solar Cooking***

**Applicable baseline and monitoring methodologies:**

**Table 6.4: Applicable approved CDM methodologies**

| Solar cooking-baseline option | Applicable methodology |
|---|---|
| Non renewable biomass | AMS I.E |
| Fossil fuel | AMS I.C |

Approved CDM methodologies applicable for solar cooking are listed in the table 6.4.

**AMS I.C.** *Thermal energy for the user with or without electricity*

This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels.

***Validation Requirements:*** CDM EB has released validation and verification manual[44] for DOEs. According to the manual, purpose of validation is to ensure a thorough, independent assessment of proposed project activities submitted for registration against the applicable CDM requirements. The DOE shall apply standard auditing techniques to assess the correctness of the information provided by the PoA managing/co-ordinating entity by means of document review, cross checks, site visit, interviews and other references.

***Monitoring requirements:*** Monitoring requirements include metering the energy produced by a sample of the solar cookers. If the emissions reduction per system is less than 5 tonnes of CO2e a year, the monitoring requirements shall be: (i) Recording annually the number of solar cookers operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute); and (ii) Estimating the annual hours of operation of an average solar cooker, if necessary using survey methods.

In case the project activity involves the replacement of equipment (solar cooker), and the replaced equipment is scrapped, an independent monitoring of scrapping of replaced solar cooker needs to be implemented. The monitoring should include a check if the number of solar cookers distributed by the PoA and the number of scrapped solar cookers correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.

**AMS I.E.** *Switch from Non-Renewable Biomass for Thermal Applications by the User*

This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies.

[44] VVM. CDM EB-44, Annex 3

***Validation requirements:*** Validation requirements are generally same to those described above. In addition, it must be ensured that the proposed CPA is not saving the nonrenewable biomass accounted for by the other registered project activities/CPAs.

***Monitoring requirements:*** The PoA manager/coordinator will have to demonstrate that non-renewable biomass has been used since 31 December 1989, using survey methods.

In case a CPA involves the replacement of equipment (solar cooker) by scrapping, an independent monitoring of scrapping of replaced cook-stoves needs to be implemented. The monitoring should include a check if the number of solar cookers distributed by the project and the number of scrapped stoves correspond with each other. For this purpose, scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.

**Approach for CDM Programme of Activities**

Variants of Technology prototype model (with elements of business hybrid model) can be used as a framework. A technology supplier (manufacturer of solar cooker) launches a PoA. It distributes solar cooker technology on loan to the implementing agency - cluster of *panchayats* at or an NGO. The manufacturer may also establish arrangements to implement the CPAs by itself. The implementing agency is responsible for training the end users to use the solar cooking technology and also training the group that will be responsible for O&M, M&V. End users pay nominal charges that can be used for expenses of the group. The M&V information flows from the group to Implementing agency where it is checked and compiled and sent to the managing/co-ordinating entity. CER revenues help to offset some part of the initial cost, part of the revenue can be spent in promoting sustainable development by the implementing agencies.

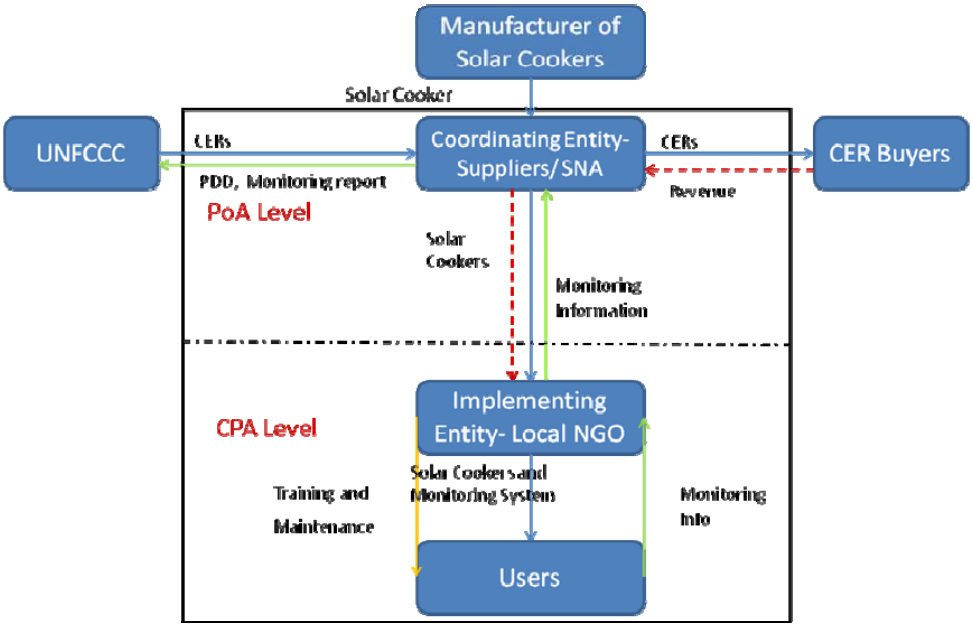



**Figure 6.3: PoA framework for Solar cookers**



***Solar Cooking***

**Conclusion**

Solar cookers are GHG free and thus save substantial amount of emissions from fossil fuel or non renewable biomass based cooking. Dispersed nature of solar cooker program makes it appropriate for taking up through programmatic CDM route. This chapter has analyzed emission reduction potential and identified prevailing practice and low level of acceptance as major barrier in implementing this program. These barriers can be overcome through CDM PoA. A variant of technology prototype model (with elements from business hybrid model) has been suggested for PoA implementation. However typical barriers may come in implementation of this model like user may default in paying back the cost of solar cooker or may not operate it which will ultimately result in less CER generation. These barriers can be overcome through incentivizing user on every day cooking basis from some portion of CER revenue. Also, awareness programs will play a crucial role in successful implementation of CDM PoA in this sector.

# Chapter 7
# Solar Water Heating

Solar energy is non exhaustible resource and a clean form of energy. Solar energy can be used for various purposes of heat application such as for water heating and producing steam and distilled water. Solar water heating systems are heat exchangers designed to use solar energy in the process of water heating.

Solar energy can be effectively used to heat water both in households and in industries. Solar water heating may not fully replace conventional fuels but plays an important role in reducing their consumption. Water can be heated at 60-80$^{o}$C for domestic (households, hostels, canteens etc.), commercial (hotels, hospitals, restaurants, dairies etc) and industrial applications. Solar water heaters (SWHs) of 100-300 liters capacity are suited for domestic application. Larger systems can be used for commercial and industrial applications.

Wide spread utilization of solar water heaters can reduce a significant portion of the GHG emissions generated by fossil fuel and electricity being used for heating water. A demonstration program was launched by Government of India during the 1980s' for promoting SWHs in the country[45]. A range of monetary incentives have been offered to the users to encourage the use of SWHs. These incentives include capital subsidy, low interest loan, accelerated depreciation related benefit etc. The total collector area of SWHs installed in the country was 1.66 million m$^2$ till 31st January 2007. This is below the expected levels of penetration that can be attributed to a large number of barriers.

### Scope- eligible activities

Being renewable and GHG free energy convertors, solar water heaters pose no net positive radiative forcing on atmosphere. Solar water heaters can contribute in mitigating climate change by replacing grid electricity, non renewable biomass, kerosene, fuel oil, diesel oil, coal and LPG, natural gas or a combination of above in households and commercial/ industrial water heating applications in rural and urban areas.

**Table 7.1: Appropriateness of CDM PoA**

| Elements | Solar Water Heating |
|---|---|
| Sites | Multiple, dispersed |
| Possibility of adding new devices over time | High |
| CER potential per unit device per year | Medium |
| Size of device | Small/Large |
| *Ex-ante* identification of project sites | Difficult |
| Project developers/promoters | Less |
| Degree of Replicability of projects | High |

[45] MNRE 2007. Annual Report: 2006–2007. Ministry of New and Renewable Energy (MNRE), Government of India, CGO Complex, Lodhi Road, New Delhi.

Thus it can be concluded that programmatic route will be appropriate to undertake solar water heating program.

**Baseline scenario for solar water heating:**

Baseline scenarios can be determined through PoA/CPA specific baseline surveys in the region and/or industrial sector where solar water heating CPAs are being implemented. Plausible baseline scenarios could be stand alone or mix of heat energy sources like grid electricity, cooking coal, kerosene, LPG, non-renewable or renewable biomass and dung cakes. These scenarios are shown in Figure 7.1. Real baseline scenario can only be determined by conducting the PoA region specific surveys only.

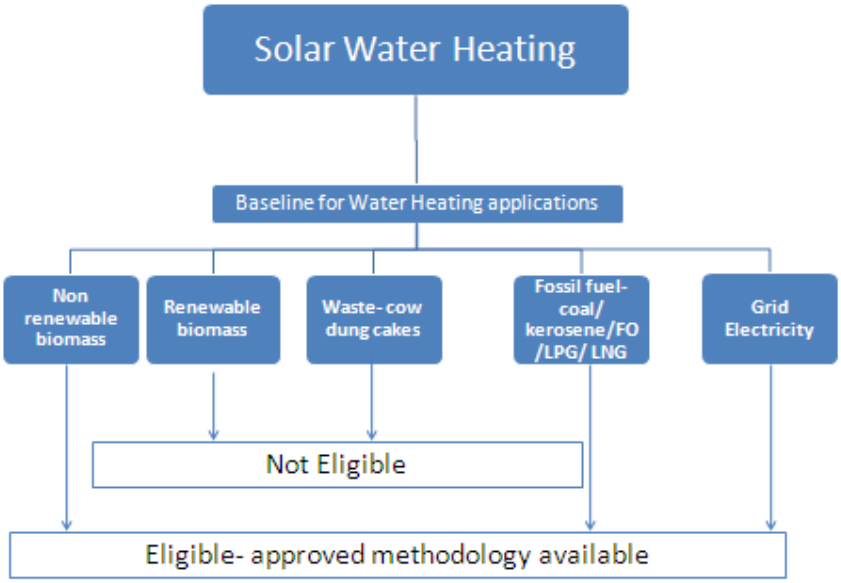



**Figure7.1: Baseline for SWH**

SWHs may become of special relevance for the programmatic CDM because they are dispersed in nature and significantly contribute to sustainable development[46]. Use of these systems can play a vital role in environmental protection[47]. Installation of these systems may create employment opportunities as the solar water heaters can be manufactured locally. Moreover, the introduction of these systems will replace coal generated electricity that will reduce emissions of suspended particulate matters.

A solar water heating system usually replaces electricity[48,49]. For assessment in this report this is assumed that baseline in grid electricity.

[46] Pokharel, S., 2007. Kyoto protocol and Nepal's energy sector. Energy Policy 35 (4), 2514–2525.
[47] Kalogirou, S.A., 2004. Environmental benefits of domestic solar energy systems. Energy Conversion and Management 45 (18–19), 3075– 3092.
[48] Chandrasekar, B., Kandpal, T.C., 2004. Techno-economic evaluation of domestic solar water heating systems in India. Renewable Energy 29 (3), 319–332.
[49] Purohit, P., Michaelowa, A. 2006. CDM Potential of Solar Energy Technologies in India, World Renewable Energy Congress (WREX – IX), Florence, Italy

**Emission Reduction Potential**

Demand of hot water may vary from household to household in India. A domestic water heating system with a capacity of one hundred liter per day (lpd) has been most frequently distributed in the country[50].

**Table 7.2: Definitions for the purpose of this section**

| Utility Type (Name) | Definition |
|---|---|
| Small Hotels | Hotels with average occupancy 10 guests per day |
| Large Hotels | Hotels with average occupancy 100 guests per day |
| Hospitals | All hospitals of average 100 bed occupancy per day |
| Hostels | All hostels of average 100 boarders capacity |
| Restaurants | All restaurants of 50 diners per day |
| Small Commercial buildings | Buildings with 10 shops on an average |
| Large Commercial Buildings | Buildings with 100 shops on an average |
| Government Buildings | All government buildings with 10 rooms on an average |
| Schools | All schools with 15 class rooms on average |
| Other Educational Institutions | All other educational institutions with 50 rooms/halls on an average |

Following assumptions have been applied for emission reduction assessment in this chapter:

1. Per capita hot water consumption in different utilities[51]

**Table 7.3: Hot water requirement**

| Utility Type (Name) | Hot water requirement in l/user/day |
|---|---|
| Small Hotels | 40 |
| Large Hotels | 140 |
| Hospitals | 15 |
| Hostels | 100 |
| Restaurants | 5 |
| Small Commercial buildings | 10 |
| Large Commercial Buildings | 10 |
| Government Buildings | 10 |
| Schools | 10 |
| Other Educational Institutions | 10 |

2. Change in water temperature = 45°C
3. Number of days in operation = In the range of 300 to 360 days in different utilities
4. Number of each utility type = 15
5. Efficiency of baseline system = 80%
6. Grid Emission factor for India = 0.9 tonnes of $CO_2$/ MWh[52]

[50] Chandrasekar, B., Kandpal, T.C., 2004. Techno-economic evaluation of domestic solar water heating systems in India. Renewable Energy 29 (3), 319–332.
[51] HAREDA website, Procedure for installation of Solar Water Heating System in Haryana. www.hareda.gov.in
[52] 75%OM+25% BM for the year 2007-08.CEA website, CO2 emission database. www.cea.nic.in

**Table 7.4: Analysis Table**

| Utility Type (Name) | t CO2/utility/year |
|---|---|
| Small Hotels | 3 |
| Large Hotels | 107 |
| Hospitals | 11 |
| Hostels | 76 |
| Restaurants | 2 |
| Small Commercial buildings | 4 |
| Large Commercial Buildings | 25 |
| Government Buildings | 3 |
| Schools | 3 |
| Other Educational Institutions | 16 |

This should be noted that emission reduction potentials given above are indicative only and will strictly depend on SWH specifications, days of operation, hot water requirements, number of persons etc.

**Additionality Analysis**

Additionality of SWH program can be demonstrated either through Investment analysis or Barrier Analysis. A brief barrier analysis is given below.

Low level of penetration of SWH in India can be attributed to a number of barriers including high up-front system costs compared to conventional alternatives, unwillingness of banks to finance, and a lack of awareness about the positive lifecycle economics of solar water heating technology as compared to conventional water heaters[53].

Expense of retrofitting plumbing in households and industries is a major barrier[54]. The operation of the solar water heating system is dependent on climatic conditions such as clear skies and sufficient sunlight.

Kandpal and Garg (2004)[55] gave financial performance indicators of investments in SWHs. These financial figures of merit have been estimated for different resource-technology combinations and prices. It is concluded that except higher prices of electricity, natural gas and kerosene the use of SWHs is financially not feasible. In India, the electricity tariff is different in different states. With current electricity price the NPV of an investment in the solar water heating system is not attractive. There are other barriers to project implementation such as the fear of users not to receive maintenance in case of breakdown and the unfamiliarity of the technology.

**Applicable Baseline and Monitoring Methodology**

Applicable approved CDM methodology is:

**AMS I.C.** *Thermal energy for user with or without electricity*

[53] Pallav Purohit and Axel Michaelowa (2008). CDM potential of solar water heating systems in India. Solar Energy 82 (2008) P. 799–811.
[54] IEP-2006. P.97
[55] Kandpal, T.C., Garg, H.P., 2003. Financial Evaluation of Renewable Energy Technologies. Macmillan India Ltd., New Delhi.

***Applicability Conditions of the Methodology:*** This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. Examples include solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass for water heating, space heating, or drying, and other technologies that provide thermal energy that displaces fossil fuel.

***Validation requirements:*** will be same as mentioned in Chapter 6.

***Monitoring requirements:*** There are two variables that need to be monitored and verified in order to correctly establish emission reductions from SWHs according to AMS I.C: number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute); and annual hours of operation of an average system, if necessary estimated using survey methods. Annual hours of operation can be estimated from total output and output per hour if an accurate value of output per hour is available.

**Approach for CDM Programme of Activities**

Variant of Business hybrid model (with attributes from Technology prototype model) can be used as a framework. A technology supplier (manufacturer of solar water heating systems) launches a PoA. The supplier distributes SWH technology on loan to the implementing agency – a local NGO. Alternatively the SWH may be purchased by state nodal agency for renewable energy acting as managing/co-ordinating entity of the PoA. The implementing agency (NGO) will be responsible for training the end users to use the solar water heating technology and also training the group that will be responsible for O&M, M&V. End users pay nominal charges that can be used for expenses of the group. The M&V information flows from the group to Implementing agency where it is checked and compiled and sent to the managing/co-ordinating entity. CER revenues help to offset some part of the initial cost, part of the revenue can be spent in promoting sustainable development by the implementing agencies.

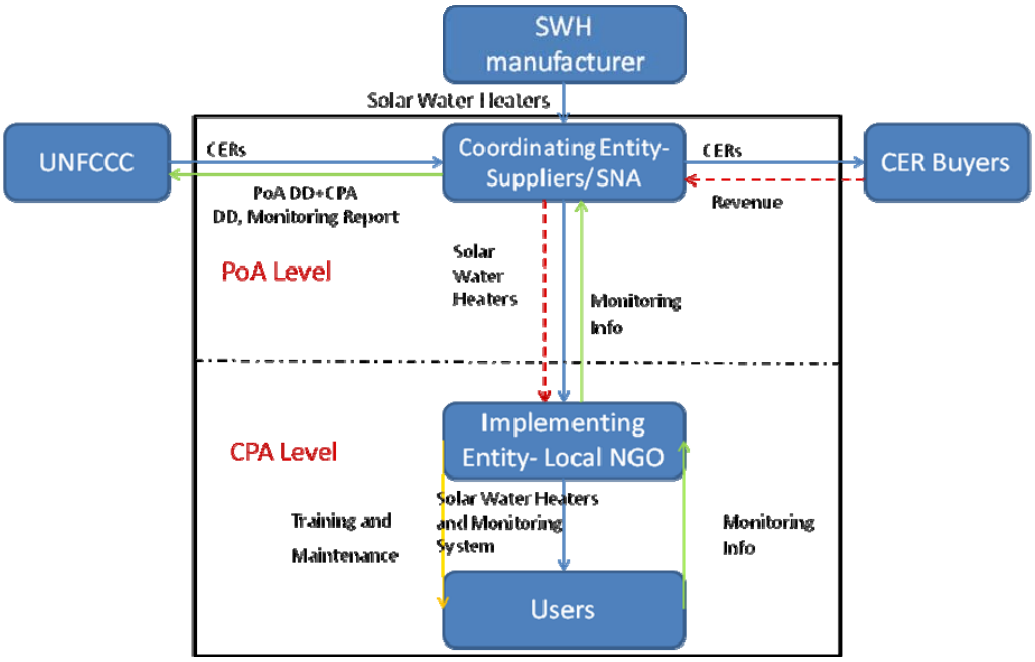



**Figure 7.2: Model for PoA implementation in SWH PoA**

**Conclusion**

Solar water heating reduces emissions mainly from replacing grid electricity consumption in households, commercial, institutional and industrial sector. Dispersed nature of SWH program makes it appropriate for taking up through programmatic CDM route. This chapter has analyzed emission reduction potential and identified high initial cost of technology as major barrier in implementing this program. These barriers can be overcome through CDM PoA. A variant of business hybrid model (with elements from technology prototype model) has been suggested for PoA implementation.

# Chapter 8
# Biomass Applications in Industries

Biomass means non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms. This also includes products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes. Biomass also includes gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material[56].

Only recently, it has been realized that the biomass available in our country has a huge energy potential for industries. Biomass is finding increased usages all over the world. It has been estimated that about 38% of Energy of the world would come from biomass by 2050[57]. Biomass has huge potential for meeting both power and heating needs of industries. The major industries where biomass can, and has been playing an important role as fuel are sugar industries, textile industries, paper industries, SMEs [small and medium enterprises (which depend heavily on grid power for their operations and to some extent other fuel oil based energy generation)], brick making, etc.

The industrial sector consumed about 35% of the total power produced in the country[58]. The industries either buy power from the state electricity board or produce captive power using diesel or coal. Process steam requirements are mostly met by fossil fuel fired boilers. Many industries also use cogeneration systems to meet their energy demands. Industries require continuous and stable supply of energy (steam or power) to run the plants. The power from state grids is not always a reliable source of energy and power cuts are a common occurrence in many parts of the country. Hence, most of the industries have installed their captive power systems. The unavailability of state power has a greater impact on SMEs as these run on small budgets and cannot afford a captive power plant in most cases. Moreover, the size of the individual SME does not make it feasible to go for a CPP. Hence, these rely heavily in grid power.

India is an agriculture dominated country and plenty of biomass is generated. The availability of biomass in India is estimated at about 540 million tonnes per year[59] covering residues from agriculture, agro-industrial, forestry, and plantations. 120-150 million tonnes of usable agro industrial and agricultural residues per year can be made available for power generation[60]. It has been estimated that there is a potential for generation of about 16,000 MW through co-generation in various core industries in the country[61], including sugar industry. Power generated from such co-generation plants can be used for meeting the captive requirements and the surplus power can be exported to the grid. In particular, there is significant potential in breweries, caustic soda plants, textile mills, distilleries, fertilizer plants, paper and pulp industry, solvent extraction units,

[56] Glossary of CDM terms Version 4.0. EB 41
[57] Combustion characteristic of different biomass fuels. Demirbas A., Progress in energy and combustion Science, 30 (2004), 219-230
[58] MNES Annual Report 2007-08. Para 4.47
[59] MNES Annual Report 2003-04. Chapter 5, Page 6.
[60] http://mnes.nic.in/annualreport/2007_2008_English/Chapter%205/chapter%205_1.htm
[61] MNRE. http://mnes.nic.in/prog-biomasspower.htm

rice mills, petrochemical plants, etc. Similarly, there is a good potential for deployment of gasification systems for the generation of electricity in various institutions for meeting their captive power requirement[62]. India is the world's second largest producer of Sugarcane. The Indian sugarcane industry generated about 45 million tons of dry bagasse in 2006-07. Most of the bagasse is used by the sugar industries for meeting the captive power and steam requirements.
Recognizing the huge potential of biomass as a resource, The Ministry of New and Renewable Energy (MNRE) sponsored a survey to estimate the state-wise and crop-wise residue generation. Taluka/District level biomass studies were also sponsored by the MNRE through 1995-2004. These surveys indicated that 15-20% of total crop residues could be used for power generation, without altering their present uses[63]. These studies are required to be updated to cater to the requirements of the CDM PoA such that there should not be any competing use of biomass. The MNRE has sponsored a project by Indian Institute of Science; Bangalore under which a GIS based biomass atlas has been developed. The ministry developed a scheme during the year 2005-06 to tap the vast potential of thermal energy and power for captive use in industry and captive electricity requirement of institutions. The scheme is known as *"Development of a Programme on Biomass Energy and Co-generation (non-bagasse) in Industry and Institutions"*.

MNRE has been providing incentives to users of biomass based power systems. The level of incentives is based on the configuration of the technology used. The incentives are based on limited funds and not all potential projects can be funded. Hence CDM PoA can play a major role.

**Scope- eligible activities**

Renewable biomass is a GHG neutral source of energy. Biomass can be utilized either by direct burning in boilers/ furnaces or can be gasified and producer gas can be combusted in order to generate heat/power. Biomass based energy system can contribute to the GHG mitigation processes in the following ways:

1. **Biomass based power generation:** *(Stand alone electricity generation with or without grid connection)*- The crop residues, *e.g.* rice husk, soya husk, bagasse, etc. are considered as carbon neutral fuels as the amount of $CO_2$ emitted during the burning is taken up by the growing crops. The power generated from biomass based power plants can be used either for meeting captive demand or for selling to the state grid or both. Industries may either set up captive power plants or install independent power plants for supplying power to grids. The carbon neutral power thus produced displaces an equivalent amount of power being supplied by the state grids, which are mainly fed by fossil fuel fired power plants[64], thus resulting in lower GHG emissions.
2. **Biomass based steam generation (for heat):** *Stand alone thermal energy generation*- Mostly, industries use fossil fuel fired boilers to produce steam for process heating requirements. Fossil fuels like coal and HSD/LSD are highly carbon intensive fuels and lead to net positive GHG emissions. Biomass based power plants, being carbon neutral do not result in net GHG emissions and avoid emissions which would have occurred due to firing of fossil fuels.
3. **Biomass based Cogeneration:**
   Combined heat and power generation based on biomass as fuel, with our without connection to grid.

[62] MNES Annual Report 2007-08.
[63] Shukla et al, 2008. 25 years of Renewable energy in India. MNRE.
[64] CEA Annual report 2006-07

4. **Thermal energy with electricity generation in same facility** (excluding cogeneration), with or without grid connection.

**Table 8.1: Appropriateness of PoA**

| Elements | Biomass based power | Biomass based heat | Biomass based cogeneration |
|---|---|---|---|
| Sites | Multiple, clustered | Multiple, clustered | Multiple, clustered |
| Possibility of adding new devices over time | High | High | High |
| CER potential per unit device per year | Medium | Medium/High | Medium/High |
| Size of device | Medium/Large | Medium/Large | Medium/Large |
| *Ex-ante* identification of project sites | Less difficult | Less difficult | Less difficult |
| Project developers/promoters | Many | Many | Many |
| Degree of Replicability of projects | High | High | High |

Thus it can be concluded that in addition to conventional CDM project activities, programmatic route will also be helpful in diffusion of biomass application in industries.

**Baseline Scenario**

***Biomass Based Power generation:***

There can be two plausible baseline scenarios in case of biomass based power generation:

- *The equivalent amount of power would have been drawn from grid*
  Since August 2006, all regional grids except the Southern Grid have been integrated and are operating in synchronous mode. Central Electricity Authority accordingly revised CO2 Baseline Database for the Indian Power Sector in November, 2008. Northern, Eastern, Western and North Eastern grids were integrated into one NEWNE grid. Consequently, the Northern, Eastern, Western and North-Eastern grids will be treated as a single grid and is named as NEWNE grid from FY 2007-08 onwards for the purpose of calculating baseline emissions and/or emission reductions. The Southern grid has also been planned to be synchronously operated with rest of all Indian Grid by early 12th Plan (2012-2017). Presently Southern grid is connected with Western and Eastern grid.

**Table 8.2 Geographical Scope of regional grids in India**

| NEWNE Grid | | | | Southern grid |
|---|---|---|---|---|
| ***Northern region*** | ***Eastern region*** | ***Western region*** | ***North-Eastern region*** | ***Southern region*** |
| Chandigarh | Bihar | Chhattisgarh | Arunachal Pradesh | Andhra Pradesh |
| Delhi | Jharkhand | Gujarat | Assam | Karnataka |
| Haryana | Orissa | Daman & Diu | Manipur | Kerala |
| Himachal Pradesh | West Bengal | Dadar & Nagar Haveli | Meghalaya | Tamil Nadu |

| | | | | |
|---|---|---|---|---|
| Jammu & Kashmir | Sikkim | Madhya Pradesh | Mizoram | Pondicherry |
| Punjab | Andaman-Nicobar | Maharashtra | Nagaland | Lakshadweep |
| Rajasthan | --- | Goa | Tripura | --- |
| Uttar Pradesh | --- | --- | --- | --- |
| Uttarakhand | --- | --- | --- | --- |

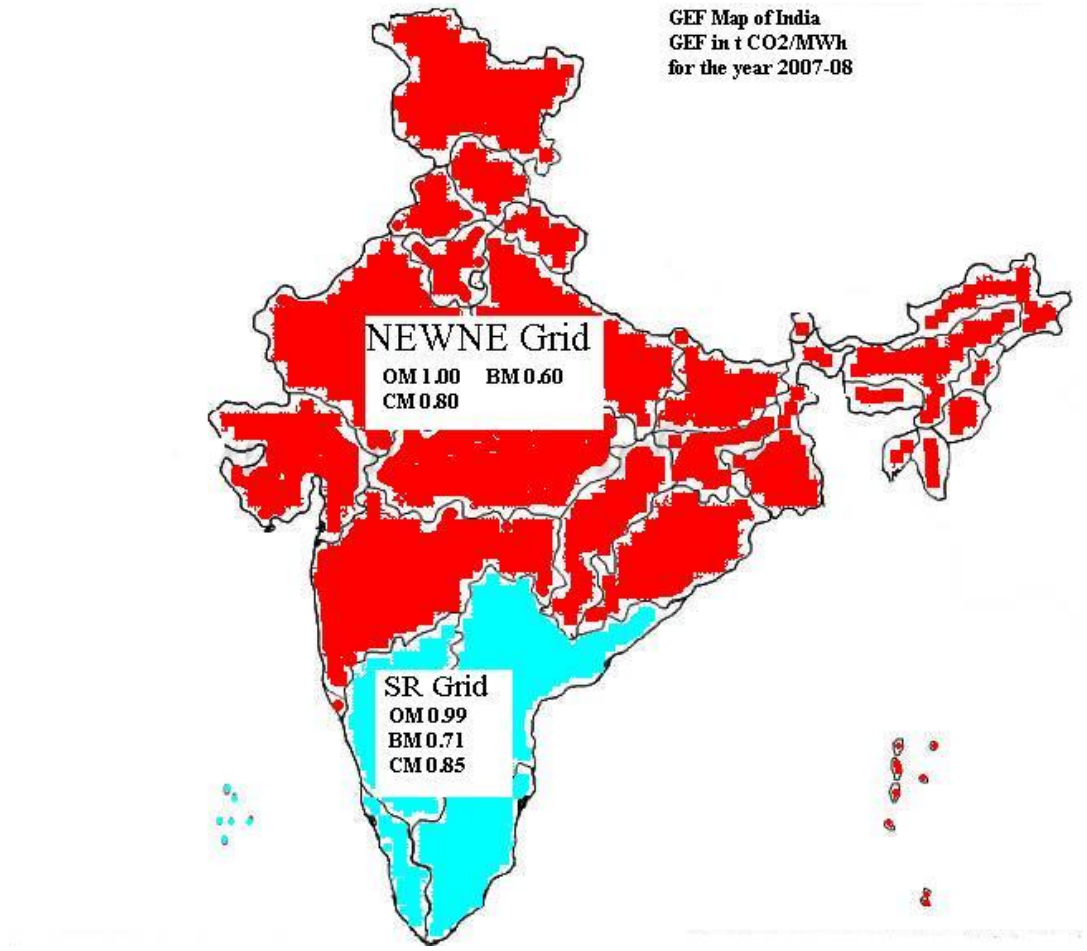



**Figure 8-1: GEF Map of India**

Emission factors for the grids in tCO2/MWh are[65]:

| Grid | Average | OM | BM | CM |
|---|---|---|---|---|
| **NEWNE** | 0.81 | 1.00 | 0.60 | 0.80 |

[65] Baseline Carbon Dioxide Emission Database Version 4.0. Central Electricity Authority, 2008 http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

| | | | | |
|---|---|---|---|---|
| **Southern** | 0.72 | 0.99 | 0.71 | 0.85 |
| **India** | 0.79 | 1.00 | 0.63 | 0.81 |

- *The CPA implementer would have generated captive power using fossil fuels* (either a coal based boiler turbine system or a DG set). Emission factor in such system can be calculated using past data on power generation and fuel consumption. *In lieu* of actual data, IPCC default values and technological specification of plants can also be used.

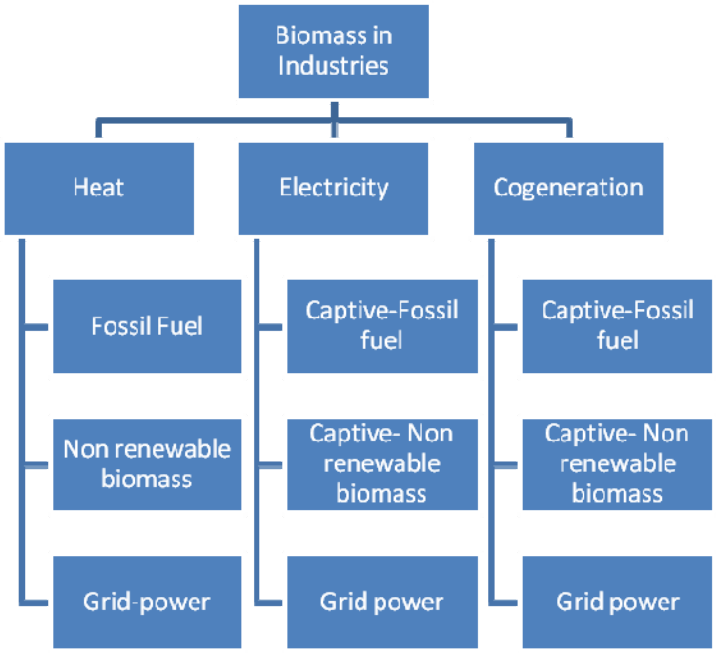



**Figure 8-2: Baselines for biomass application in industries**

***Biomass Based Heat/ co-generation:***

Heat generation/Cogeneration can be accomplished in industries using coal, furnace oil, diesel or non-renewable biomass. The baseline can be identified using past data of plant operation or by survey of the industry sector/region where the PoA is to be launched and CPAs are to be located. In terms of GHG emission reduction, only renewable biomass[66] is considered as a carbon neutral fuel. For definition of *renewable biomass* please see Annex III- glossary of relevant CDM terms. There could be number of scenarios for biomass based cogeneration. For these scenarios, as given in approved CDM methodology ACM0006 please see table below:

[66] *Definition of renewable biomass*. EB 23 Annex 18.

| | Scenario | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cogeneration | Applicable to cogeneration projects | X | X | X | X | | | X | X | | X | X | X | X | X | X | X | X | X | X | X | X |
| | Applicable to projects without cogeneration | X | X | | X | X | X | | | X | X | X | | X | X | X | | | | | | |
| Historic on-site Power Generation | No power generation | X | X | X | X | | | | | | | | | | | | | | | | X | X |
| | With biomass residues | | | | | | | | | X | X | X | X | X | X | | X | | X | X | | X |
| | With fossil fuels | | | | | X | X | X | X | | | | | | | X | | X | | | | X |
| Biomass use in the baseline | Dumped, left to decay or burned (B1, B2, or B3) | | X | X | | X | | X | | | X | | | | | X | X | X | | | X | X |
| | Use at the project site (B4) | | | X | X | | | | | | | X | X | X | X | | X | | X | X | X | X |
| | Use at other sites (B5) | X | | | | | X | | X | X | | | | | | | | | | | | |
| Heat Generation in the baseline (in case of cogeneration projects) | Cogeneration with biomass residues | | | | X | | | | | | | X | | X | X | | | | X | X | | X |
| | Cogeneration with fossil fuels | | | | | | | X | X | | | | | | | X | | | | | | X |
| | Boiler with biomass residues (H4) | | | X | | | | | | | | | X | | | | X | | | | X | |
| | Boiler with fossil fuels (H6) | X | X | | | | | | | | X | | | | | | X | X | | | X | |
| | External sources or other technologies (H7 or H8) | X | X | | | | | | | | X | | | | | | | X | | | | |

**Emission Reduction Potential**

**Power Generation:**

A total of about 495 MW capacity of biomass based power projects are under implementation, apart from about 1200 MW of cogeneration projects[67]. A 495 MW capacity addition in coming years may bring about approximately 2.4 million CERs per annum (taking an emission factor of 0.8 tCO2/MWh, PLF of 80% and auxiliary consumption of 10%). 1200 MW cogeneration projects may bring further 6 million CERs.

Annual Emission Reduction per MW of installed capacity of biomass based power plant[68]:

| Baseline | Emission Reductions ~t CO2/MW/Year |
|---|---|
| NEWNE grid | 5606 |
| Southern Grid | 5957 |
| Coal | 6735 |
| FO | 4882 |
| HSD/LDO | 4674 |
| NG fired gas engine | 2831 |
| Non renewable biomass | 3532 |

[67] MNRE

[68] Based on IPCC default values and normal performance statistics of power generation technologies

Presently, as per the CDM pipeline[69], about 1000 MW of biomass power projects are already registered under the Kyoto Protocol of UNFCCC. This converts to approximately 5 million CERs per annum collectively. Apart from this, about 1400 MW of projects are under the validation stage. Thus, we see that there is a huge potential for carbon credits in the field of biomass power.

**Steam generation for process heat:**

Biomass is also used for generating steam for process heating purposes. Such a project activity is also eligible for carbon credit benefits. The biomass availability per annum has been estimated to be 540 million tonnes in India[70]. Of this, approximately 150 million tonnes of residues can be utilized for energy generation. The following table provides the emission reduction potential for steam generation:

| | | |
|---|---|---|
| NCV Solid biomass* | 11.6 | TJ/Gg |
| Quantity of biomass | 150000 | Gg |
| Total energy content | 1740000 | TJ |
| Emission Factor-coal* | 96.1 | tCO2/TJ |
| Emission Factor-Diesel* | 74.1 | tCO2/TJ |
| Emission reductions-coal | **167.2** | million CERs |
| Emission Reductions-diesel | **128.9** | million CERs |

* IPCC default values[71]

**Additionality Analysis**

***Investment Barriers***

In case of an IPP, the Internal Rate of Return for the project activity can be compared to a suitable benchmark to prove the additionality of the project. Either Project IRR or Equity IRR can be used. The choice of benchmark can be as per the guidelines laid down by the UNFCCC. The project activity can be proven additional in case the returns are lower than the benchmark.

In case of a captive power plant, per unit cost of electricity generation for different fuels can be compared. Biomass power plants require high capital investment and the recurring maintenance costs and fuel costs make a significant difference in per unit cost of electricity generation.

***Technological barrier***

Most types of biomass are high in alkaline content. This leads to erosion of boiler linings and tubes. Hence, the equipment requires frequent maintenance. This increases the O & M costs of the biomass based system. Also, biomass based power plants do have lower efficiency levels compared to for example a coal fired power plant. Also, technology limitations are more in case of a biomass fired power plant. Revenues from carbon credits can help proponents tide over the extra input costs.

***Biomass prices and supply chain related problems***

Prices of biomass keep fluctuating. In most of the cases, per unit costs of steam generation or power generation is higher in case of biomass based systems. The increased costs can be a significant barrier in implementing of the project activity. Maintaining sustainable availability of

[69] www.cdmpipeline.org

[70] http://mnes.nic.in/annualreport/2007_2008_English/Chapter%205/chapter%205_1.htm

[71] IPCC NGGIP 2006 Chapter 2.

biomass also needs effort from promoters as though the biomass may be available, a mechanism to collect and transport is required.

**Applicable baseline and monitoring methodologies:**

Activity wise applicable approved CDM methodologies are listed below:

| Activity | | Methodology |
|---|---|---|
| Biomass based electricity generation | Grid connected | AMS.I.D, AM0042, ACM0006 |
| | Isolated grid | AMS.I.A, AM0045 |
| Thermal application of biomass | Baseline- fossil fuel | AMS.I.C, AM0036 |
| | Baseline- non renewable biomass | AMS.I.E |
| Biomass based cogeneration | | AMS.I.C, AM0007, ACM0006 |

Descriptions of the methodologies that can apply to biomass application in industries are given below:

**AMS I.C-** *Thermal energy for the user with or without electricity*

***Applicability***: This methodology is applicable for renewable energy technologies that supply thermal energy that displaces fossil fuels. Biomass-based co-generating systems that produce heat and electricity are included in this category. Thermal generation capacity is specified by the manufacturer, it shall be less than 45 MW.
For biomass based programs the applicability of the methodology is limited to either CPAs that use biomass residues only or biomass from dedicated plantations complying with the applicability conditions of AM0042.

***Validation and monitoring requirements-*** Leakage is of special concern for biomass PoAs. An important potential source of leakage for these CPAs could be an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the PoA.
If biomass residues are co-fired in the project plant, PoA coordinator shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA implementer/ PoA manager will have to assess the supply situation for each type of biomass residue used in the project plant.
In case the CPAs involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the PoA and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.

**AMS.I.A-** *Electricity generation by the user*

***Applicability:*** The applicability is limited to households and users (including small industries) that do not have a grid connection except an isolated mini grid where the capacity of the generating units does not exceed 15 MW; or The emissions reduction per renewable energy based

lighting system is less than 5 tonnes of CO2e a year and where it can be shown that fossil fuel would have been used in the absence of the project activity by a representative sample survey; or Official statistics from the host country government agencies.

***Monitoring requirements***: Monitoring shall consist of an annual check of all systems or a sample to ensure that they are still operating (other evidence of continuing operation, such as on-going rental/lease payments could be a substitute). OR metering the electricity generated by all systems in of a sample.
The amount of biomass and fossil fuel input shall be monitored. A specific fuel consumption of each type of fuel (biomass or fossil) to be used should be specified *ex ante*. Renewable biomass used in such PoAs should be biomass residues only or biomass from dedicated plantations complying with the applicability conditions of AM0042.

**AMS I.D-** *Grid connected renewable electricity generation*

***Applicability:*** This category comprises application of renewable biomass that supply electricity to and/or displace electricity from a fossil fuel contributed electricity distribution system. The installed capacity of the power generation units in a CPA will be limited to 15MW.

***Validation and Monitoring requirements:*** The amount of biomass and fossil fuel input shall be monitored. If more than one type of biomass fuel is consumed each shall be monitored separately. Applicability of the methodology is limited to either project activities that use biomass residues only or biomass from dedicated plantations complying with the applicability conditions of AM0042 as given below.

**AMS.I.E-** *Switch from Non-Renewable Biomass for Thermal Applications by the User*

***Applicability:*** This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies.
If any similar registered small-scale CDM project activities/ CPA exist in the same region as the proposed project activity then it must be ensured that the proposed PoA is not saving the nonrenewable biomass accounted for by the other registered project activities.
PoA manager/co-ordinator will show that non-renewable biomass has been used since 31 December 1989, using survey methods.

***Monitoring requirements:*** Monitoring shall consist of an annual check of all appliances or a representative sample to ensure that they are still operating or are replaced by an equivalent in service appliance. Monitoring should confirm the displacement or substitution of the non-renewable biomass at each location. In the case of appliances switching to renewable biomass the quantity of renewable biomass used shall be monitored.

***AM0007-*** *Analysis of the least-cost fuel option for seasonally-operating biomass cogeneration plants.*

***Applicability:*** This methodology is applicable to the renovation and fuel-switch of biomass cogeneration projects connected to the grid with the following conditions:

1. The proposed PoA has access to biomass that is not currently used for energy purposes;
2. The PoA proposes to operate existing equipment using other fuel(s) during the offseason (when biomass associated to the main activity of the unit – for instance bagasse in case of a sugar mill - is not being produced);
3. Project must operate in seasonal mode.

**AM0036-** *Fuel switch from fossil fuels to biomass residues in boilers for heat generation*

***Applicability:*** The methodology is applicable under the following conditions:

1. The heat generated in the boiler(s) is either not used for power generation; or if power is generated, it is not increased as a result of the CPA,
2. The use of biomass residues or increasing the use of biomass residues beyond historical levels is technically not possible at the project site without a significant capital investment.
3. Existing boilers at the project site have used no biomass or have used only defined biomass residues for heat generation during the most recent three years
4. No biomass types other than defined biomass residues, will be used in the boiler(s)
5. For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process.
6. The biomass residues used at the project site, should not be stored for more than one year.
7. Biodiesel/waste oil is not eligible.
8. The biomass residues are directly generated at the project site or transported to the project site by trucks.

**AM0042-** *Grid-connected electricity generation using biomass from newly developed dedicated plantations*

***Applicability:*** The PoA involves the installation of a new plant that is mainly fired with renewable biomass from a dedicated plantation (fossil fuels or other types of biomass may be co-fired);

- Prior to the implementation of the CPA, no steam/heat was generated at the project site (i.e., the project plant does not substitute or amend any existing generation at the project site);
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;
- Biomass used by the project facility is not stored for more than one year;
- The dedicated plantation must be newly established as part of the project activity for the purpose of supplying biomass exclusively to the project.
- The biomass from the plantation is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc) prior to combustion in the project plant but it may be processed mechanically or be dried;
- The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity;
- The land area of the dedicated plantation will be planted by direct planting and/or seeding;
- After harvest, regeneration will occur either by direct planting or natural sprouting;
- Grazing will not occur within the plantation;
- No irrigation is undertaken for the biomass plantations;

***Validation and monitoring requirements:*** The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the project activity would have not been used for any other agricultural or forestry activity. The land degradation can be demonstrated using one or more of the following indicators:

(a) Vegetation degradation, e.g., Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities;
(b) Soil degradation, e.g., Soil erosion has increased in the recent past; Soil organic matter content has decreased in the recent past.
(c) Anthropogenic influences, e.g., There is a recent history of loss of soil and vegetation due to anthropogenic actions; and Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.

Power generation will be monitored.

**AM0045-** *Grid connection of isolated electricity systems*

***Applicability***: The methodology is applicable to PoAs consisting of:

1. The expansion of an interconnected electricity grid to isolated systems;
2. The displacement of power generation in isolated systems by more efficient, less carbon intensive power generation from the interconnected grid.
3. Emission factors estimated take into account the increase of demand of the isolated systems and the remaining lifetime of the equipments.
4. Renewable energy based electricity generation in the isolated systems is not displaced and its operation is not significantly affected.
5. All fossil fuel fired power plants in the isolated system are 100% displaced.

**ACM 0006-** *Consolidated methodology electricity generation from biomass residues*

***Applicability:*** This methodology is applicable to biomass residue fired electricity generation PoAs, including cogeneration plants.
The CPAs may include the following activities:

- A green-field power projects; or
- The installation of a new biomass residue fired power plant, which replaces or is operated next to existing power plants fired with either fossil fuels or the same type of biomass residue as in the project plant (power capacity expansion projects); or
- The improvement of energy efficiency of an existing power plant (energy efficiency improvement projects), e.g. by retrofitting the existing plant or by installing a more efficient plant that replaces the existing plant; or
- the replacement of fossil fuels by biomass residues in an existing power plant (fuel switch projects).
  Other applicability conditions are same as given above for AM0036.

The above mentioned methodologies are applicable to project activities having renewable electricity generation units. Under a PoA, biomass residues or biomass from dedicated plantation are to be used in the project activity. The scrapped/replaced equipment also needs to be monitored in order to take into account the leakage, if any.

**Approach for CDM Programme of Activity**

Use of biomass has many social benefits linked to it. Earlier, the agro residues were simply left as waste. Now, farmers get a good income by selling the agro-residues to industries. This has created an additional source of income for the farmers. There is additional employment generation as people are involved in transportation and supply of biomass. Demand for biomass by industries has created a market for a product which was earlier left to rot on open fields.

The important Players involved in the Programme of Activity are:

1. Managing or Coordinating Agency at the PoA level
2. Implementing Agency at the CPA level
3. Industries (large or SMEs)

**Managing/Coordinating entity at the CPA level**

It may be noted that special organizational and management skills are required to coordinate amongst various agencies to organize a CDM programme of activity. The coordinating entity should essentially be a group with huge network and penetration in the rural areas. Technology suppliers and corporate/industry itself can play this role. Alternatively industry associations can launch a program. The POA is especially beneficial to SMEs, who do not have a large capital to invest in individual power/steam plants The coordinating entity would be required to obtain biomass based plants facilitate the implementation of these plants in the industries. They will also be required to audit the performance and keep the records for monitoring. As the agency would have considered CDM PoA initially, they can launch the program and go for registration of CDM project activity. Hence they are entitled to design and coordinate implementation of the PoA, authorized to communicate with the CDM Executive Board and also ensure that there is no double counting.

The benefit flow depends on who does the investment. In this case, a number of SMEs can form a cluster and invest in a single biomass based power plant to generate power for meeting the power requirements of the SMEs. Such a program can then be launched across a greater geographical area wherein various SMEs for a cluster and invest in a biomass based power plant. Thus, a single cluster shall manage its own investments. MNRE can play the role of an umbrella organisation coordinating between various clusters for the CDM PoA. Revenue from carbon credits may be shared equitably between the clusters.

**Implementing Agency at the CPA level**

The entity should in the past have worked with the local community (or other community comparable to the program) and have shared a good rapport with them. State Nodal Agency, NGO, Private, MFIs etc can serve this role.

The implementing entity would be required to train people and delegate staff for maintenance of the plants. The entity would also help in providing monitoring system and related information.
Variants of business hybrid model of CDM PoA would be appropriate for biomass application in Industries.

A business entity for example a technology supplier launches a Program. MFI is interested in the clean energy technology and buys it from the supplier. MFI gives this technology to the end user on loan, which is repayed back in installments (similar to normal lending process). The end user enjoys the benefits without paying huge capital cost initialy. The MFI also gives training to use the technology. A group is appointed and trained for O&M and M&V . MFI bears the related expenses. The CDM revenue are shared by the technology supplier and the MFI. The technology supplier invests in further R&D. The MFIs also provide vocational training to the end users for their development.

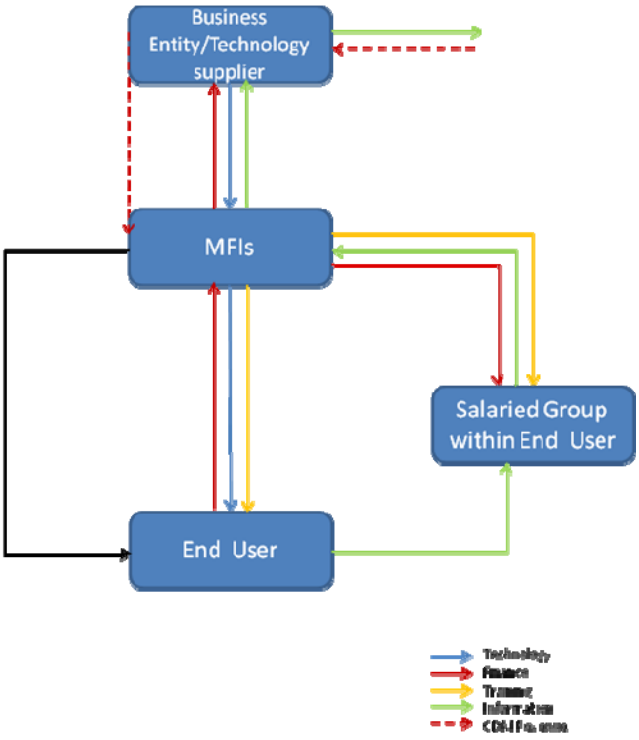



**Figure 8-2: CDM PoA implementation framework for Biomass application in industries**

**Conclusion**

Renewable Biomass is GHG neutral and thus can save large amount of emissions from fossil fuel use for power and/heat generation. This chapter has analyzed emission reduction potential in replacement of fossil fuel/grid by biomass in industries and identified major barriers in implementing this program. These barriers can be overcome through CDM PoA. A variant of business hybrid model has been suggested for PoA implementation.

# Chapter 9
# Cook-stoves Program

Cooking is an important daily household activity and accounts for over 80% of total household energy consumption in rural India[72]. Biomass is a significant cooking fuel in rural India. Firewood chips contribute to around 75% of cooking energy needs in rural areas whereas it meets the cooking need of around 21% households in urban areas[73]. In most of the rural areas of India people use fuel wood, wood waste and wood chips in inefficient smoky cook-stoves. These stoves utilize a lot of energy and hence require large quantities of fuel. As per the FAO's State of World's Forests report (2007) 303.84 million cubic meter of fuel wood was removed from forests in India in the year 2004[74]. It is likely that the rural people would continue to encroach upon public land and forests for obtaining fuel. In addition, the use of unprocessed solid fuels, particularly wood and dung, in inefficient cook-stoves without proper ventilation exposes people to high levels of indoor air pollution by emitting noxious oxides and smoke. Other renewable alternative sources of energy and improved energy efficient cook-stove are yet to gain widespread popularity.

In order to have a deeper penetration of technology, a bottom-up approach is required where the end users get the actual benefits. CDM can play a major role in the support of such a programme. The Programs of Activities (PoA) approach under the Clean Development Mechanism can be a helpful tool to implement and promote the adoption of such energy efficient technology. The accrued benefits from the sale of carbon credits can be disbursed down to the end-users. However it is important that the availability of such technologies must be known to the people. It is here, that the NGOs can play a pivotal role in helping promote awareness generation among the rural people about the new technology and the beneficial policies associated with it.

Referring to the emission reductions due to an improved cookstove, the basic calculations shall remain the same as those for energy efficiency improvement[75], since improved cookstoves basically result in higher fuel efficiency in cooking. The most common fuels used in traditional cookstoves across rural India are cattle dung, crop residues and fuel wood[76].

**Scope- eligible activities**

[72] TERI Energy data directory and yearbook 2007. P. 348.
[73] NSSO (National Sample Survey Organization). 2007. Energy Sources of Indian Households for Cooking and Lighting, 2004/05. NSS 61st Round (July 2004=-June 2005); Report No. 511(61/1/.0/4). Kolkata: NSSO, Ministry of Statistics and Public information, Government of India. P.213.
[74] FAO (2007). State of the World's Forests. P. 125.
[75] Only when non-renewable biomass is being used in the baseline and project activity
[76] Financial analysis of cooking energy options for India. Gupta S. and Ravindranath N. H., Energy Conservation and Management Vol 38, No. 18, pp1869-1876. 1997



***Improved Cook-stoves***

These programs can be with or without the change of fuel. If fuel changes, *e.g.* non renewable to renewable biomass, the program will fall under renewable energy whereas if fuel is not changed and its consumption is reduced *i.e.* consumption of non renewable biomass is reduced and hence overall energy efficiency is improved, the program will be treated as energy efficiency PoA.
Programs of Activities can be launched to introduce improved cookstoves with or without changing baseline fuel within a distinct geographical area to switch from inefficient *chulha* having significant green-house gas emissions. The low emission cookstoves replace relatively high-emission *chulha* of the baseline scenarios. Some examples of high-emission baseline technologies are biomass stoves, dung stoves and kerosene stoves and examples of low emission cook stove are improved biomass stoves, LPG stoves, use of stove displacing technologies such as solar cookers, water purifiers and heat retention cookers, renewable-based electricity (biogas, hydro, wind, PV, etc), and measures that reduce consumption of non-renewable biomass or other green-house emitting fuels.

**Table 9.1: Appropriateness of PoA**

| Elements | Solar Cooking |
|---|---|
| Sites | Multiple, dispersed |
| Possibility of adding new devices over time | High |
| CER potential per unit device per year | Low |
| Size of device | Small |
| *Ex-ante* identification of project sites | Difficult |
| Project developers/promoters | Less |
| Degree of Replicability of projects | High |

Thus it can be concluded that programmatic route will be appropriate to undertake improved cookstoves program.

**Baseline scenarios for improved cook-stoves**

The baseline scenario is established to picture the situation of cooking regime prior to the implementation of newly improved cook-stoves. The improved cook stoves can either be adopted progressively through the project period or all cook stoves can be installed at the start of the project period. The baseline situation in the former may change in the course of the program therefore the dynamic baseline approach must be adopted. The baseline hence would be monitored alongside the project activity. In the later case, where all stoves are installed at the start or in which conditions are static during the PoA period, a single baseline fixed for the pre-project situation can be used. A Baseline Study should be carried out to estimate and quantify baseline conditions in scenario not using the improved stove. It is because in case of cooking different types of *chulha* in different proportions are being used and also fuel type differs significantly. In case no similar studies available, a sample survey can be conducted in a transparent manner prior to establishing the baseline of the project. Government bodies, research organizations, institutes, universities or NGOs may conduct these specific surveys at appropriate level (a block would be ideal). The results of such surveys could then be directly used by the PoA managing entities and/or CPA implementing agencies and cost of survey can be reduced to large extent. This would also help in authenticating the data from a third party reliable source.

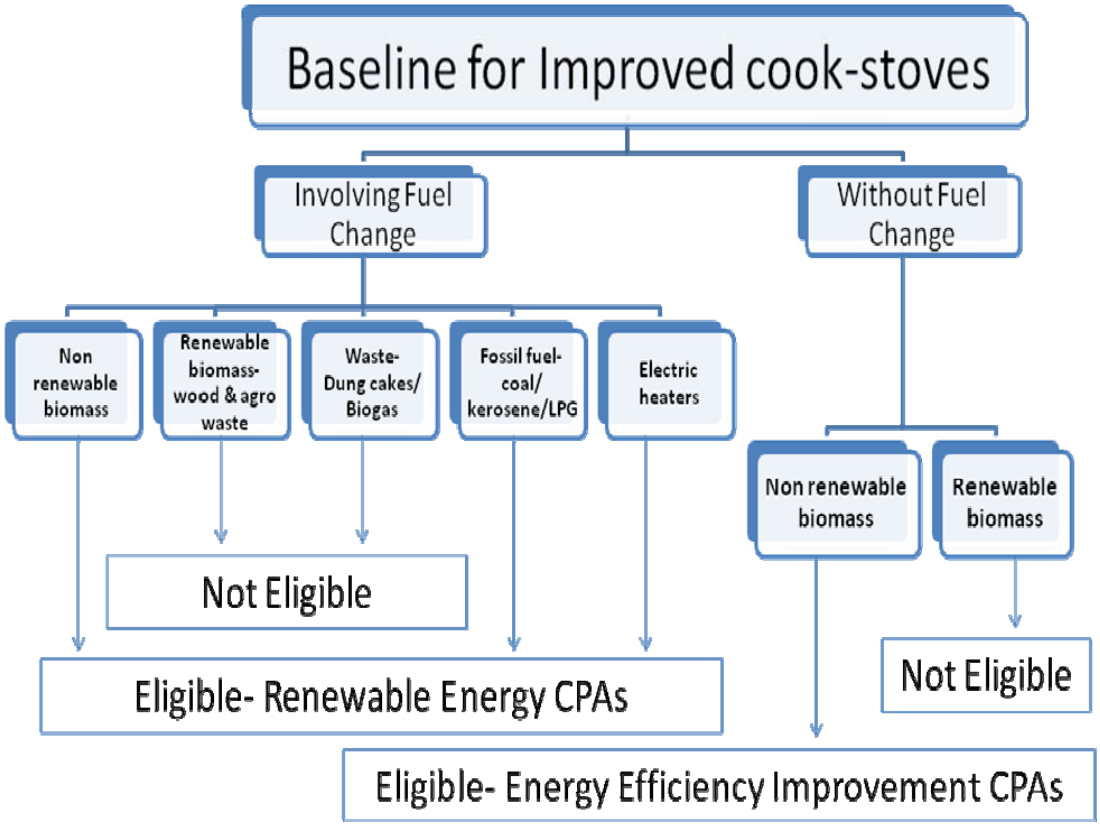



**Figure 9-1: Baseline for Improved cook-stove projects**

A second approach for the Project Proponents can be to carry out the survey in their distinct geographical region till such surveys are made available at national level. For this, a CPA can be determined by identifying cluster of villages/users. A random sample can be chosen to establish a pilot sales record which would provisionally assess fuel types, fuel mix, and kitchen regimes. The purpose of the pilot sales record is to collect the names of cook-stove purchasers who could be the subjects of surveys for kitchen practices prior to use of the improved stoves. This implies that the pilot sales are recorded at the same time or immediately prior to Surveys and Tests, since the fresh customers can best describe pre-intervention behavior and host old-stove tests. This would further be used in analyzing the renewability status of the fuel mix. The fuel mix in India generally comprises of renewable and non-renewable biomass, renewable energy fuels such as biogas, solar cookers, alternative fuels such as fossil fuels, dung etc. Once this is done, calculations for establishing baseline emissions can be done to set the baseline.

**Emission Reduction Potential**

Assuming that per household consumption of non renewable fuel wood/wood waste in rural India is around 1500 kg/year and thermal efficiency improvement is 10% with improved cook-stoves emission reduction potential per thousand households (or per thousand improved cook-stoves) is of the order of 275 t CO2/year.

**Additionality Analysis**

Improved cook-stove Programs would be additional because the program would not be viable without the presence of carbon finance as the initial investment and the on-going costs of distribution, operation, maintenance may not be affordable by the target project population in the form of high prices of improved cook-stove.
The project may also be additional because the target group of users may not have the means to purchase the fuel wood saving devices. The average income of the target group in a specific CPA may be quite low. It would mean a significant part of the income of the target population. It is only by the means of finance by a Project Investor, who actually pre-finances the returns of the CERs, is it possible to realize the execution of the project. This would enable introduction of better technology devices as the feasibility of the project would not depend on low priced components. The use of improved technology results in longer lifetime, high efficiency and better combustion with low emissions of smoke. In this way the project would overcome problems arising from the insufficient adaptation to the needs of the users, low lifespan and minor savings of fuel wood.

**Applicable baseline and monitoring methodologies:**

| Activity | Approved CDM methodology |
|---|---|
| Improved cookstoves involving fuel change (Renewable Energy) | AMS I.C, AMS I.E |
| Improved cookstoves with no fuel change (Energy Efficiency) | AMS II.G |

**AMS I.C.-** *Thermal energy for the user with or without electricity*

***Applicability:*** AMS I.C is applicable for renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. The monitoring involves recording the number of systems operating and the average hours of operation for each system, based on proper surveys. Also, the **monitoring** should include a record of the scrapped equipment in order to rule out leakage calculations from the project.

**AMS I.E-** *Switch from Non-Renewable Biomass for Thermal Applications by the User*

***Applicability:*** This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies.
If any similar registered small-scale CDM project activities/ CPA exist in the same region as the proposed project activity then it must be ensured that the proposed PoA is not saving the nonrenewable biomass accounted for by the other registered project activities.
PoA manager/co-ordinator will show that non-renewable biomass has been used since 31 December 1989, using survey methods.

***Monitoring:*** Monitoring shall consist of an annual check of all appliances or a representative sample to ensure that they are still operating or are replaced by an equivalent in service appliance. Monitoring should confirm the displacement or substitution of the non-renewable biomass at each location. In the

case of appliances switching to renewable biomass the quantity of renewable biomass used shall be monitored.

**AMS II.G-** Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass

***Applicability:*** This category comprises small appliances involving the efficiency improvements in the thermal applications of non-renewable biomass. This includes the introduction of high efficiency biomass fired cook stoves or improvement of energy efficiency of existing biomass fired cook stoves.
It must be ensured that the proposed CPA is not saving the nonrenewable biomass accounted for by other registered CDM project activities/ CPAs.
This needs to be demonstrated that non-renewable biomass has been used since 31 December 1989, using survey methods. The share of renewable and non-renewable biomass in the total biomass consumption using nationally approved methods (e.g. surveys or government data if available) should be determined.
For definition of renewable biomass please see Annex III.

***Validation requirements and monitoring:***
To complement the survey results, national or local statistics, or other sources of information such as remote sensing data can be used to establish the portion of the biomass used that can be considered as non renewable. Inference derived from historical data may also be used if available for this purpose. Maps can be used to illustrate the biomass supply area, where necessary. The following indicators may be useful for conducting surveys in the local areas:

- Increasing trend of time spent or distance travelled by users for gathering fuel wood;
- Increasing trends in fuel wood price indicating scarcity;
- Trends in the type of biomass collected by users, suggesting scarcity of woody biomass

A single indicator may not provide sufficient evidence that biomass in the region is non renewable and therefore more than one indicator may be used. Trends seen should not be on account of enforcement of local/national regulations.

Leakage relating to the non-renewable biomass shall be assessed from *ex post* surveys of users and areas from where biomass is sourced. Potential sources of leakage could be:

(a) Use/diversion of non-renewable biomass saved under the project activity by non-project households/users who previously used renewable energy sources.
(b) Use of non-renewable biomass saved under the project activity to justify the baseline of other CDM project activities can also be potential source of leakage.
(c) Increase in the use of non-renewable biomass outside the project boundary to create nonrenewable biomass baselines can also be potential source of leakage.

If the equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

***Monitoring Procedure***
The CPA implementing body should maintain and make available accurate records for validation/verification. The CDM PoA coordinating or managing entity is responsible to collate a composite electronic sales record and also maintain a paper records. Monitoring of the CPAs can be done by monthly random visits of households by local representatives of the CPA implementing agency. Each distributed cookstove can be given out upon signing of a user agreement for 7 years with a prolongation

clause or an agreement for 10 years, which states, that in case of not using the cook stoves, representatives of CPA implementing body are allowed to hand over the devices to another user. Also, the old *chulhas* may be abandoned when new cook-stoves are distributed to ensure 100% use. However, as in some cases new cook-stoves may not be capable or have some technical faults, in that case old *chullas* may be used in such situations and this must be communicated at the time of survey. The parameters to be recorded for the monthly monitored data are number of households using the cook stoves predominantly, number of households using the cook stoves together with high use of traditional fireplaces, number of households not using the cook stoves and number of installed cook stoves. These can be recorded by the monthly visits and questionnaires of the households by the monitoring agents and number of installed cook stoves can be determined by the number of signed user agreements. This evaluation will be forwarded to the PoA managing entity for recording on a quarterly basis. Regular visits and meetings in the communities will help to obtain additional feedback about the actual usage, cooperativeness and correct recordings. It would depict the results of appropriate use of this newly adopted technology and highlight the reasons wherein the technology has not been operational. The visits should intend to give the utmost assistance to the users in changing their cooking habits in a sustainable manner.

**Framework for CDM Programme of Activities**

The improved cookstoves based CDM PoAs will contribute to sustainable development by improving the standard of households, improving health and environment and enabling income generation of the households by using appropriate firewood saving technologies. The continuous high utilization of the forest biomass leading to its rapid depletion can also be reduced.
The key players involved in the Programme of Activity are:

4. Managing or Coordinating Agency at the PoA level
5. Implementing Agency at the CPA level
6. Households/ communities

The Roles and Requirements for each entity are discussed below.

***Managing or Coordinating Entity at the Programme of Activity level***
The coordinating entity should essentially be a group with huge network and penetration in the rural areas. An NGO or an MFI can also serve this role.
The coordinating entity would be required to obtain cookstoves and facilitate the implementation of these plants in the rural areas. They will also be required to audit the performance and keep the records for monitoring. As the agency would have considered CDM PoA initially, they can launch the program and go for registration of CDM PoA. Hence they are entitled to design and coordinate the implementation of the PoA, authorized to communicate with the Board and also ensure that there is no double counting. The local bodies, NGOs can play a major role in the implementation of such a project activity since these bodies have a greater outreach among the rural population.

***Benefit Flow***
The initial investment is done by the Coordinating entity and so they should be entitled to get CDM benefits. The community gets the benefit of using the cookstoves and would replace the commonly used inefficient wood/ dung/ coal/kerosene fired mud stoves technology. The benefits so earned through the CDM PoA should thus go to the Coordinating entity to recover the initial capital costs incurred in setting up of Biogas plants and monitoring system and maintenance. However, the coordinating entity can also give certain share from the revenue towards community development projects.

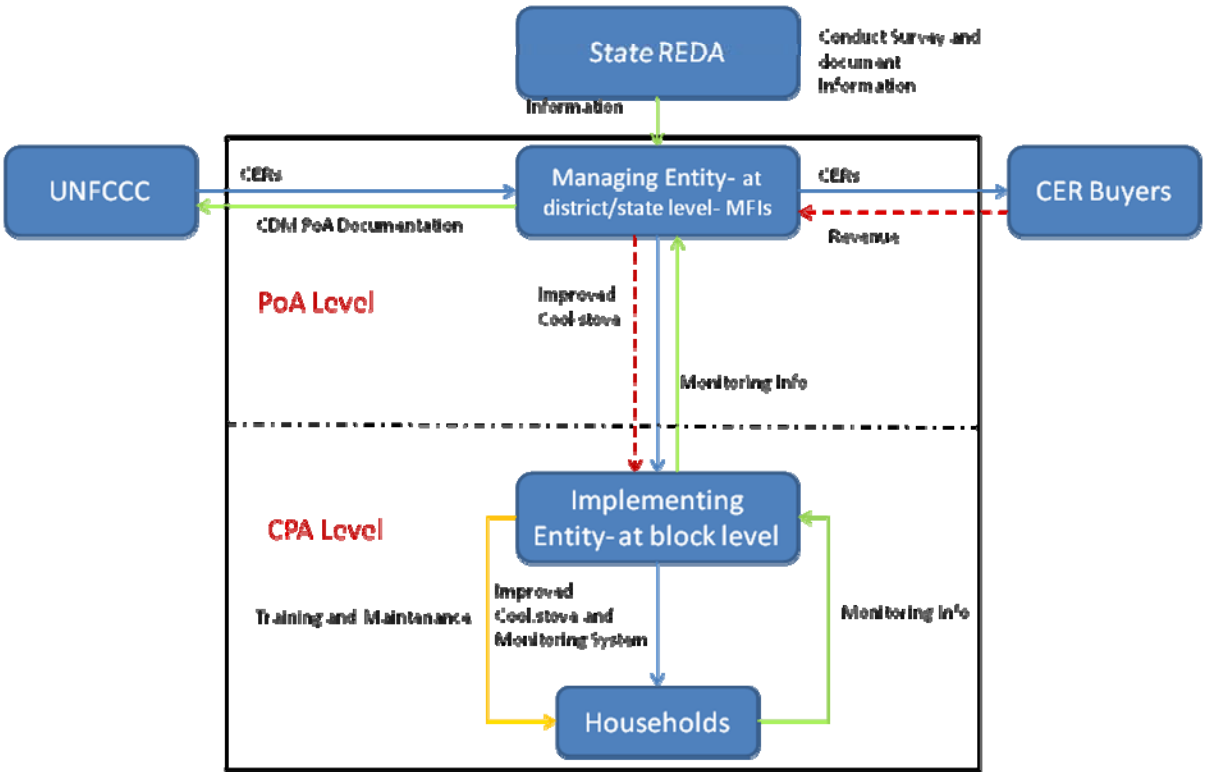



**Figure 9-2 Framework for CDM PoA, Improved Cookstove**

***Implementing Agency at the CPA level***

The entity should in the past have worked with the local community (or other community comparable to the program) and have shared a good rapport with them. The implementing entity should be a local body at block/village level like Village Energy Security Committee, Panchayat etc.

The implementing entity would be required to train people and delegate staff for maintenance of the improved cookstove. The entity would also conduct and document the monitoring survey.

**Conclusion**

Improved cookstoves can reduce GHG emissions in two ways:

(a) Replacing either fossil fuel or non renewable biomass consumption in cooking for renewable biomass

(b) Reducing consumption of non renewable biomass as compared to existing cooking systems (traditional *chulha*)

Dispersed nature of improved cookstoves program makes it appropriate for taking up through programmatic CDM route. This chapter has analyzed emission reduction potential in switching from



***Improved Cook-stoves***

traditional to improved cook-stove. Barriers in large scale dissemination of improved cook-stoves can be beaten with the help of CDM PoA. A variant of technology prototype model has been suggested for PoA implementation. However typical barriers may come in implementation of this model like user may not operate it which will ultimately result in less/no CER generation. These barriers can be overcome through incentivizing user on every day cooking basis from some portion of CER revenue. Also, awareness programs will play a crucial role in successful implementation of CDM PoA in this sector.

# Chapter 10
# Village Electrification Programme

One of the major challenges faced by India is a prevalent and imminent power shortage. Presently only around 60% of households are electrified leaving over 20 million households without power[77]. The supply of electricity across India currently lacks both quality and quantity with an extensive shortfall in supply, a poor record for outages, high levels of transmission and distribution (T&D) losses and an overall need for extended and improved infrastructure. Rural consumers like farmers, householders, village industries and commercial users have to tolerate a poor quality, unreliable and intermittent supply[78].

**Table 10.1: Electricity access in 2005 for South Asia[79]**

| Country | Electrification rate % | Population without electricity (million) | Population with electricity (million) |
|---|---|---|---|
| Afghanistan | 7.0 | 27.0 | 2.0 |
| Bangladesh | 32.0 | 96.2 | 45.3 |
| India | 55.5 | 487.2 | 607.6 |
| Nepal | 33.0 | 18.1 | 8.9 |
| Pakistan | 54.0 | 71.1 | 83.5 |
| Sri Lanka | 66.0 | 6.7 | 13.0 |
| *South Asia* | *51.8* | *706.2* | *760.3* |

In the view of this impending energy shortage, an action plan is required for sweeping changes in technology up gradation, policy measures, institutional reforms, inter-ministry collaboration and implementation strategies for India to attain the energy sufficiency and to eradicate poverty. The current policy structure is rudimentary and innovative measures such as DDG for renewable energy technologies would be the way forward.

A distributed decentralized generation (DDG) using renewable energy resource would be the way forward for attaining self sufficient electricity supplies in all the villages and to reduce the GHG emissions[80].

**Scope- eligible activities**

This section describes the identification of appropriate technologies which could be initiated with a view of CDM PoA in India. Each technology is resource dependent; hence the availability of resources limits the technologies to their respective areas. Rural areas are mainly suitable for renewable energy off grid applications due to their geographical location and the lack of critical mass.

[77] Chopra SK, 2004. Energy policy for India: towards sustainable energy security in India in the twenty first century. Oxford & IBH Publishing, New Delhi.
[78] World Bank. 2000, Energy Services for the world's poor, World Bank (http://www-wds.worldbank.org).
[79] World Bank, 2004. Rural access to electricity: strategic option for India (www-wds.worldbank.org).
[80] World Bank. 2000, Energy Services for the world's poor, World Bank (http://www-wds.worldbank.org).

Rural electrification often demands decentralized solutions, namely isolated systems covering basic electricity needs or mini grids which are larger systems providing electricity to several households. Renewable energies based mini grids are less dependent on larger-scale infrastructure and could be placed in service faster, especially in rural areas. Renewable energy technologies avoid greenhouse emissions, have low operation and maintenance costs, generate employment and allow decentralized production for the development of dispersed populations. Within rural areas, they are capable of electrifying homes, villages, farms and small industries as well as being used for telecommunications, water supply and irrigation[81].

India is a country with a lot of climatic and geographical variations. The supply of DDG through renewable resources will be season specific for each resource. Outlined below is a set of technologies which are resource specific and consequently region specific[82,83]:

a. Small hydro power plants
b. Biomass electricity generation
c. Biogas generation system
d. Solar photovoltaic system (Including SPV lighting)
e. Mini wind system
f. Hybrid system (Combination of wind and solar)

The way to determine the most appropriate technological solution implies always a feasibility study based on gathering field data for each specific site. Technical, economic, financial, and socio-cultural considerations must all be including in the decision process to ensure the appropriate choice of technologies.

Optimum combinations of various renewable technologies could be utilized depending upon the specific requirements of a village. The systems would ideally be designed on the basis of a load capability of around 1 unit (kWh)/ household/ day including supply of electricity for loads such as irrigation, drinking water pumping, village industries, health care, commercial establishments including shops, etc.

**Baseline Scenario for Village electrification**

Table 10.4 summarizes the total number of electrified villages through the RGGVY scheme. However, the percentage of households electrified in all the states is far from satisfactory[84]. Though this program outlines a DDG scheme and supply, there are no reports of number of villages where the DDG scheme has been implemented. Table 10.2 summarizes the fossil fuel dependency for electrification in India and Table 10.3 highlights the inefficiencies of centralized distribution of electrification with 32.15% attributed towards transmission, distribution, transformation and unaccounted energy losses.

Table 10.2 summarizes the fossil fuel dependency for electrification in India and Table 10.3 highlights the inefficiencies of centralized distribution of electrification with 32.15% attributed towards transmission, distribution, transformation and unaccounted energy losses. Both tables and figure 10.1 give enough insights on not only the fossil fuel intensive electricity generation in India but also on the inadequate efficiency of such distribution. RGGVY scheme also targets fossil fuel powered grid electricity for the electrification of un-electrified regions.

[81] Ren21, 2006. Renewables: Global status report (www.ren21.net).
[82] UNEP, 2007. Global trends in sustainable energy investment (www.ren21.net)
[83] Banerjee, 2006. Comparison of options for distributed generation in India. Energy policy, 34: 101-111
[84] MOP, 2003. Gokak Committee Report on distributed generation. New Delhi, India: Ministry of Power (MOP), Government of India.

The funds and subsidy for capital investment in DDG scheme (90% subsidy and 10% loan) is well thought about, nonetheless, lack of awareness in the villages and slow progress has hindered the development of the program. The payment scheme has also been hugely subsidized for Below Poverty Line (BPL) and SC/ST in BPL category. A role of an active agency to specifically target DDG and renewable technologies for rural electrification is the necessity not only from the technology viewpoint but also for policy regulations and further monitoring of the programme.

**Table 10.2: Dependency on fossil fuel for power generation in India[85]**

| Sector | Hydro | Thermal | | | | Nucle -ar | Other Renew. | Total |
|---|---|---|---|---|---|---|---|---|
| | | Coal | Gas | Diesel | Total | | | |
| ***State*** | 26086.8 | 42047.5 | 3834.2 | 604.6 | 46486.3 | 0.0 | 2200.0 | 74773.1 |
| ***Central*** | 8592.0 | 29010.0 | 6639.0 | 0.0 | 35649.0 | 4120.0 | 0.0 | 48361.0 |
| ***Private*** | 1230.0 | 4991.4 | 4183.0 | 597.1 | 9771.5 | 0.0 | 9994.5 | 20996.1 |
| ***All India*** | 35908.8 | 76048.9 | 14656.2 | 1201.8 | 91906.8 | 4120.0 | 12194.6 | 144130.2 |

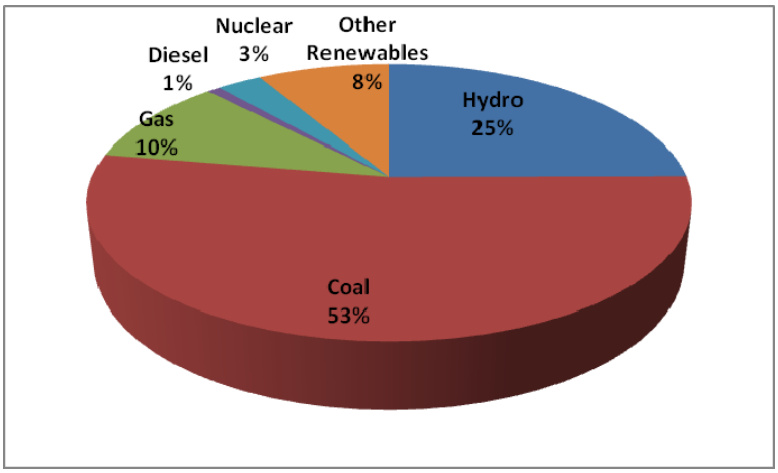



**Figure 10-1: Sector- wise installed capacity (MW) as on 31.03.2008[10]**

**Table 10.3: Gross sector-wise electricity generation in India[86]**

| Gross Generation 2004-05 | |
|---|---|
| Hydro | 84497 GWh |
| Nuclear | 16638 GWh |
| Thermal and Wind | 486031 GWh |
| No. Villages electrified | 498286 |

[85] CEA, 2008. CO2 Baseline Database for the Indian Power Sector User Guide Version 4.0 October 2008. Central Electricity Authority, Ministry of Power, Government of India.
[86] MOP, 2005. Rajiv Gandhi Grameen Vidyutikaran Yojana: scheme for rural electricity infrastructure and household electrification. New Delhi, India: Ministry of Power (MOP), Government of India.

| | |
|---|---|
| Length of Transmission & Distribution lines | 6497727 Circuit km. |
| Per Capita consumption | 606.2 kWh |
| Losses | 32.15% |

Though the subsidy based system is an attractive short term option, it discourages the policy makers to fund sufficient money in achieving higher efficiency in grid based centralized electrification and to invest in renewable energy technologies for rural electrification. Thus a DDG with pay to use scheme with a collaborative effort of government agencies, private entities, NGOs, technology suppliers and local stakeholders is the way forward. Subsidy and payment may be considered on the energy saving basis. This entire scheme will only work effectively with the involvement of a new government corporation under a government ministry.

**Table 10.4: Number of Villages Targeted for Electrification / Intensive Electrification under RGGVY[87]**

| S. No. | State (No. of Districts) | No. of Villages | | | |
|---|---|---|---|---|---|
| | | Un-Electrified | De-Electrified | Electrified | Total |
| 1 | Andhra Pradesh (23) | 0 | 0 | 14765 | 14765 |
| 2 | Arunachal Pradesh (16) | 1662 | 311 | 182 | 2155 |
| 3 | Assam (23) | 4353 | 3916 | 3630 | 11899 |
| 4 | Bihar (38) | 10611 | 12077 | 3201 | 25889 |
| 5 | Chhattisgarh (16) | 735 | 33 | 7442 | 8210 |
| 6 | Gujarat (25) | 0 | 0 | 3373 | 3373 |
| 7 | Haryana (19) | 0 | 0 | 596 | 596 |
| 8 | Himachal Pradesh (12) | 82 | 0 | 9715 | 9797 |
| 9 | Jammu & Kashmir (14) | 191 | 46 | 2034 | 2271 |
| 10 | Jharkhand (22) | 17326 | 2679 | 6572 | 26577 |
| 11 | Karnataka (27) | 32 | 5 | 4288 | 4325 |
| 12 | Kerala (14) | 0 | 0 | 23 | 23 |
| 13 | Madhya Pradesh (48) | 436 | 441 | 13975 | 14852 |
| 14 | Maharashtra (36) | 7 | 1 | 2878 | 2886 |
| 15 | Manipur (9) | 160 | 324 | 385 | 869 |
| 16 | Meghalaya (7) | 1586 | 338 | 5 | 1929 |
| 17 | Mizoram (8) | 39 | 86 | 258 | 383 |
| 18 | Nagaland (11) | 62 | 41 | 0 | 103 |
| 19 | Orissa (30) | 13621 | 4031 | 15843 | 33495 |
| 20 | Punjab (17) | 0 | 0 | 1029 | 1029 |
| 21 | Rajasthan (32) | 787 | 3642 | 21939 | 26368 |
| 22 | Sikkim (4) | 0 | 0 | 294 | 294 |
| 23 | Tamilnadu (30) | 0 | 0 | 354 | 354 |
| 24 | Tripura (4) | 157 | 0 | 0 | 157 |
| 25 | Uttar Pradesh (71) | 27419 | 282 | 502 | 28203 |
| 26 | Uttarakhand (13) | 780 | 679 | 1884 | 3343 |
| 27 | West Bengal (18) | 4753 | 72 | 6857 | 11682 |

The DDG programme if implemented properly will not only help in offsetting the costs of generation, transmission and distribution of electricity through centralized electricity distribution system in unviable areas but also leads to sustainable development with impetus to global

[87] http://rggvy.gov.in/rggvy/rggvyportal/index.html

warming mitigation. The emission reduction consideration through DDG system is very rationale in this era of sustainable development and climate change. The village electrification programme thus needs a systematic impetus for sustainable development of Indian villages. The potential of CDM PoA in village electrification is enormous not only in providing a systematic impetus towards village electrification but also in overall sustainable development of the villages. The VEP through CDM PoA would help in involvement of public-private partnership, evaluation of project site and technology, technology transfer, implementation of technology, validation of the entire exercise and probably will lead to issuance of CERs which will further offset the capital costs.

**Emission reduction potential calculation:**

According to the new definition of village electrification (effective from 2004–2005) total number of un-electrified villages is estimated to be around 125,000. The National Electricity Policy, 2005 has laid down an objective of provision of capacity for availability of a minimum of a lifeline consumption of 1 kWh of electricity/ household/ day[88]. Therefore in deal situation, every village should be connected to the grid and supplied with electricity from the grid.

However, in remote areas, grid connectivity is not the cost effective option owing to the uneven territory etc. In such areas, villagers tend to switch to the cheapest available option which is kerosene. For simplicity purposes, this report considers un-electrified villages and baseline considered is the traditional grid connected electricity from burning of fossil fuels. The assumptions such as 62500 un-electrified villages, 500 households per village and a lifeline consumption of 1 kWh of electricity/ household/ day have been considered for conservativeness of the estimations.

**Table 10.5: Calculation of Emission Reduction Potential (ERP) for grid connected village in NEWNE grid**

| Grid | No. of household in the village | Total Electricity Consumption per day (kWh) | Annual electricity Consumption (kWh) | GEF (2007 - 08) (tCO2e/ MWh) | ERP ($tCO_2e$/ annum) | Total ERP (28 yr crediting period) |
|---|---|---|---|---|---|---|
| NEWNE | 1000 | 1000 | 365000 | 0.80 | 292 | 8176 |
| Southern Grid | 1000 | 1000 | 365000 | 0.85 | 310 | 8687 |

For baseline options other than grid (diesel/FO), emission reduction can be conservatively calculated at the rate of 0.8 t CO2/MWh.

ERP for Solar LEDs:
1 solar LED lights / household
Emission factor for kerosene tin lamp: 0.123 kg CO2/h
Average lighting use – 3.5 Hours/day (as per AMS.I.A methodology)

The emissions baseline is the historic fuel consumption calculated times the CO2 emission factor for the fuel displaced. IPCC default values for emission factors may be used. Baseline fuel

[88] MOP, 2005. National Electricity Policy. New Delhi, India: Ministry of Power (MOP), Government of India (www.powermin.nic.in).

consumption is calculated to be 65 L/annum/unit. Thus emission reduction potential will be 0.1672 tCO2/year/unit(LED).

**Additionality**

A generic additionality analysis for renewable energy technologies integrated VEP has been presented below:

Barrier analysis includes the identification of barriers such as investment barrier, institutional barriers, technological barrier, barriers related to local tradition, barriers due to prevailing practice and large price risk due to the fluctuation in the prices of biomass incase of biomass projects. Electricity subsidies and theft cause the State Electricity Boards to incur big financial losses. The levels of transmission and distribution (T&D) losses and own use of electricity in power stations in India, as a share of total electricity generation, are among the highest in the world. All the barriers listed above are very much applicable to the renewable energy technologies for VEP. Implementation of renewable energy technology for project activity involves at least one of the barriers, if not more.

**Table 10.6: Costs of Electrifying Households in India[89]**

| | Central grid | Mini-grid hydro | Mini-grid biomass gasifier | Mini-grid wind power | Off-grid diesel | Off-grid photo-voltaic |
|---|---|---|---|---|---|---|
| kWh per household per month | 30 | 30 | 30 | 30 | 30 | 30 |
| kWh per person per year | 73 | 73 | 73 | 73 | 73 | 73 |
| Installed kW per person | 0.02 | 0.03 | 0.05 | 0.04 | 0.04 | 0.04 |
| Investment cost per kW ($)* | 2 300 | 1 150 | 1 200 | 3 500 | 700 | 10 000 |
| Investment cost per person ($) | 41 | 31 | 57 | 133 | 29 | 417 |

***Investment Analysis***

Any renewable energy related project activity would face investment barrier, institutional barriers, technological barrier, barriers related to local tradition, barriers due to prevailing practice as discussed in the earlier section. These barriers would prove to be a sufficient additionality test for CDM consideration. However, a financial indicator such as a simple cost analysis would be effective financial indicator for solar based project.

The investment analysis has to prove that the without the revenue from the sale of carbon credits, the project is not the most financially or economically attractive option of the identified alternatives (i.e. there is at least one option providing the same service that has a greater NPV, IRR or other financial indicator); or the project is not economically or financially feasible (as determined through industry benchmarks, interest rate of government bond rates etc.)

[89] World Energy Outlook 2007. Table 20.3

Table 10.6 provides an estimate of the cost of providing access to electricity to the 412 million people without access in 2005.

### Applicable CDM Baseline and Monitoring Methodologies

The VEP technologies which are being considered are renewable energy technologies which not only aid in GHGs emissions reduction but also will help in the sustainable development of the villages. Considering the resources in each village, electricity consumption and finance mobilization for VEP, most projects if taken up through CPA would come under small-scale methodologies. Accordingly, if installed capacity of VEP technology is lesser than 15 MW or 45$MW_{th}$ or 60 ktonnes $CO_2$ depending on the project type, the CPA will fall under the small scale project activities (Table 10.6).
If installed capacity of VEP technology is lesser than 15 MW, the CPA will fall under the small scale project activities. The baseline scenario would be the electrification of the village by fossil fuel powered grid connections. Hence the renewable energy technologies would definitely result in the emission reduction when compared to baseline scenario.

**Table 10.7 : Methodologies applicable in CDM for PoA projects in village electrification sector**

| Activity | | Applicable methodology |
|---|---|---|
| Village electrification- grid connected | Small scale | AMS I.D |
| | Large scale | ACM0002, ACM0006, AM0042, AM0026, AM0019 |
| Village electrification- isolated grid/no grid | Small scale | AMS I.A |
| | Large scale | AM0045 |
| Other- mechanical energy | Small scale | AMS I.B |

The technologies which have been considered in this chapter for VEP are renewable energy resource dependent technologies. India being a vast country with lot of geographical variations some technologies and subsequently some methodologies are not applicable to certain regions in India (Table 10.7). The CDM methodologies which shall be considered for each technology has been enlisted below with reasons for considerations:

**Table 10.8: Regional consideration of each technology and consequent methodologies**

| Technologies considered | Applicable methodologies | Regions in India |
|---|---|---|
| Small Hydro Power systems | AMS I.A, AMS I.B, AMS I.D | Most part of India excluding Rajasthan and Parts of J&K |
| Biomass electricity generation | AMS I.A, AMS I.C, AMS I.D | Most part of India excluding Delhi |
| Biogas generation system | AMS I.A, AMS I.C, AMS I.D | Most part of India; Some areas may have seasonal variation in biogas generation |

| | | |
|---|---|---|
| Solar photovoltaic system | AMS I.A, AMS I.B, AMS I.D | Most part of India excluding J&K, Himachal Pradesh, Northern Bihar, Sikkim and some parts of NE states |
| Solar PV home lightening system | AMS I.A, AMS I.D | Most part of India excluding J&K, Himachal Pradesh, Northern Bihar, Sikkim and some parts of NE states |
| Mini Wind systems | AMS I.A, AMS I.B, AMS I.D | Most coastal states of India, Rajasthan, Parts of J&K and NE states |
| Hybrid system | AMS I.A, AMS I.B, AMS I.D | Most parts of India |

***AMS I.A-*** *Electricity generation by the user:*

***Applicability:***

This category comprises renewable energy generation units that supply individual households or users or groups of households or users with electricity. The applicability is limited to households and users that do not have a grid connection except when;

(a) A group of households or users are supplied electricity through an isolated minigrid where the capacity of the generating units does not exceed 15 MW; or

(b) The emissions reduction per renewable energy based lighting system is less than 5 tonnes of $CO_2e$ a year and where it can be shown by a representative sample survey or official statistics from government agencies that fossil fuel would have been used in the absence of the project activity.

These units include technologies such as solar power, hydropower, wind power, and other technologies that produce electricity all of which is used on-site by the user, e.g. solar home systems, and wind battery chargers. The renewable generating units may be new or replace existing fossil-fuel-fired generation. The capacity of these renewable energy generators shall not exceed 15 MW.

***AMS I.B-*** *Mechanical energy for the user*

***Applicability:***

This category comprises renewable energy generation units that supply individual households or users or groups of households or users with mechanical energy who otherwise would have been supplied with fossil fuel based energy. These units include technologies such as hydropower, wind power, and other technologies that provide mechanical energy, all of which is used on-site by the individual household(s) or user(s), such as wind-powered pumps, solar water pumps, water mills and wind mills.

***AMS I.D-*** *Grid connected renewable electricity generation*

***Applicability:***

This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.

***Monitoring:***

While monitoring the emission reductions from the program the PoA managing/co-ordinating entity shall:

(a) Electronically archive all data collected as part of monitoring for a period of 2 years from the end of the crediting period;

(b) Data variables that are most directly related to the emission reductions (e.g. quantity of the fuel inputs, the amount of heat or electricity produced, gas captured) should be measured continuously. Data elements that are generally constant and indirectly related to the emission reductions (e.g. Emission factors, Calorific Value, System Efficiencies) should be measured or calculated at least once in an year, unless detailed specifications are provided as part of the indicated methodology;

(c) Measuring equipment should be certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer specifications, but at least once in 3 years;

(d) The measured data with high levels of uncertainty or without adequate calibration should be compared with location/national data and commercial data to ensure consistency;

(e) Wherever a statistical sample is proposed for monitoring, the sample should be representative of the population and should have a minimum level of confidence of one times the standard deviation (one sigma), unless detailed specifications are provided as part of the indicated methodology.

**Logical frameworks in identified sectors**

Though earlier chapters have adequately discussed a generic framework and framework analysis has been presented, the problems associated with VEP is complex with multiple stakeholders and hence a separate framework for renewable energy specific VEP has been detailed below (Figure 10.2):

***Role of Central Ministry/State Governments/Rural Electrification Corporation***

Identification of un-electrified villages/hamlets can be carried out by the Rural Electrification Corporation, New Delhi. Necessary inputs such as the list of villages not likely to be electrified by the State Governments etc. can be provided to the central ministry for onward forwarding to REC.

Initial surveys and studies can also be conducted state-wise lists of remote un-electrified census villages and hamlets for assessing the renewable energy resources available in the villages and energy requirements of the community and identification of appropriate technology options for electrification. Preparation of State-wise Master Plans should be encouraged to facilitate activities like adoption of village by corporates and NGOs.

***Role of Managing/Coordinating Entity***

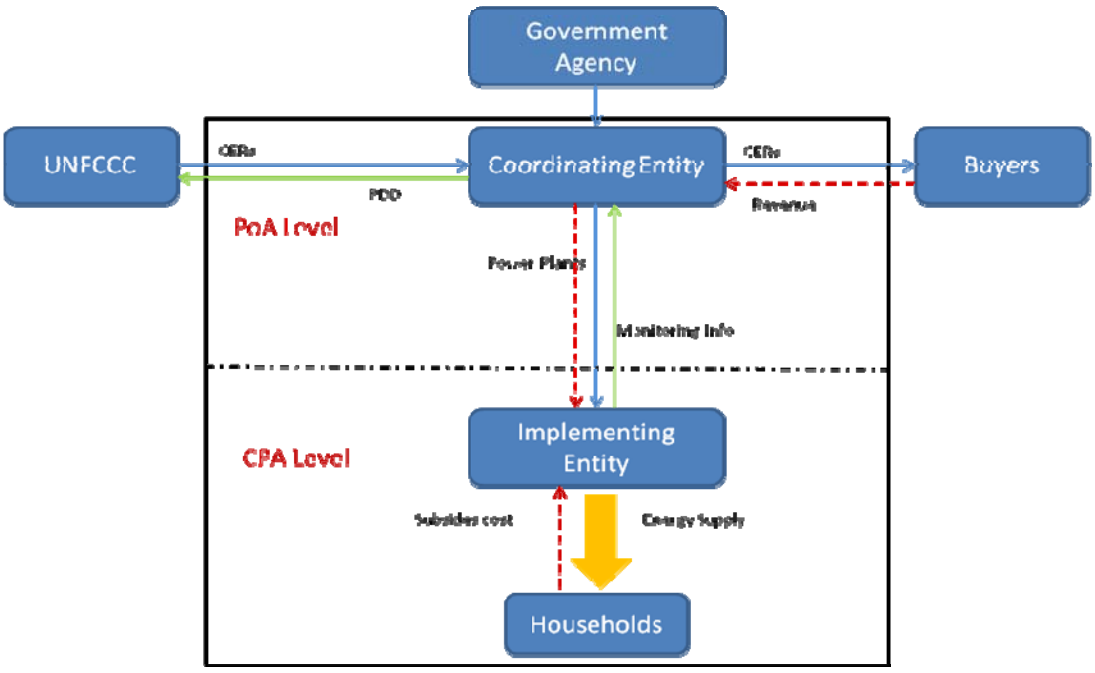
Managing entity may include corporate and NGOs willing to adopt a village. The managing entity should submit a detailed plan which includes the criteria for selection of the technologies chosen for rural electrification and a comparison of the cost of electricity from each of the feasible options. Detailed justification of unfeasibility of avoided options may also be enclosed. The criteria for selection of renewable energy resource shall include the criteria indicated earlier in

this chapter. Managing entity should also facilitate installation of power plants based on small hydro power, biomass, wind, biogas and solar photovoltaic. Managing entity should provide for institution development and capacity building, development of repair and maintenance infrastructure and make the implementing agency self sufficient. In the long run, managing entity would spearhead the monitoring and evaluation of individual projects or the programme as a whole, including technical, operational and socio-economic aspects, user feedback, impact assessment and, development of management information systems for proper coordination and monitoring.

***Implementing Agency***

After installation, it would be the responsibility of the implementing agencies to ensure functionality of the systems and periodic monitoring may be carried out by the implementing agency. The district/village level agencies like Village Energy Security Committee and Panchayat should be closely associated in planning, implementation and monitoring of all projects. The implementing entity would be required to train people and delegate staff for maintenance of the plants. The entity would also provide monitoring system to the households.

**Figure 10.2: Framework for the implementation of renewable energy PoA for VEP**



***Case study of a CPA aided VEP***

This section discusses a case study of CPA aided VEP in India. The case study will delineate in detail following steps for the effective implementation of the same. The project activity analyzed for this case study is solar photovoltaic system

***a. Site selection***

The case study involves the use of solar photovoltaic system for VEP. India has only one registered solar related CDM project. The region in India which is most suitable for this technology to be implemented is Rajasthan. Discussed in this section is solar PV electrification process for a village in Rajasthan with 1000 households (Assumption). The advantages of considering Rajasthan are the following:

- Best solar insolation in India (Conservative Daily Average of 5.0 kWh/$m^2$)
- Maximum number of sunny days
- Rajasthan has more than 175000 sq km of desert land
- Total potential for Rajasthan = 875,000 MW

***b. Identification of stakeholders***

As with all DDG mechanism, the stakeholders for the project activity will not only involve government agencies, managing entity and implementing agency, but also local people. The local community would be a part of decision making, management, implementation, operation and maintenance of the projects. The above framework would help in identification of stakeholders at the all steps of project activity.

***c. Identification of technologies with mutual consent of stakeholders***

The technology which could be implemented for a specific region is very much dependent on scientific analysis of the region and feasibility modeling for the implementation of the same. The technology to be implemented has to be further deliberated with the local stakeholders such as district administration; local community for traditional knowledge as in the case of biomass projects and their mutual consent is prerequisite as this mechanism is a payback scheme. Once a technology is decided as in the case of Rajasthan solar photovoltaic scheme, house hold surveys and implementation process have to be convened. The solar photovoltaic system requires in addition to the solar modules, battery, inverter and charge controller.

***d. House hold surveys***

The house hold survey is an integral part of any technology implementation for rural electrification. A household survey may include survey on demand for electricity, average load per house, ability to pay and other valuable information to determine the financial estimates of the projects and the scale of the power plant required. In this section the target laid down by the National Electricity Policy, 2005 for electricity provision of a minimum of a lifeline consumption of 1 kWh of electricity/ household/ day is used as a bench mark.

***e. Identification of technology suppliers and implementation***

The success of solar power plants depend on the technology selection, hence a detailed proposal would be needed which has to be scrutinized thoroughly by the government agency before approving the same. The solar photovoltaic technology has vastly improved from a defined design and module to consumer specific module. The technology is improving by the day and innovations galore by prominent suppliers to stay on top bracket in the market. In India, the most recent technology developments include building integrated photovoltaic which shall be integrated in corporate buildings, crystalline silicon solar cells with versatility in applications and suited for

residential, commercial and industrial purposes. Such consumer specific modules are now possible with advancing technology. Hence for large scale implementation of solar photovoltaic projects for VEP, technology would be supplied depending on the requirements of the region.

The framework discussed above below discusses the entity responsible shall be used for effective implementation of solar based technologies in Rajasthan. Implementation of the project should be entrusted with the coordinating entity and local stakeholders (Implementing entity). Since sound knowledge of technology is required for implementation incase of solar projects coordinating entity such as corporate, technology suppliers themselves shall be required to act as implementing entities as well. The coordinating entity and local stakeholders may be required shall be required for successful implementation, monitoring, operation and maintenance of the project activity.

**Conclusion**

The village electrification programme is paramount for the development of India. Village electrification through renewable energy technologies would serve as a sustainable development mechanism which a global requirement is considering the effect of fossil fuel on climatic patterns. The major hurdles for the implementation of RE technologies in rural India are the non availability of sufficient finance for the projects and lack of technology expertise. The government's vision to implement VEP scheme in remote parts of the country to provide electricity for all households in India by 2010 is commendable. However, the costs incurred for the same are monumental and would hinder the effective implementation of the programme. The CDM PoA based VEP, if implemented would not only provide a solid structure for the implementation of the programme but also as evidenced in the case study would help offsets the costs for the entire programme. From a sustainability viewpoint, the RE technologies based VEP would also result in the emission reductions from fossil fuel based power plants. The CDM PoA aided RE energy projects for VEP would thus be a blessing for the sustainable development of Indian villages.

**CLEAN DEVELOPMENT MECHANISM**
**SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM**
**(CDM-SSC-PoA-DD) Version 01**

**CONTENTS**



NOTE:

(i) This form is for the submission of a CDM PoA whose CPAs apply a small scale approved methodology.

(ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using a real case).

## SECTION A. General description of small-scale programme of activities (PoA)

### A.1 Title of the small-scale programme of activities (PoA):

Title: **Installation of Biomass Gasifier systems in Small Industries.**
Version: 1.0
Date: DD/MM/YYYY (date of PDD completion will be put here)

This document is Annex I to the MNRE study- *Developing a framework for Programmatic CDM projects in renewable energy area.* This is a model PoA DD and is not intended to be used as a PoA DD for submission to a DOE for validation or to a DNA for host country approval. Underlined text represents guidance on relevant sections.

### A.2. Description of the small-scale programme of activities (PoA):

The following information is included in this section:

1. General operating and implementing framework of PoA
2. Policy/measure or stated goal of the PoA
3. Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity.

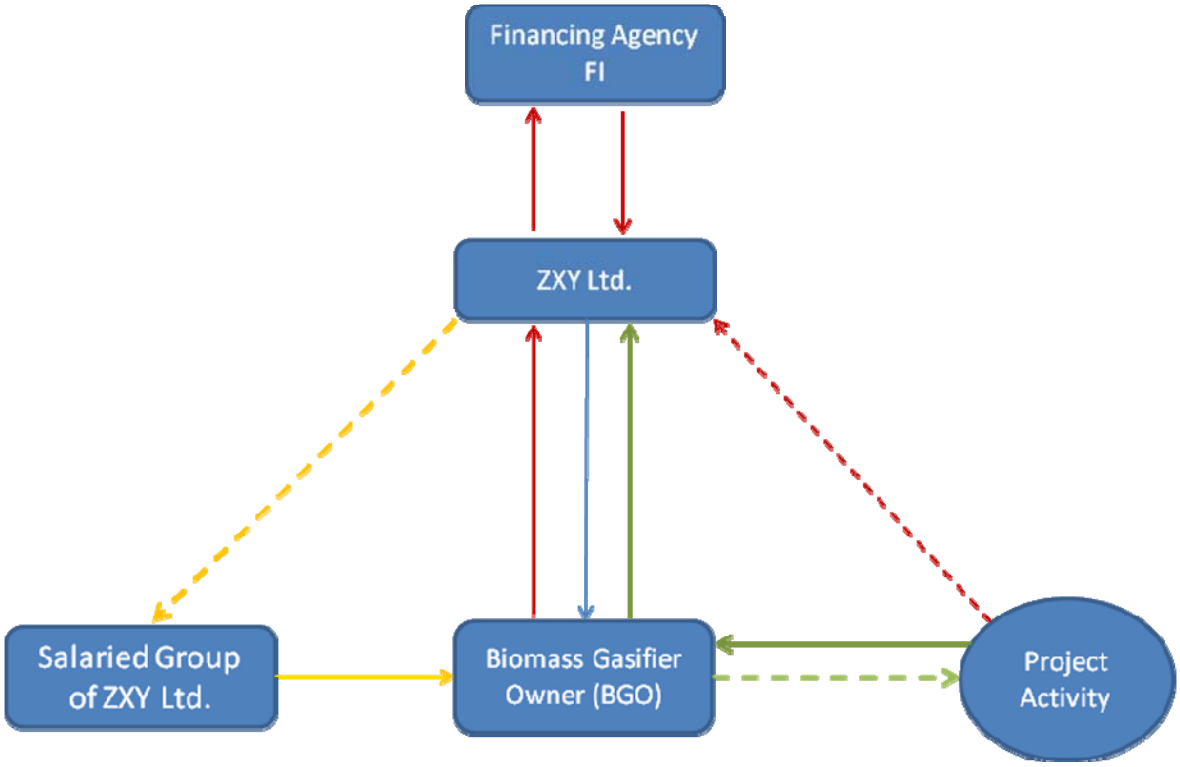
**General operating and implementing framework of PoA**

Proposed biomass Gasifier programme is being implemented through ZXY Ltd. (hereafter referred as the coordinating/ managing entity, ZXY). ZXY provides the technology and selects project areas, potential customers, installs the systems and provides maintenance support.

Three parties *i.e.*, ***i. ZXY Ltd.(ZXY) ii. Biomass gasifier owner (BGO) iii. Financing Agency (FI)*** will be involved in implementation and operation of proposed project activity. A schematic flow diagram of operating and implementing framework of the project is given below.

**Activities:**

- Financial Flows. Loan from FI to ZXY on behalf of BGO, Loan Repayment, BGO invests the money to implement the project activity as part payment from BGO to ZXY
- ZXY provides technology to BGO
- ZXY appoints a training and implementation group to support the CPA
- ZXY provides training and implementation through a salaried group
- BGO provides operation, maintenance and monitoring
- Monitoring information
- CER revenue




ZXY would be responsible for implementation and operation of the proposed Programme of Activities. ZXY will provide financial (up to 30% of the total project cost) and technical support for implementation of the activity. The financing agency will finance ZXY to implement the project activity. ZXY will borrow the money on behalf of BGO and loans the technology to the BGO until the loan is paid off. Remaining cost (up to 70% of project cost) will directly paid by the BGO. ZXY will facilitate training and implementation of the activity through a salaried group. BGO will facilitate operation and maintenance of the gasifiers and the monitoring of the data to be monitored for emission reduction calculation. The BGO would either facilitate the operation & maintenance themselves through their own staff or contract it out to ZXY. The CER will be issued in the name of ZXY. ZXY will allocate some portion of the total CDM revenue for operation and maintenance cost and rest for loan repayment. When the capital will be recovered, the financing agency will wind up its involvement and the benefits from CERs will be shared as per the agreement signed between ZXY and BGO and the ownership of the technology is formally transferred to BGO.

### Policy/measure or stated goal of the PoA

The program is launched in small and medium enterprises. The power generation in the project would be used to meet the captive demand of power in these units. The expected result from the PoA is significant reduction of greenhouse gases (GHGs) by avoiding use of fossil fuel for generation of electrical energy in these units, leading to the better environmental conditions and local livelihood.

**Confirmation on voluntary action:**
The coordinating agency, ZXY would be responsible for implementation and monitoring of the PoA. This is a voluntary action from ZXY. There are no laws/ policies in the country enforcing the installation of biomass Gasifier for industrial application.

## A.3. Coordinating/managing entity and participants of SSC-POA:

The following information needs to be included in this section:

1. Coordinating or managing entity of the PoA as the entity which communicates with the Board
2. Project participants being registered in relation to the PoA. Project participants may or may not be involved in one of the CPAs related to the PoA.

The coordinating entity for this PoA is ZXY Ltd., located at Delhi Road, Gurgaon, Haryana, India.

The party involved in the proposed PoA is given in following table.

| Name of Party involved (*) ((host) indicates a host Party) | Private and/or public entity(ies) Project participants (*) (as applicable) | Does the party involved want to be considered as project participant? (Yes/No) |
|---|---|---|
| India (Host party) | ZXY Ltd. (Private entity) | No |
| (*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required. | | |

## A.4. Technical description of the small-scale programme of activities:

### A.4.1. Location of the programme of activities:

#### A.4.1.1. Host Party(ies):

India

#### A.4.1.2. Physical/ Geographical boundary:

Definition of the boundary for the PoA in terms of a geographical area (*e.g.* municipality, region within a country, country or several countries) within which all small-scale CDM programme activities (SSC-CPAs) included in the PoA will be implemented, taking into consideration the requirement that all applicable national and/or sectoral policies and regulations of each host country within that chosen boundary.

The boundary of a PoA is defined as the geographical area within which all the small scale CDM programme activities (SSC- CPAs) included in the PoA will be implemented. The proposed activity in PoA will be implemented in India. Therefore the boundary of the PoA is defined as India.


**Figure 0-1: Geographical boundary of the proposed PoA**

## A.4.2. Description of a typical small-scale CDM programme activity (CPA):

### A.4.2.1. Technology or measures to be employed by the SSC-CPA:

The project comprises installation of biomass gasifier based power generation units in the capacity range of 50-1500kW$_e$. The main raw materials (biomass) used are fuel Wood, Agriculture Stalk , Coconut Shell, Briquettes of several residues, Mustard Stalk, Cashew Nut Shells, Lantana and other agricultural residues which are renewable biomass, available in surplus in the project region. Biomass is fed into the Gasifier system for producing Producer Gas. Producer gas is combusted in the engine to generate electricity.

The power generation through biomass gasifier system has been shown schematically in the figure below. Basic steps involved in power generation are as follows:

1. Gasification
2. Gas cooling and cleaning
3. Power generation

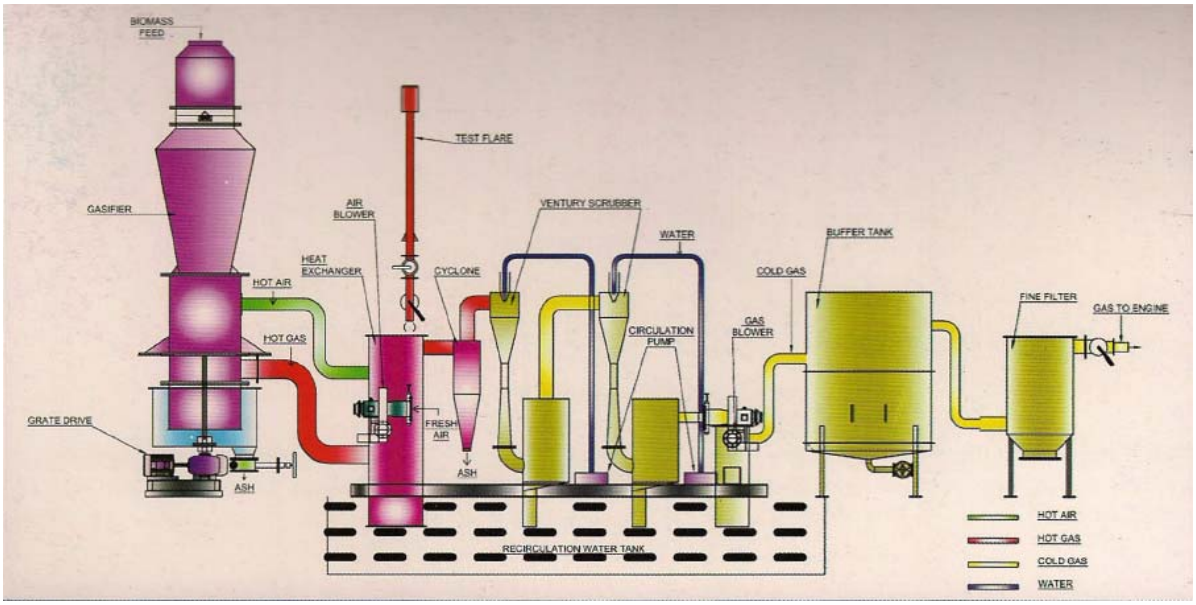



**Figure 0-2: Flowchart of Biomass gasifier based power generation** *(Courtsy: ZXYL)*

1. **Biomass gasification:** Biomass gasification is basically conversion of solid fuels (*i.e.* wood/wood waste, agricultural residues etc.) into combustible gas mixture normally called "Producer gas", typically contains carbon monoxide (20% - 22%), hydrogen (12% - 15%), nitrogen (50% - 54%), carbon dioxide (9% - 11%) and methane (2% - 3%). The producer gas has low calorific value, ranging from 1000 to 1100 kcal/$Nm^3$.

   The gasifier is essentially a chemical reactor where various complex physical and chemical processes take place. Biomass gets dried, heated, pyrolysed, partially oxidised and reduced in this reactor as it owes through it. Four distinct processes take place in a gasifier: drying of the fuel, pyrolysis, combustion and reduction. Although there is a considerable overlap, each process can be considered to be occupying a separate zone in which fundamentally different chemical and thermal reaction takes place. The fuel must pass through all of these zones to be completely converted. On the basis of the flow direction of air/gas vis-à-vis biomass in a gasification reactor, the gasifiers are classified as updraught, downdraught and cross-draught gasifiers. In all these gasifiers, biomass flows downwards by gravity. If the flow of air and gas is upwards, resulting in a counter-flow configuration, it is an updraught gasifier. If the air/gas flow is also downwards, resulting in a co-current configuration, it is a downdraught gasifier. In a cross-draught gasifier, the air/gas flow is horizontal, perpendicular to the flow direction of biomass. Gasifiers are also classified based upon the bed in use. Types of beds in vogue are fixed, fluidized and entrained bed. The gasifier that would be used in this project activity is fixed/fluidized bed downdraft gasifier. The chemical processes taking place in a downdraft gasifier can be assumed to occur in four zones.

   a. Drying zone: Temperature in this zone is around $150^0$C, moisture in the solid fuel is removed, no chemical break takes place.

b. Pyrolysis zone: Thermal breakdown of fuel takes place in absence of air, resulting in the formation of methanol, acetic acid an heavy hydrocarbons including tar. The temperature in this zone is around $400^0$C. In addition to pyrolysis vapours, carbon in the form of char is the output of this zone.

c. Combustion zone: The temperature is in the range of 900 to $1300^0$C. The outer layer of char burns to provide heat and products of combustion for further reactions. The orgsnic vspours and tar formed in the pyro;ysis zone are forced to pass through a narrow area (throat) to crack them. The principal reactions that take place are:

$$CO_2 + C \rightarrow 2CO - 172,600\ KJ$$
$$CO_2 + H_2 \rightarrow CO + H_2O + 41,200\ KJ$$
$$C + 2H_2 \rightarrow CH_4 + 75,000\ KJ$$

d. Reduction zone: The products of oxidation zone then pass through the reduction zone. Reduction zone is packed with a bed of charcoal. This charcoal is initially supplied from external sources. Later it is in the continuous process of being consumed by the reduction reaction and being simultaneously replenished by the char produced in the pyrolysis zone .The temperature in this zone is maintained at 900 – 600° C.

2. **Gas cooling and cleaning system**: The gas coming out from the gasifier is hot (250 – $500^0$C) and contains some contaminants which need to be cooled and cleaned before feeding into the engine. The cooling-cleaning system consists of scrubbers and filters. The contaminants are washed off with water in the scrubbers and finally filtered.

3. **Power generation**: After cooling and cleaning, the gas is fed into the gas engine to generate power. To produce power with gasifiers, there are two routes available:
   a. Dual fuel application: In this system diesel generation sets are used. Producer gas is fed to D.G. sets which replaces upto 60 – 70% of the diesel consumption.
   b. 100% producer gas application: In this system spark ignition engines are used and the engines are run on 100% producer gas.

**A.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:**

In this section, only a description of criteria for enrolling the CPA is given.

The following criteria will be followed for inclusion of a SSC – CPA in the PoA.

1. All biomass gasification based power generation projects that displace electricity from anelectricity distribution system.
2. The project is implemented in an industrial unit under SME.
3. All gasifier units under a CPA are implemented either by the coordinating/ managing entity or affiliated companies or by companies appointed by the coordinating/ managing entity acting in the name of the coordinating/ managing entity.

4. All gasifier units under a CPA have monitoring equipments installed and access for monitoring is granted to the coordinating/ managing entity or affiliated companies or by companies appointed by the coordinating/ managing entity acting in the name of the coordinating/ managing entity.
5. All biomass gasifier owner has signed an agreement, specifying CERs ownership with the coordinating/ managing entity or affiliated companies or by companies appointed by the coordinating/ managing entity acting in the name of the coordinating/ managing entity.
6. The proposed CPA must be within the country of India.
7. Biomass used in the Gasifier is renewable and surplus.

**A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):**

The following information is demonstrated here:

(i) The proposed PoA is a voluntary coordinated action;
(ii) If the PoA is implementing a voluntary coordinated action, it would not be implemented in the absence of the PoA;
(iii) If the PoA is implementing a mandatory policy/regulation, this would/is not enforced;
(iv) If mandatory a policy/regulation is enforced, the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.

The information presented here shall constitute the demonstration of additionality of the PoA as a whole.

The proposed PoA is not mandated by any union or state low and is a voluntary coordinated action by ZXY Limited. The action would not be implemented in the absence of the PoA. Infact, the gasification technology is a novel concept in India, which requires high investment and faces various barriers in its successful operation.

Additionality will be demonstrated based on the Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities. The information presented here constitutes the demonstration of additionality of the PoA as a whole.

The project activity would not have occurred anyway due to at least one of the following barriers:

***Investment barrier***

The main objective of the overall Gasifier program in small industries is to commercialize the biomass gasification technology across the country. However, so far biomass gasification technology remains a non commercial activity in India given the high upfront investment cost and technical constraint. The total investment includes land cost; cost of civil works; cost of gasifier, cleaning and cooling system, gas engine etc. The investment in biomass gasification project is risky due to the reasons given below:

- High system cost

- gasification is a recently rediscovered technology and most of the development is still on learning curve.

High system costs are driven by high capital costs and high costs of transportation in supplying the technology from manufacturing to user site. Difficulties in capital access for users hinder adoption. The economic viability for power applications may improve with a shift from dual-fuel to 100%- producer-gas-based systems but there are high costs associated with development of these systems related to engine redesign and modification, and derating in engine capacities that effectively increases costs.

SMEs often perceive high risks – technological and financial—for biomass gasification projects. The former is related to uncertainties in gasifier and/or system performance while the latter is related to uncertainties in the recovery of investment. Project failure due to these uncertainities would lead to disrupt the main activity of the project developer which would affect the production and quality of the products.

***Technological barrier***

The biomass gasifiers have suffered from technical problems like:

- Extreme engine wear due to strong tar contamination of the gas,
- Unreliable and unstable operation due to slagging conditions in the reactor,
- Undefined gas composition and unreliable operation due to variations in pressure drop over the reactor.

The main reason for those problems is the occurrence of large variations in the key parameters determining the quality of the biomass fuel.

**Biomass quality and impacts on gasification process[90]:**

The performance of a biomass Gasifier depends on various properties of biomass. The most important properties relating to biomass gasification are:

- moisture content;
- ash content;
- dust content;
- bulk density and morphology;
- tar content.

***Moisture content[91]:*** It is desirable to use fuel with low moisture content in gasifier because heat loss due to its evaporation before gasification is considerable and the heat budget of the gasification reaction is impaired. For example, for fuel at 25$^{0}$C and raw gas exit temperature from gasifier at 300$^{0}$C, 2875 KJ/kg moisture must be supplied by fuel to heat and evaporate moisture. Besides impairing the gasifier heat

[90] H.E.M. Stassen and H.A.M. Knoef, "Small Scale gasification system".

[91] Rajvanshi, A.K., "Biomass Gasification", Published as a chapter in book Alternative Energy in Agriculture, Vol. II (Ed. D.Yogi Goswami), CRC Press, 1986

budget, high moisture content also puts load on cooling and filtering equipment by increasing the pressure drop across these units because of condensing liquid. Generally desirable moisture content for fuel should be less than 20%. Thus in order to reduce the moisture content of fuel some pretreatment of fuel is required. In practice natural drying (i.e. on field) is cheap but requires long drying times. Artificial drying is more expensive but also more effective.

***Ash content:***
The amount of ash between different types of feedstocks differs widely (0.1% for wood up to 15% for some agricultural products) and influences the design of the reactor, particularly the ash removal system. The ash content of a fuel and the ash composition has a major impact on trouble free operation of gasifier. Ash melting can cause slagging and channel formation in the reactor. Ash basically interferes with gasification process in two ways:

1. It fuses together to form slag and this clinker stops or inhibits the downward flow of biomass feed.
2. Even if it does not fuse together it shelters the points in fuel where ignition is initiated and thus lowers the fuel's reaction response.

***Dust content[92]:*** The biomass fuels produce dust inside the gasifier. This dust is a nuisance since it can clog the internal combustion engine and hence has to be removed. The gasifier design should be such that it should not produce more than 2-6 $g/m^3$ of dust. The higher the dust produced, more load is put on filters necessitating their frequent flushing and increased maintenance.

***Bulk density and morphology[93]:*** Bulk density of biomass feedstock determines the energy density of it. Biomass of low bulk density is expensive to handle, transport and store. Apart from handling and storing behaviour, the bulk density is important for the performance of the biomass as a fuel inside the reactor: a high void age tends to result in channelling, bridging, incomplete conversion and a decrease in the capacity of the gasifier.

***Tar content[94]:*** The amount of volatiles presence in feedstock has a major impact on the tar production levels in gasifiers. Tar is one of the most unpleasant constituents of the gas as it tends to deposit in the carburettor and intake valves causing sticking and troublesome operations. It is a product of highly irreversible process taking place in the pyrolysis zone. Therefore major effort has to be given on cleaning this tar by filters and coolers. A well-designed gasifier should put out less than 1 $g/m^3$ of tar.

[92] Rajvanshi, A.K., "Biomass Gasification", Published as a chapter in book Alternative Energy in Agriculture, Vol. II (Ed. D.Yogi Goswami), CRC Press, 1986

[93] Rajvanshi, A.K., "Biomass Gasification", Published as a chapter in book Alternative Energy in Agriculture, Vol. II (Ed. D.Yogi Goswami), CRC Press, 1986

[94] H.E.M. Stassen and H.A.M. Knoef, "Small Scale gasification system".

**Long start up time[95]:** Relatively long time (10-20 minutes) is required to start up of IC engines.

**Low equipment Performance, reliability and quality[96]:**
A number of performance aspects of gasifier power plants are much below manufacturers' specifications. Specifically maximum engine power output and diesel fuel savings (in dual-fuel systems) of some plants are much lower than could be expected from the manufacturer's information.
Because of the prototypical character of the biomass gasifier, technical and operational problems were to be expected, especially because the performance of power gasifiers appears to be sensitive to relatively small changes in fuel and energy demand related parameters.

**Operating Personnel[97]:**
Properly operating a biomass gasification system requires training and experience. The labour required for operating a gasification plant is quite different from such required for running of an equivalent diesel engine. Motivation and discipline are necessary, but the operator must also be able to react adequately on two or three input parameters as well as have some basic technical skills. Achieving this appears to require not only an adequate initial training programme but also continuous technical back-up for a prolonged period of at least one year.

## A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):

### A.4.4.1. Operational and management plan:

Description of the operational and management arrangements established by the coordinating/managing entity for the implementation of the PoA, including:

(i) A record keeping system for each CPA under the PoA,
(ii) A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA,
(iii) The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.
(iv) The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA;

[95] Rajvanshi, A.K., "Biomass Gasification", Published as a chapter in book Alternative Energy in Agriculture, Vol. II (Ed. D.Yogi Goswami), CRC Press, 1986

[96] Debyani Ghosh, Ambuj Sagar, V. V. N. Kishore, "Scaling up biomass gasifier use: Application, berriers and interventaions". Handbook of biomass downdraft gasifier engine syatems by Solar Energy Research Institute, USA

[97] Debyani Ghosh, Ambuj Sagar, V. V. N. Kishore, "Scaling up biomass gasifier use: Application, berriers and interventaions". Handbook of biomass downdraft gasifier engine syatems by Solar Energy Research Institute, USA

The following arrangements will be made by the coordinating/ managing agency to ensure a reliable operation and management of PoA;

***1. A record keeping system for each CPA under PoA:***

A record keeping system will be set by the coordinating /managing agency. It will include the following information;

1. Number of Biomass gasifiers.
2. Identification number.
3. Technical specification of the gasifier including capacities etc.
4. Information on subscription of the CPA to the PoA.
5. Location of the project activity.
6. Ownership of Biomass Gasifier.
7. Contact details.
8. Commissioning date.

***2. A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA:***

A system/ procedure will be put in place to avoid double accounting i.e., to avoid the case of including a new CPA that has already been registered either as a CDM project or a CPA of another PoA. The procedure will also ensure that one installation should not be added to more than one CPA.

***3. The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity:***

As per the EB guidelines on de-bundling for SSC projects, SSC CPA included in the PoA is not a de bundled component of another CDM programme activity or CDM project activity.

There is no other registered small scale PoA, nor an application to register another small scale CPA of a PoA or another CDM registered project activity which:

a. has the coordinating/ managing entity as activity implementer, and the coordinating/ managing entity does not manage a large scale PoA of same sectoral scope.
b. The boundary s 1 KM of the proposed small scale CPA, at the closet point.

***4. The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA;***

All Biomass gasifier owners involved in SSC-CPA of PoA are aware and have agreed that their units will be the part of SSC CPA through legal agreements/ contracts between BGO and ZXY that will be put in place before the specific CPA is added to the PoA.

**A.4.4.2. Monitoring plan:**

The following information shall be provided here:

(i) Description of the proposed statistically sound sampling method/procedure to be used by DOEs for verification of the amount of reductions of anthropogenic emissions by sources or removals by sinks of greenhouse gases achieved by CPAs under the PoA.

(ii) In case the coordinating/managing entity opts for a verification method that does not use sampling but verifies each CPA (whether in groups or not, with different or identical verification periods) a transparent system is to be defined and described that ensures that no double accounting occurs and that the status of verification can be determined anytime for each CPA;

Monitoring will be carried out per CPA DD. For each CPA, all parameters included in section E.7.1 will be monitored by the BGO of the CPA according to the procedures established in E.7.2 and will be submitted to the managing entity. The managing entity will store the data in Log books. Primary data will be stored by the BGO. Verification will occur either separately for each CPA or in groups. In any case data shall be verified per CPA and the verification status of each CPA will be recorded by the managing entity in the database.

### A.4.5. Public funding of the programme of activities (PoA):

No Public funding (ODA and/ or Annex I countries) for the project activity.

## SECTION B. Duration of the programme of activities (PoA)

### B.1. Starting date of the programme of activities (PoA):

Date of publication of the News paper Advertisement inviting small industries to operate as CPA implementer.

### B.2. Length of the programme of activities (PoA):

28 years

**SECTION C. Environmental Analysis**

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**C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:**

1. Environmental Analysis is done at PoA level √
2. Environmental Analysis is done at SSC-CPA level ×

As per the Schedule 1 of Ministry of Environment and Forests (MoEF - Government of India) notification dated September 14,2006, - 39 activities are required to undertake environmental impact assessment studies[98]. This project activity does not fall under the specified categories therefore Environment Impact Assessment is not required for the project activity.

**C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

The project activity involves the use of renewable biomass as fuel for energy generation and displacement of fossil fuels. There is no adverse impact by the project activity on air, water and soil. It has only positive impacts in terms of GHG emission reduction.

**C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA),:**

As mentioned earlier, according to Indian regulation, the implementation of Biomass based energy generation project does not require an Environmental Impact Assessment (EIA). As per the Ministry of Environment and Forests (MoEF), Government of India notification dated September 14th, 2006 regarding the requirement of EIA studies as per the Environment Protection Rule, 1986 (MoEF, 2002), EIA is not required for this project activity.

**SECTION D. Stakeholders' comments**

>>

**D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:**

[98] Environmental Impact Assessment Notification – 2006(14/9/06) Published in the Gazette of India, Extraordinary, Part-II, and Section 3, Sub-section (ii), Ministry of Environment and Forest, Government of India.

http://moef.nic.in/divisions/iass/envclr.html

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at SSC-CPA level ☐

If local stakeholder comments are invited at the PoA level, include information on how comments by local stakeholders were invited, a summary of the comments received and how due account was taken of any comments received, as applicable.

Stakeholder consultation for the project activity is conducted to account for the views of the people impacted either directly or indirectly due to the project activity. This is carried out at two levels:

1. At PoA level
2. At CPA level

The stakeholders include under this programme of activities–

A. District Magistrate
B. Local gram panchayat
C. Local community
D. Villagers

**Stakeholder Consultation at PoA level:** An advertisement will be published to inform regarding the project activity. The newspaper advertisement describes in brief about the project activity, the benefits associated with the project activity and ask for the views from local people.

**Stakeholder Consultation at CPA level:** The following procedure should be adopted to complete the process at CPA level.

***Meeting with local community, Villagers and Gram Panchayat:*** Meeting will be organized with the local people, villagers and Gram Panchayat before starting a new program or scaling up an existing program. CPW staff will also visit the project site to get feedback. Feedback will be discussed during the meeting and incorporated into the programs.

***Meeting with District authority:*** A letter will be sent to district authority about the details of the project activity and request for their suggestions and/or a meeting will be organized with the district authority.

| **D.2. Brief description how comments by local stakeholders have been invited and compiled:** |
|---|

An advertisement will be published to inform local people regarding the project activity. The newspaper advertisement describes in brief about the project activity, the benefits associated with the project activity and ask for the views from local people.

| **D.3. Summary of the comments received:** |
|---|

Summary of comments shall be included here.

| **D.4. Report on how due account was taken of any comments received:** |
|---|

Actions/plans to be included here based on local stakeholders' commnets.

## SECTION E. Application of a baseline and monitoring methodology

This section shall demonstrate the application of the baseline and monitoring methodology to a typical SSC-CPA. The information defines the PoA specific elements that shall be included in preparing the PoA specific form used to define and include a SSC-CPA in this PoA (PoA specific CDM-SSC-CPA-DD).

### E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:

The approved SSC baseline and monitoring methodology should be approved for use in a PoA by the CDM Executive Board.

The following approved methodology is applied:

*AMS I D* ***"Grid connected renewable electricity generation",*** *Version 13****,*** *Sectoral Scope 01, EB-36, Dated 14th December2007.*

***Reference:***
The list of the small-scale CDM project activity categories contained in Appendix B of the simplified M&P for small-scale CDM project activities[99].

### E.2. Justification of the choice of the methodology and why it is applicable to a SSC-CPA:

In the case of CPAs which individually do not exceed the SSC threshold, SSC methodologies may be used once they have first been reviewed and, as needed, revised to account for leakage in the context of a SSC-CPA.

The position of the CDM project activity vis-à-vis applicability conditions in the AMS-I.D is described in the following table.

| Applicability Conditions | Position of the project activity vis-à-vis applicability conditions |
|---|---|
| This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or | The project activity comprises biomass gasifier based renewable energy generation system that displaces electricity from an |

[99] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_PHPV5WESACMBTJ2YY54GAJYSIEI3HD

| | |
|---|---|
| displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit. | electricity distribution system. |
| If the unit added has both renewable and non renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW. | In each CPA of the proposed PoA, the generation capacity would be less than 15MW. |
| Combined heat and power (co-generation) systems are not eligible under this category. | The project activity does not involve the combined generation of heat and power. |
| In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units. | The project activity is not the addition of renewable energy generation units at an existing renewable energy facility. |
| Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW. | The project activity is not the retrofitting or modification of an existing facility. |

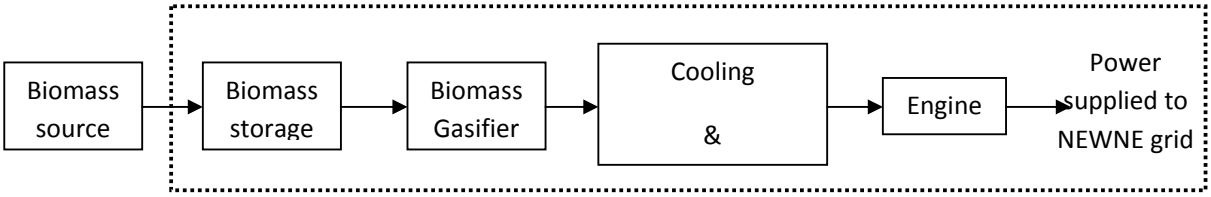
The following conditions apply for use of methodology AMS I D in a project activity under a programme of activities:

| **Applicability Conditions** | **Position of the project activity vis-à-vis applicability conditions** |
|---|---|
| In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues only or biomass from dedicated plantations complying with the applicability conditions of AM0042. | Biomass residue and biomass from dedicated plantation will be used in the project activity. |
| In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of appendix B) or following the prescriptions included in the leakage section of AM0042 as in annex 1 of this document. | Determination of leakage will be done following the general guidance for leakage. |
| In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the | The project activity does not involve the replacement of equipment. |

| | |
|---|---|
| number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified. | |

## E.3. Description of the sources and gases included in the SSC-CPA boundary

The project boundary encompasses the physical, geographical site of the gasification plant including auxiliary electricity use of the plant. The flow chart of the project and its boundaries is shown in the figure below.




The emission sources and gases included in the project boundary for the determination of both baseline and project emissions are presented as follows:

| Emissions | Source | Gas | Included? | Justification/ explanation |
|---|---|---|---|---|
| **Baseline** | Electricity generation, grid | $CO_2$ | Included | Main emission source |
| | | $CH_4$ | Excluded | Miner emission source. Excluded for simplification. Conservative. |
| | | $N_2O$ | Excluded | Miner emission source. Excluded for simplification. Conservative. |
| **Project Activity** | Supplemental fossil fuel consumption at the project plant | $CO_2$ | Included | Main emission source. |
| | | $CH_4$ | Excluded | Miner emission source. Excluded for simplification. |
| | | $N_2O$ | Excluded | Miner emission source. Excluded for simplification. |
| | Supplemental electricity consumption. | $CO_2$ | Included | Main emission source |
| | | $CH_4$ | Excluded | Miner emission source. Excluded for simplification. |
| | | $N_2O$ | Excluded | Miner emission source. Excluded for simplification. |

**E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

Approved methodology AMS ID has been applied to the project activity as it meets applicability criteria outlined in the methodology. Following paragraphs demonstrate selection of baseline scenario out of the various alternatives available to the project proponent.

**Identification of alternative baseline scenarios:**
The methodology as applied to the project activity involves the identification of baseline scenario from various alternatives available. The possible alternative scenarios available to the project proponent are as follows:

1. Electricity is imported from the grid;
2. Electricity is produced in an onsite DG set;
3. Electricity is produced using biomass in gasifiers without CDM benefits.

***Alternative 1: Electricity is imported from the grid:***
It considers import of electricity from grid in the absence of project. Since the grid connection facility is available nearby the project site, BGO would most likely import grid power. This is a feasible option and is considered as an alternative of baseline scenario.

***Alternative 2: Electricity is produced in an onsite DG set:***
Electricity is produced in the onsite DG sets. However, electricity generation through DG sets is much costlier as compared to electricity import from the grid as shown in table below and hence is economically unattractive. Thus this option is not considered as possible baseline alternatives.

**Table-1**

| | |
|---|---|
| Diesel price | 34.86 Rs./L[100] |
| Electrical energy produced in DG sets per quantity of Diesel used (Kwh/L) | 3.2KWh/L |
| **Cost of Power Generation by DG Sets** | **Rs. 10.89/kWh** |
| **Cost of Power imported from grid** | **Rs. 3.5/kWh** |

***Alternative 3: Electricity is produced using biomass in gasifiers without CDM benefits:***
This alternative faces many barriers (refer section E.5.1 of this document) and hence cannot be a plausible baseline option for energy generation for the project proponent.

Hence it can be concluded that Alternative 1 would have been the choice for power generation for the project proponent over other alternatives. Thus the most plausible baseline scenario for this project activity is the ***Alternative 1: Electricity is imported from grid.***

[100] http://www.iocl.com/products/HighSpeedDiesel.aspx

| **E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA): >>** |
|---|

| **E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:** |
|---|

Here the PPs shall demonstrate, using the procedure provided in the baseline and monitoring methodology applied, additionality of a typical CPA.

The investment barrier identified in section A.4.3 will be fully applied to each and any typical CPA. The following checklist will be applied to assess additionality of a typical CPA.

| Parameters | Details | purpose |
|---|---|---|
| Investment barrier | Total project cost including cost of transportation | These factors would be used for establishing additionality of the typical CPA. |
| | Financial model | |
| | Government incentives, supports | |
| | Biomass price change trend | |
| | Operation and maintenance cost | |
| | Difficulties encountered in financing | |
| **E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:** | | |

Here the PPs shall provide the key criteria for assessing additionality of a CPA when proposed to be included in the registered PoA. The criteria shall be based on additionality assessment undertaken in E.5.1 above. The project participants shall justify the choice of criteria based on analysis in above section.
It shall be demonstrated how these criteria would be applied to assess the additionality of a typical CPA at the time of inclusion.

NOTE: Information provided here shall be incorporated into the PoA specific CDM-SSC-CPA-DD that shall be included in documentation submitted by project participants at registration of PoA.

The barriers identified in section E.5.1 (A.4.3) is *Investment barrier.*
To prove the existence of the investment barrier the following criterion shall be applied to assess the additionality of a CPA:

- An explanation of the financing mechanisms available to BGOs and the role of the CDM, and
- Demonstration that CDM revenues (whole or in part) play a role in helping to expand the program.

**E.6. Estimation of Emission reductions of a CPA:**

**E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:**

As per AMS 1.D./Version 13 (December 14, 2007) the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg $CO_2$e/kWh) calculated in a transparent and conservative manner as:

a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.

OR

b) The weighted average emissions (in kg $CO_2$e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source and made publicly available where-

**Calculation of Simple Operating Margin ($EF_{OM,y}$):** Simple OM is applicable as low-cost / must run resources constitute less than 50% of total generation.

$$EF_{OM\,y} = \frac{\sum_{i,j} F_{i,j,y} \,.\, COEF_{i,j}}{\sum Gen_{j,y}}$$

The Operating Margin emission factor is calculated with the most recent data available and uses the weighted average emission per electricity unit of all electricity generating sources supplying the grid.

**Calculating the build margin ($EF_{BM,y}$)**

The build margin is selected from the following, whichever is greater (i.e. greater number of plants):

a. The generation-weighted average emission rate of the most recent 20% of plants built, on a generation basis OR
b. The most recent five (5) plants built.

For the purpose of calculation for this Project, the first option of the emission factor of generation-weighted average emission rate of the most recent 20% of plants built, on a generation basis is being calculated.

$$EF_{BM\,y} = \frac{\sum_{i,j} F_{i,j,y} \,.\, COEF_{i,j}}{\sum Gen_{j,y}}$$

**Determining the combined margin**

The combined margin is calculated based on the weighted average of the operating margin emission factor and the weighted average of the build margin emission factor. Equal weights have been provided

by default as per the norms. The project is seen to have equal effects on both the operating and build margins.

$EF_y = w_{OM} . EF_{OM,y} + w_{BM} . EF_{BM,y}$
$ER_y = BE_y - PE_y - L_y$
$BE_y = EG_y \otimes EF_y$

For this project activity, most conservative fixed ex-ante baseline emission factor calculated in a transparent and systematic manner by the CEA published in the $CO_2$ baseline database for Indian power sector user guide version 4.0 dated October 2008[101] would be used. The detailed calculation of grid emission factor is mentioned in Annex-3 (Baseline Emission) of this PDD.

**E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:**

This project activity has adopted AMS 1.D./ Version 13 (December 14, 2007) for the emission reduction calculations.

**Baseline emission:**
The baseline emission is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg $CO_2e$/kWh) calculated in a transparent and conservative manner.

Baseline emission factor is calculated as combined margin, consisting of a combination of operating margin (OM) and build margin (BM) factors (For detailed calculation, refer Annex-3).

$BE_y = EG_y * EF_y$ (1)

Where,
$BE_y$ is the baseline emissions due to displacement of electricity during the year y (tonnes of $CO_2$)
$EG_y$ is the unit of electricity exported to the grid due to this project activity in year y (MWh)
$EF_y$ is the emission factor of the grid in year y ($tCO_2$/MWh).

**Project emission:**
There are no project activity emissions as this is a renewable project activity. However, small quantity of fossil fuel would be used for start up the boiler and as co-firing in the project activity. Project emissions on account of use of fossil fuel would be considered and monitored.

Project Emissions due to Auxiliary Fuel (e.g. Coal) Consumption is estimated as per the following equation:

$\mathbf{PE_{,y} = \Sigma FF_{i,y} X NCV_i X EF_i}$ (2)

[101] http://cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Where

| | |
|---|---|
| $PF_y$ | Project emissions from on-site fossil fuel combustion in year y, tCO2e |
| $\Sigma FF_{i,y}$ | Quantity of fossil fuel combusted in the project plant in year y, tonne |
| $NCV_i$ | Net calorific value of fossil fuel type i, TJ/tonne |
| $EF_i$ | Emission factor for fuel i; IPCC default value, tCO2/ TJ |

**Leakages ($L_y$):**

A. **As per the "General guidance on leakage in biomass project activities, Version 02, EB 28"** leakage estimation has been done as below:

The project activity proposes using surplus biomass available surplus in the region. The guidance has highlighted three distinct possibilities of leakage in biomass usage.

| **Biomass type** | **Activity/source** | **Shift of pre-project activities** | **Emission from biomass generation/cultivation** | **Competing use of biomass** |
|---|---|---|---|---|
| Biomass from forest | Existing forest* | - | - | X |
| | New forest | X | X | - |
| Biomass from croplands or grasslands (woody or non woody) | In the absence of the project the land would be used as cropland/wasteland | X | X | - |
| | In the absence of the project activity land would be abandoned | - | X | - |
| Biomass residues or wastes* | Biomass residues or wastes are collected and used | - | - | X |

*Applicable to the project activity.

The project activity involves procurement of biomass available in the region. For this as per the guidance, the project participant shall evaluate annually if there is a surplus of the biomass in the region of the project activity, which is not utilized. It will be demonstrated using published literature, official reports, surveys etc. that the quantity of available biomass in the region, is at least 25% larger than the quantity of biomass that is utilized including the project activity, then this source of leakage can be neglected otherwise this leakage shall be estimated and deducted from the emission reductions.

In case when the biomass residue available in the region is not at least 25% higher than the quantity of biomass that is utilized including the project activity, following procedure would be adopted for estimation of leakage-

$Ly = EF_{CO2,LE} * \sum BF_{k,y} * NCV_k$

Where;

$L_y$ = Leakage emissions during year y, tCO2
$EF_{CO2, LE}$ = CO2 emission factor of the most carbon intensive fuel used in the country, tCO2/ GJ, National Emission Factor Value (0.1062 tCO2/GJ for Lignite)[102]
$BF_{k,y}$ = Quantity of biomass residue k used in project activity not available in surplus in the region in year y
$NCV_k$ = Net calorific value of biomass residue k, GJ/ tonne

**B. Leakage due to transportation of biomass to the plant site**

The project activity is expected to cause leakage emissions due to transportation of biomass. This is calculated using equation below:

$L_{y,trans} = BF_{k,y} \times AVD_y \times EF_{km,CO2} / TL_y$
Where
$L_{y,trans}$ = Leakage emission due to transportation of biomass residues in year y, tCO2
$BF_{k,y}$ = Quantity of biomass residue k transported to project site in year y, MT
$AVD_y$ = Average round trip distance in year y, km/ trip
$EF_{km,CO2}$= Emission factor for trucks in year y, tCO2e/ km
$TL_y$ = Average truck load of trucks used in year y, MT

And
$EF_{km,CO2,y} = FE_y \times NCV_y \times EF_y \times l_y / 1000$

Where;

| | | |
|---|---|---|
| $FE_y$ | = | Fuel economy of the truck used in year y, l/ km<br>(PP has considered it for 3 km/l which is conservative) |
| $NCV_y$ | = | Net calorific value of fuel used in year y, TJ/ tonne (43.0 TJ/ 10^3 tonne) for diesel, IPCC default 2006) |
| $EF_y$ | = | Emission factor for fuel used in year y, tCO2/ TJ (for diesel 74.1 tCO2/ tonne, IPCC default 2006) |
| $l_y$ | = | Density of fuel used in year y, kg/ l<br>For diesel 0.82, http://www.siamindia.com/scripts/diesel.aspx |

[102] http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver3.pdf

**Emission reduction ($ER_y$):**
The emission reduction achieved by the project activity will be the difference between the baseline emission and the sum of the project emission and leakage.

$$ER_y = BE_y – (PE_y + L_y) \quad (4)$$

**Fixed parametric values:**
1. NEWNE grid Emission factor

**E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:**

**NA**

**E.7. Application of the monitoring methodology and description of the monitoring plan:**

**D.7.1. Data and parameters to be monitored by each SSC-CPA:**

| **Data / Parameter:** | **$EG_y$** |
|---|---|
| Data unit: | MWh |
| Description: | Net electricity generated by the project activity |
| Source of data to be used: | Monthly energy meter reading records. |
| Value of data | - |
| Description of measurement methods and procedures to be applied: | Measured monthly using the calibrated energy meters. |
| QA/QC procedures to be applied: | The energy meters used will be calibrated and maintained at the accuracy levels as per manufacturer spacification. |
| Any comment: | - |

| Data / Parameter: | $Q_{biomass, i,y}$ |
|---|---|
| Data unit: | Kg |
| Description: | Quantity of biomass of type i combusted in year y |
| Source of data to be used: | On-site measurement |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | - |
| Description of | Quantity of biomass used in project activity would be measured using weigh |

| | |
|---|---|
| measurement methods and procedures to be applied: | scales and recorded in Log books. |
| QA/QC procedures to be applied: | The data will be cross checked with the biomass procurement data. |
| Any comment: | - |

| | |
|---|---|
| Data / Parameter: | $Q_{fossil, i,y}$ |
| Data unit: | Mass or volume unit |
| Description: | Quantity of fossil fuel of type i combusted in year y |
| Source of data to be used: | On-site measurement |
| Value of data | |
| Description of measurement methods and procedures to be applied: | Quantity of fossil fuel used in project activity would be measured using weigh scales and recorded in Log books. |
| QA/QC procedures to be applied: | The data will be cross checked with the fossil fuel procurement data. |
| Any comment: | - |

| | |
|---|---|
| Data / Parameter: | Biomass availability |
| Data unit: | Tonnes |
| Description: | Surplus biomass availability in the region |
| Source of data to be used: | To be based on publicly available reports on biomass availability in the region from state or central Government agencies and/ or other institutions of repute.<br>Sterling Agro Industries Ltd. would carry out its own assessment through external experts/ in-house resources in case of non-availability of such information otherwise.<br>The assessment would be done annually. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | |
| Description of measurement methods and procedures to be applied: | - |
| QA/QC procedures to be applied: | No need of QA/QC procedure |
| Any comment: | - |
| Data / Parameter: | NCVi |

| | |
|---|---|
| Data unit: | TJ / tonne |
| Description: | Net calorific value of fossil fuel i |
| Source of data to be used: | Sample tests |
| Value of data | - |
| Description of measurement methods and procedures to be applied: | Sample test of fossil fuel used would be conducted |
| QA/QC procedures to be applied: | |
| Any comment: | Frequency of monitoring: Sampling of stock |

| | |
|---|---|
| **Data / Parameter:** | $AVD_y$ |
| Data unit: | km / trip |
| Description: | Average round trip distance in year y |
| Source of data to be used: | Estimated distance between source and project site |
| Value of data | - |
| Description of measurement methods and procedures to be applied: | Estimated based upon purchase records of biomass |
| QA/QC procedures to be applied: | - |
| Any comment: | Frequency of monitoring: Continual |

| | |
|---|---|
| **Data / Parameter:** | $BF_{k,y}$ |
| Data unit: | MT |
| Description: | Quantity of biomass residue k transported to project site in year y |
| Source of data to be used: | Biomass procurement records |
| Value of data | - |
| Description of measurement methods and procedures to be applied: | Estimated from biomass procurement records available on site |
| QA/QC procedures to be applied: | - |
| Any comment: | Frequency of monitoring: Continual |

| | |
|---|---|
| **Data / Parameter:** | $TL_y$ |
| Data unit: | MT |
| Description: | Average truck load of trucks used in year y |

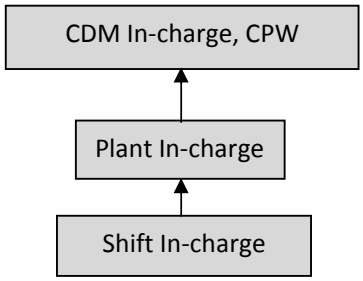
| | |
|---|---|
| Source of data to be used: | Biomass procurement records |
| Value of data | - |
| Description of measurement methods and procedures to be applied: | Estimated from biomass procurement records available on site |
| QA/QC procedures to be applied: | - |
| Any comment: | Frequency of monitoring: Continual |

### E.7.2. Description of the monitoring plan for a SSC-CPA:

The following structure has been proposed for data monitoring, collection, data archiving and calibration of equipments for this project activity. The team comprises of the following members.

1. CDM In-charge, CPW
2. Plant In-charge
3. Shift In-charge

**Organisational Structure for Monitoring**




***Responsibilities of CDM In-Charge, CPW:*** Overall functioning and maintenance of the project activity.

***Responsibilities of Plant In-charge:*** Responsibility for Maintains the data records, ensures completeness of data, and reliability of data (calibration of equipments).

***Responsibilities of Shift In-charge:*** Responsibility for day to day data collection and maintains day to day log book for monitored data.

***Data source:*** As per section B.7.1

***Data collection and record keeping:*** Data will be collected at the plant operation site under the supervision of the shift-in-charge and records will be maintained in daily logs. The reports are checked periodically by the Plant In-charge and discussed thoroughly with the data monitoring personnel. A separate log will also be maintained for the biomass supply on the site, its storage and usage in the project activity.

***Reliability of data collected:*** The reliability of the measuring equipments will be calibrated as per section B.7.1. Documents pertaining to testing of equipments shall be maintained by Plant In-charge.

***Frequency of monitoring:*** As per section B.7.1.

***Archiving of data:*** The data, collected as part of monitoring, is to be archived and be kept for at least 2 years after the crediting period or from last issuance.

***Maintenance of instruments and equipments used in data monitoring:*** The Operations Department shall be responsible for the proper functioning of the equipments/ instruments and shall take a corrective action if found not operating, as required.

***Emergency preparedness:*** The project activity will not result in any unidentified activity that can result in substantial emissions from the project activity. No need for emergency preparedness in data monitoring is visualized.

***Emission reduction calculation:*** Emission reduction calculations and monitoring report will be done annually based on the data collected. This will be done by the team. The monitoring report and the emission reduction calculation will be maintained by the CDM In-Charge, CPW for verification.

**E.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)**

Date: 05.01.2009

Lokesh Chandra Dube
Gurgaon, Haryana.
E-mail: lokeshchandradube@gmail.com

## Annex 1

### CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

| | |
|---|---|
| Organization: | ZXY Limited |
| Street/P.O.Box: | Name/Number |
| Building: | Name |
| City: | Name |
| State/Region: | Name |
| Postfix/ZIP: | Number |
| Country: | India |
| Telephone: | +91 --- |
| FAX: | +91 --- |
| E-Mail: | E-mail id of the entity |
| URL: | www. |
| Represented by: | Full name of the contact person (representative) |
| Title: | Position of the contact person |
| Salutation: | Mr./Ms. |
| Last Name: | Family name of the contact person |
| Middle Name: | Middle name of the contact person |
| First Name: | First name of the contact person |
| Department: | Name |
| Mobile: | Number |
| Direct FAX: | Number |
| Direct tel: | Number |
| Personal E-Mail: | E-Mail id of the contact person |

## Annex 2

## INFORMATION REGARDING PUBLIC FUNDING

No public funding involved.

## Annex 3

## BASELINE INFORMATION

***Calculation of Grid emission factor:***
As per methodology:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.

OR

(b) The weighted average emissions (in kg $CO_2$e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source (where available) and made publicly available.

**Option (a) has been considered to calculate the grid emission factor as per the** 'Tool to calculate the emission factor for an electricity system' as per the methodology as data is available from an official source.

***Baseline Methodology Procedure:***

Project participants shall apply the following six steps:

STEP 1. Identify the relevant electric power system.
STEP 2. Select an operating margin (OM) method.
STEP 3. Calculate the operating margin emission factor according to the selected method.
STEP 4. Identify the cohort of power units to be included in the build margin (BM).
STEP 5. Calculate the build margin emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

***STEP 1. Identify the relevant electric power system:***

The tool defines the *electric power system* as the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. Keeping this into consideration, the Indian grid system was divided into five independent regional grids, namely Northern, Eastern, Western, Southern, and North-Eastern. Each grid covered several states (see Table 3.1). **Since August 2006, however, all regional grids except the Southern Grid have been integrated and are operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids will be treated as a single grid and is being named as NEWNE grid.**

**Table 3.1 Geographical Scope of regional grids in India**

| NEWNE Grid | | | | Southern grid |
|---|---|---|---|---|
| Northern | Eastern | Western | North-Eastern | |
| Chandigarh | Bihar | Chhattisgarh | Arunachal pradesh | Andhra Pradesh |
| Delhi | Jharkhand | Gujarat | Assam | Karnataka |
| Haryana | Orissa | Daman & Diu | Manipur | Kerala |
| Himachal pradesh | West Bengal | Dadar & Nagar Haveli | Meghalaya | Tamil Nadu |
| Jammu & Kashmir | Sikkim | Madhya Pradesh | Mizoram | Pondicherry |
| Punjab | Andaman-Nicobar | Maharashtra | Nagaland | Lakshadweep |
| Rajasthan | | Goa | Tripura | |
| Uttar Pradesh | | | | |
| Uttarakhand | | | | |
| | | | | |

***STEP 2. Select an operating margin (OM) method:***

The calculation of the operating margin emission factor ($EF_{OM,y}$) is based on one of the following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

Any of the four methods can be used, however, the simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in:

1) average of the five most recent years, or
2) based on long-term averages for hydroelectricity production.

Table below analyses whether simple OM can be used in the project case or not:

| Generation source | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | Average (last five years) |
|---|---|---|---|---|---|---|
| **NEWNE grid** | | | | | | |
| Net Generation (GWh) | 389,003 | 413,746 | 437,877 | 465,361 | 496,119 | 440421 |
| % of Low cost/ Must run sources | 15..97 | 17.21 | 17.95 | 18.45 | 19.04 | 18.16 |

The above table clearly shows that the percentage of total grid generation by low-cost/must-run plants (on the basis of average of five most recent years) for all regional grids is much lesser than 50% of the total generation. Thus, Simple OM method can be used for calculating the emission factor.

***STEP 3. Calculate the operating margin emission factor according to the selected method:***

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

• *Ex ante* option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or

• *Ex post* option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

The simple OM emission factor is calculated as the generation-weighted average $CO_2$ emissions per unit net electricity generation ($tCO_2/MWh$) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

***Method adopted for Simple OM in the project activity:***

In the project activity, (*ex-ante*) the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission has been considered. The data is published annually by the Central Electricity Authority. **This is designed to be consistent with version 1.1 of the Tool to calculate the emission factor for an electricity system published by CDM Executive Board.** It is confirmed that ex-ante vintage is considered in the project activity and cannot be changed during the crediting period.

***STEP 4. Identify the cohort of power units to be included in the build margin (BM):***

The value of the data has been taken from the data published by CEA as referred in earlier step. The CEA Baseline Database has been calculated as per the tool and the details of the key assumptions considered to calculate the figure can be found in the User Guide of the same.

Project participants can choose between one of the following two options:

***Option 1:***
Calculate the Build Margin emission factor $EF_{BM,y}$ **ex-ante** based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group *m* consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

***Option 2:***

For the first crediting period, the Build Margin emission factor $EF_{BM,y}$ must be updated annually ex-post for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, $EF_{BM,y}$ should be calculated ex-ante, as described in option 1 above. The sample group *m* consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

***STEP 5. Calculate the build margin emission factor (EFgrid, BM,y):***

Option 1 as described above is chosen in the project activity. BM is calculated ex-ante based on the most recent information available at the time of submission of PDD and is fixed for the entire crediting period.

***STEP 6. Calculate the combined margin (CM) emissions factor (EFgrid, CM, y ):***

The CM can be calculated as per the following:

$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$

Where:

| Parameter | Detail |
|---|---|
| EFgrid, OM,y | Build Margin CO2 emission factor in the year *y* (tCO2/GWh) |
| EFgrid, BM,y | Operating Margin CO2 emission factor in the year *y* (tCO2/GWh) |
| WOM | Weighting of operating margin emission factor (%) |
| WBM | Weighting of build margin emission factor (%) |

Where:

Weights $w_{OM}$ and $w_{BM}$, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$)

In the project activity, **combined margin has been chosen as the baseline emission factor** for grid emission factor. The value chosen is taken from relevant official sources and is publicly available[103].

In the project activity, combined margin has been chosen as the baseline emission factor for grid emission factor.

**Reference: Tool to calculate the emission factor for an electricity system**
**Source of Data:** http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver4.pdf

**Annex 4**

[103] http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver4.pdf

## MONITORING INFORMATION

Left blank intentionally.

PoA specific Monitoring information to be included here, if any, avoiding repetition.

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**CLEAN DEVELOPMENT MECHANISM**
**SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)**
**Version 01**

**CONTENTS**



**Annexes**



NOTE:

(i) This form is for submission of CPAs that apply a small scale approved methodology using the provision of the proposed small scale CDM PoA.

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[104,105] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

[104] The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

[105] At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

## SECTION A. General description of small scale CDM programme activity (CPA)

### A.1. Title of the small-scale CPA:

**Installation of Biomass Gasifier system in small industry BGO.**
Version: 01.0
Date: DD/MM/YY (date of completion of the CPA-DD to be put here)

This document is Annex II to the MNRE study- *Developing a framework for Programmatic CDM projects in renewable energy area.* This is a model CPA DD (Typical) and is not intended to be used as a CPA DD for submission to a DOE for validation or to a DNA for host country approval. Underlined text represents guidance on relevant sections.

### A.2. Description of the small-scale CPA:

**Purpose of the program activity**

This CDM program activity is a proposed as a part of proposed biomass gasifier programme "Installation of Biomass Gasifier systems in small industries". The proposed CPA is being implemented through BGO (hereafter referred as the implementing agency/ CPA operator, BGO). ZXY Ltd. is the coordinating/ managing entity of the proposed PoA. ZXY provides the technology and selects project areas, potential customers, installs the systems and provides maintenance support. The CDM Program Activity would help in displacing/ reducing use of fossil fuel in generation of power.

The implementing agency, BGO would be responsible for implementation and monitoring of the CPA. This is a voluntary action from the managing co-ordinating entity, ZXY. There are no laws/ policies in the country enforcing the installation of biomass Gasifier for industrial application.

The expected result for this CPA is significant reduction of greenhouse gases (GHGs) by avoiding use of fossil fuel for generation of electrical energy. Therefore the CPA will mitigate the GHG emission to the atmosphere leading to the better environmental conditions and local livelihood.

**General operating and implementing framework of CPA:**

Three parties *i.e.*, ***i. ZXY Limited (ZXY) ii. BGO Limited (BGO) iii. Financing Agency (FI)*** will be involved in implementation and operation of proposed project activity. A schematic flow diagram of operating and implementing framework of the project is given below.

ZXY would be responsible for implementation and operation of the proposed PoA. ZXY will provide financial (up to 30% of the total project cost) and technical support for implementation of the activity. The financing agency will finance ZXY to implement the project activity. ZXY will borrow the money on behalf of BGO and loans the technology to the BGO until the loan is paid off. Remaining cost (up to 70% of project cost) will directly paid by the BGO. ZXY will facilitate training and implementation of the activity through a salaried group. BGO will facilitate operation and maintenance of the gasifiers and the

monitoring of the data to be monitored for emission reduction calculation. The BGO would either facilitate the operation & maintenance themselves through their own staff or contract it out to ZXY. The CER will be issued in the name of ZXY. ZXY will allocate some portion of the total CDM revenue for operation and maintenance cost and rest for loan repayment. When the capital will be recovered, the financing agency will wind up its involvement and the benefits from CERs will be shared as per the agreement signed between ZXY and BGO and the ownership of the technology is formally transferred to BGO.

**Contribution of the proposed CPA to sustainable development of the host party:**

Proposed CPA will contribute to the sustainable development of country- India.

***Social well being***

- The main raw materials (biomass) used are fuel Wood, Agriculture Stalk , Coconut Shell, Briquettes of several residues, Mustard Stalk, Cashew Nut Shells, Lantana and other agricultural residues which are renewable biomass, available in surplus in the project region.The economy of the local people is improved by selling biomass residue for the power plant.
- The CPA will assist in alleviation of poverty to certain extent by generating both direct and indirect employment in the area of skilled/unskilled jobs for regular operation and maintenance of the power plant.

***Economic well being***

- The biomass gasification process is a alternative to fossil fuel based power plants and the decentralised power generation through biomass gasification will reduce the transmission and distribution losses.
- The program activity shall create new rural income resulting from the sales of biomass fuel like coconut shells. Increased income levels shall contribute to the economic security and empowerment of the most vulnerable sections of the society.

***Environmental Well being***

- The project is using biomass for power generation. There is no GHG emission from this CPA. Combustion of biomass in the proposed project does not result in net increase in GHG emissions of CO2, CH4 and NOx.
- There is no fly ash or solid waste from this biomass gasification process.

***Technology Well being***

- Biomass gasifier for power generation in small industries is a decentralized activity. The advantage of decentralised power generation is reduction in transmission and distribution losses and the prospect of rural electrification- a major concern for India.
- The biomass gasification is a cleaner technology there is no Green House Gas (GHG) emission.

## A.3. Entity/individual responsible for the small-scale CPA:

Information on the entity/individual responsible of the CPA, referred to as CPA implementer(s) is included in this section. CPA implementers can be project participants of the PoA, under which the CPA is submitted, provided their name is included in the registered PoA.

The CPA implementer for CPAs are Biomass Gasifier Owners (BGO) at small industries. CPA implementers are not a project participants of the PoA, under which the CPAs are being submitted.

**A.4. Technical description of the small-scale CPA:**
**A.4.1. Identification of the small-scale CPA:**

**A.4.1.1. Host Party:**

India

**A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):**

Geographic reference or other means of identification[106], Name/contact details of the CPA implementing agency.

Location of the proposed small scale CDM programme activity (SSC- CPA) to be included along with the GPS location in this section.

**A.4.2. Duration of the small-scale CPA:**

**A.4.2.1. Starting date of the small-scale CPA:**

Start date of a CPA is the date on which real action for implementing the program activity took place. This is the date of contract between ZXY and BGO.

DD/MM/YY

**A.4.2.2. Expected operational lifetime of the small-scale CPA:**

20 years (based on technology supplier's specifications)

**A.4.3. Choice of the crediting period and related information:**

**Fixed Crediting period**

**A.4.3.1. Starting date of the crediting period:**

Date of commissioning of CPA or the date of inclusion of the CPA in the PoA, whichever is later.

[106] E.g. in case of stationary CPA geographic reference, in case of mobile CPAs means such as registration number, GPS devices.

**A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:**

10 years 00 months 00 days

NOTE: Please note that the duration of crediting period of any *CPA* shall be limited to the end date of the *PoA* regardless of when the CPA was added.

**A.4.4. Estimated amount of emission reductions over the chosen crediting period:**

Estimation is based on 1 MW capacity biomass gasifier.

| Years | Annual estimation of emission reductions in tones of CO2 e |
|---|---|
| Year 1 | 5606 |
| Year 2 | 5606 |
| Year 3 | 5606 |
| Year 4 | 5606 |
| Year 5 | 5606 |
| Year 6 | 5606 |
| Year 7 | 5606 |
| Year 8 | 5606 |
| Year 9 | 5606 |
| Year 10 | 5606 |
| **Total estimated reductions** (tCO2 e) | 56060 |
| **Total number of crediting years** | 10 |
| **Annual average over the crediting period of estimated reductions (**tonnes of CO2e**)** | 5606 |

**A.4.5. Public funding of the CPA:**

The program activities will not receive public funding.

**A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component**

1. For the purposes of registration of a Programme of Activities (PoA)[107] a proposed small-scale CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity[108], which:

   (a) Has the same activity implementer as the proposed small scale CPA or has a coordinating or managing entity, which also manages a large scale PoA of the same sectoral scope, and;

   (b) The boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

2. If a proposed small-scale CPA of a PoA is deemed to be a debundled component in accordance with paragraph 2 above, but the total size of such a CPA combined with a registered small-scale CPA of a PoA or a registered CDM project activity does not exceed the limits for small-scale CDM and small-scale A/R project activities as set out in Annex II of the decision 4/CMP.1 and 5/CMP.1 respectively, the CPA of a PoA can qualify to use simplified modalities and procedures for small-scale CDM and small-scale A/R CDM project activities.

Specific information on non de-bundling for the CPA will be included here.

**A.4.7. Confirmation that small-scale CPA is neither registered as an individual CDM project activity or is part of another Registered PoA:**

The present small scale CPA is not registered as an individual CDM project and is not part of another PoA.

## SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

**B.1. Title and reference of the Registered PoA to which small-scale CPA is added:**

Installation of Biomass Gasifier systems in Small Industries

**B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA :**

***Installation of Biomass Gasifier system in small industry BGO*** is eligible to be included to the program- Installation of Biomass Gasifier systems in Small Industries because:

[107] Only those POAs need to be considered in determining de-bundling that are: (i) in the same geographical area; and (ii) use the same methodology; as the POA to which proposed CPA is being added

[108] Which may be a (i) registered small-scale CPA of a PoA, (ii) an application to register another small-scale CPA of a PoA or (iii) another registered CDM project activity

8. This is a biomass gasification based power generation project that displaces electricity from an electricity distribution system.
9. All gasifier units under this CPA are implemented either by the coordinating/ managing entity or affiliated companies or by companies appointed by the coordinating/ managing entity acting in the name of the coordinating/ managing entity.
10. All gasifier units under this CPA have monitoring equipments installed and access for monitoring is granted to the coordinating/ managing entity or affiliated companies or by companies appointed by the coordinating/ managing entity acting in the name of the coordinating/ managing entity.
11. BGO has signed an agreement, specifying CERs ownership with the coordinating/ managing entity ZXY.
12. The proposed CPA is within the territory of the country- India.
13. Biomass used in the Gasifier is renewable.

**B.3. Assessment and demonstration of additionality of the small-scale CPA , as per eligibility criteria listed in the Registered PoA:**

***Demonstrating Additionality – This will be done for each CPAs on specific basis.***

**Investment Barrier**

Unit cost of power generation for the project activity can be compared to the unit cost of power purchase from grid to prove the additionality of the project. Biomass power plants require high capital investment and the recurring maintenance costs and fuel costs make a significant difference in per unit cost of electricity generation.
Other option could be to use IRR as a financial indicator. Either Project IRR or Equity IRR can be used. The choice of benchmark can be as per the guidelines laid down by the UNFCCC. The project activity can be proven additional in case the returns are lower than the benchmark.

**Technological barrier**
Most types of biomass are high in alkaline content. This leads to erosion of boiler linings and tubes. Hence, the equipment requires frequent maintenance. This increases the O & M costs of the biomass based system. Revenues from carbon credits can help proponents tide over the extra input costs.

**Biomass prices**
Prices of biomass keep fluctuating. In most of the cases, per unit costs of steam generation or power generation is higher in case of biomass based systems. The increased costs can be a significant barrier in implementing of the project activity.

**B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.**

The emission sources and gases included in the project boundary for the determination of both baseline and project emissions are presented as follows:

| Emissions | Source | Gas | Included? | Justification/ explanation |
|---|---|---|---|---|
| **Baseline** | Electricity generation, grid | $CO_2$ | Included | Main emission source |
| | | $CH_4$ | Excluded | Miner emission source. Excluded for simplification. Conservative. |
| | | $N_2O$ | Excluded | Miner emission source. Excluded for simplification. Conservative. |
| **Project Activity** | Supplemental fossil fuel consumption at the project plant | $CO_2$ | Included | Main emission source. |
| | | $CH_4$ | Excluded | Miner emission source. Excluded for simplification. |
| | | $N_2O$ | Excluded | Miner emission source. Excluded for simplification. |
| | Supplemental electricity consumption. | $CO_2$ | Included | Main emission source |
| | | $CH_4$ | Excluded | Miner emission source. Excluded for simplification. |
| | | $N_2O$ | Excluded | Miner emission source. Excluded for simplification. |

The CPA is located within the boundaries of the Republic of India as specified in A.4.1.2.

## B.5. Emission reductions:

### B.5.1. Data and parameters that are available at validation:

| Data / Parameter: | CM |
|---|---|
| Data unit: | $tCO_2$ / MWh |
| Description: | Combined Margin Emission factor of NEWNE grid |
| Source of data used: | Central Electricity Authority, India. (2008) |
| Value applied: | 0.80 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Central Electricity Authority (India) is a government body and data published by them is as per ACM0002/ Version07, and Tool to Calculate the Emission Factor for an Electricity System (Version 01, EB 35 Annex 12). |
| Any comment: | Recent three years data of OM and BM has been used. |

### B.5.2. Ex-ante calculation of emission reductions:

The total emission reductions of the CPA are calculated on the basis of the equations and parameters presented and explained in section E.6.1 of the PoA DD and B.5.1 of this document. Baseline information for the combined margin emission factor is presented in Annex 3 of this document.

Taking into account starting date crediting period as a starting date of a 10 years crediting period, emission reductions calculations for year first year of crediting period and last year of crediting period refer to the fraction of the respective year that is covered by the crediting period.

Emission Reductions in year y,
ERy = BEy = GENy X CM /1000 t CO2
= 1MW X 80% X 24 hrs X 365 days X 0.8 t CO2/MWh = 5,606 t CO2/year

GENy = Power generation from the biomass gasification unit xxx MWh per annum (expected net power supply from all gasifiers in the CPA)
CM = Combined margin Emission factor calculated as weighted average of OM and BM = 0.92 t $CO_2$/ MWh, Ex-ante fixed value

### B.5.3. Summary of the ex-ante estimation of emission reductions:

| Year | Estimation of project activity emissions (tonnes of $CO_2$ e) | Estimation of baseline emissions (tonnes of $CO_2$ e) | Estimation of leakage (tonnes of $CO_2$ e) | Estimation of overall emission reductions (tonnes of $CO_2$ e) |
|---|---|---|---|---|
| Year 1 | 0 | 5606 | 0 | 5606 |
| Year 2 | 0 | 5606 | 0 | 5606 |
| Year 3 | 0 | 5606 | 0 | 5606 |
| Year 4 | 0 | 5606 | 0 | 5606 |
| Year 5 | 0 | 5606 | 0 | 5606 |
| Year 6 | 0 | 5606 | 0 | 5606 |
| Year 7 | 0 | 5606 | 0 | 5606 |
| Year 8 | 0 | 5606 | 0 | 5606 |
| Year 9 | 0 | 5606 | 0 | 5606 |
| Year 10 | 0 | 5606 | 0 | 5606 |
| **Total** (tonnes of $CO_2$ e) | 0 | 56060 | 0 | 56060 |

## B.6. Application of the monitoring methodology and description of the monitoring plan:

### B.6.1. Description of the monitoring plan:

The monitoring Plan of the CPA is consistent with methodology AMS-I.D. "Grid connected Renewable energy generation" (version 13). Description of the monitoring plan is presented below.

***Monitoring Plan Objective and Organisation***

The CPA implementer BGO will monitor the electricity delivered to the India's NEWNE electricity grid by the respective project. BGO personal will be trained adequately for this task. The data will be archived electronically and be stored for 2 years after the end of the crediting period of the CPA.
To ensure that the data is reliable and transparent, BGO will also establish Quality Assurance and Quality Control (QA&QC) measures to effectively control and manage data reading, recording, auditing as well as archiving data and all relevant documents.

***Monitoring Data***
Data to be monitored is the net electricity delivered to the NEWNE grid by the project.
The monitoring of electricity delivered will be further defined in each specific CPA DDs. The entity responsible for monitoring, BGO, will provide the verifying DOE with meter readings for electricity delivered and calibration certificates.

***Quality Assurance and Quality Control***
QA&QC procedures for recording, maintaining and archiving data shall be implemented as part of this CDM programme activity. The installation location of the meters will be further defined in individual/ specific CPAs. BGO will implement QA&QC measures to calibrate and guarantee the accuracy of metering and safety of the project operation.
The metering devices will be calibrated and inspected properly and periodically, according to manufactures' specifications or at least once in three yaers, whichever is lesser to ensure their accuracy.

***Verification of monitoring results***
The responsibilities for verification of the projects will be further defined when the project is at a more developed stage. BGO will carry the responsibility for providing the DOE with all required necessary information, before, during and in the event of queries, after the verification.

**C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:**

✔ This information is provided at the PoA level. In this case sections C.2. and C.3. need not be completed in this form.

**C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

Not applicable.

**C.3. Please state whether an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA), in accordance with the host Party laws/regulations:**

Not applicable.

## SECTION D. Stakeholders' comments

**D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:**

☐ Please tick if this information is provided at the PoA level. In this case sections D.2. to D.4. need not be completed in this form.

Stakeholder consultation for the project activity is conducted to account for the views of the people impacted either directly or indirectly due to the project activity. This is carried out at two levels:

3. At PoA level
4. At CPA level

The stakeholders include under this programme of activities–

E. District Administration
F. Local gram panchayat
G. Local community
H. Villagers

**Stakeholder Consultation at PoA level:** An advertisement will be published to inform regarding the project activity. The newspaper advertisement describes in brief about the project activity, the benefits associated with the project activity and ask for the views from local people.

**Stakeholder Consultation at CPA level:** The following procedure should be adopted to complete the process at CPA level.

***Meeting with local community, Villagers and Gram Panchayat:*** Meeting will be organized with the local people, villagers and Gram Panchayat before starting a new program or scaling up an existing program. CPW staff will also visit the project site to get feedback. Feedback will be discussed during the meeting and incorporated into the programs.

***Meeting with District authority:*** A letter will be sent to district authority about the details of the project activity and request for their suggestions and/or a meeting will be organized with the district authority.

**D.2. Brief description how comments by local stakeholders have been invited and compiled:**

An advertisement will be published to inform local people regarding the project activity. The newspaper advertisement describes in brief about the project activity, the benefits associated with the project activity and ask for the views from local people.

**D.3. Summary of the comments received:**

Summary of comments received in meeting, in person or in other communication methods will be included in this section.

| **D.4. Report on how due account was taken of any comments received:** |
|---|

Actions/plans to take care of stakeholders' comments to be included here.

**Annex 1**

**CONTACT INFORMATION ON ENTITY/INDIVIDUAL RESPONSIBLE FOR THE SMALL-SCALE CPA**

| | |
|---|---|
| Organization: | BGO Limited |
| Street/P.O.Box: | Road |
| Building: | Name |
| City: | City Name |
| State/Region: | State Name |
| Postfix/ZIP: | PIN |
| Country: | India |
| Telephone: | +91 --- |
| FAX: | +91 --- |
| E-Mail: | E- mail id of the company |
| URL: | Web address of the company |
| Represented by: | Full name of the contact person/representative |
| Title: | Position of the official representative |
| Salutation: | Mr/Ms |
| Last Name: | Family Name |
| Middle Name: | Middle name |
| First Name: | First name |
| Department: | Department Name |
| Mobile: | +91 --- |
| Direct FAX: | +91 --- |
| Direct tel: | +91 --- |
| Personal E-Mail: | E-mail id of the representative |

## Annex 2

## INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in development of this CPA.

## Annex 3

## BASELINE INFORMATION

Baseline emission factor is calculated in line with the requirements of the approved SSC CDM methodology AMS I.D and the tool to calculate emission factor of an electricity system.

Project activity falls under the NEWNE grid in India. Central Electricity Authority (CEA) data has been used for grid emission factor calculation. CEA publishes data of emissions in accordance with the tool to calculate emission factor of an electricity system.

| Grid | Operating Margin | Built Margin | Combined Margin |
|---|---|---|---|
| NEWNE | 1.00 | 0.6 | 0.80 |

Values of emission factors are given in tonnes $CO_2$ / MWh[109].

## Annex 4

[109] BASELINE CARBON DIOXIDE EMISSIONS FROM POWER SECTOR, VERSION 4.0, available at: http://www.cea.nic.in/planning/c and e/user_guide_ver4.pdf

## MONITORING INFORMATION

Left Blank intentionally.

CPA specific monitoring details to be included here.

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# Annex III
# Glossary of Relevant CDM Terms

**Additionality of a programme of activities**
A PoA is additional if it can be demonstrated that in the absence of the CDM (i) the proposed voluntary measure would not be implemented, or (ii) the mandatory policy/regulation would be systematically not enforced and that noncompliance with those requirements is widespread in the country/region, or (iii) that the PoA will lead to a greater level of enforcement of the existing mandatory policy /regulation. This shall constitute the demonstration of additionality of the PoA as a whole.

**Approval by Parties involved**
A written approval constitutes the authorization by a designated national authority (DNA) of specific entity(ies)' participation as project proponents in the specific CDM project activity. The approval covers the requirements of paragraphs 33 and 40 (a) and (f) of the CDM modalities and procedures. The DNA of a Party involved in a proposed CDM project activity shall issue a statement including the following:

- The Party has ratified the Kyoto Protocol.
- The approval of voluntary participation in the proposed CDM project activity
- In the case of Host Party(ies): statement that the proposed CDM project activity contributes to sustainable development of the host Party(ies).

The written approval shall be unconditional with respect to the above.

Multilateral funds do not necessarily require written approval from each participant's DNA. However those not providing a written approval may be giving up some of their rights and privileges in terms of being a Party involved in the project.

A written approval from a Party may cover more than one project provided that all projects are clearly listed in the letter.

**Baseline for small-scale CDM project activities - approved methodology**
A baseline methodology approved by the Executive Board is included in an indicative list of simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories (contained in the Appendix B to the simplified modalities and procedures for small-scale CDM project activities) and is publicly available along with relevant guidance on the UNFCCC CDM website (http://cdm.unfccc.int/methodologies/SSCmethodologies/approved) or it can be obtained through a request sent to cdm-info@unfccc.int or Fax: (49-228) 815-1999. To be applied mutatis mutandis to SSC-PoA-Baseline - approved methodology.

**Baseline scenario**
The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A (of the Kyoto Protocol) within the project boundary. A baseline shall be deemed to reasonably represent the

anthropogenic emissions by sources that would occur in the absence of the proposed project activity if it is derived using a baseline methodology referred to in paragraphs 37 and 38 of the CDM modalities and procedures.

Different scenarios may be elaborated as potential evolutions of the situation existing before the proposed CDM project activity. The continuation of a current activity could be one of them; implementing the proposed project activity may be another; and many others could be envisaged.

**Biomass**
Biomass means non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms. This shall also include products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes. Biomass also includes gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material.

**Biomass residues**
Biomass by-products, residues and waste streams from agriculture, forestry and related industries.

**Boundary for the programme of activities**
Definition of the boundary for the PoA is the geographical area (e.g., municipality, region within a country, country or several countries) within which all CDM programme activities (CPAs) included in the PoA will be implemented, taking into consideration the requirement that all applicable national and/or sectoral policies and regulations of each host country within that chosen boundary.

The physical boundary of a PoA may extend to more than one country provided that each participating non-annex I host Party provides confirmation that the PoA, and thereby all CPAs, assists it in achieving sustainable development.

**CDM Programme Activity**
CPA - CDM programme activity - a project activity under a programme of activities. A CPA is a single, or a set of interrelated measure(s), to reduce GHG emissions or result in net anthropogenic greenhouse gas removals by sinks, applied within a designated area defined in the baseline methodology. The applied approved methodology shall define whether the CPA is undertaken in a single facility/installation/land or undertaken in multiple facilities/installations/land. In the case of CPAs which individually do not exceed the SSC threshold, SSC methodologies may be used once they have first been reviewed and, as needed, revised to account for leakage in the context of a CPA.

**Certified emission reductions (CERs)**
A certified emission reduction or CER is a unit issued pursuant to Article 12 and requirements there under, as well as the relevant provisions in the CDM modalities and procedures, and is equal to one metric tonne of carbon dioxide equivalent, calculated using global warming potentials defined by decision 2/CP.3 or as subsequently revised in accordance with Article 5 of the Kyoto Protocol.

**Clean development mechanism (CDM)**
Article 12 of the Kyoto Protocol defines the clean development mechanism. “The purpose of the clean development mechanism shall be to assist Parties2 not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under article 3”.

**Coordinating/managing entity and participants of PoA**

A PoA shall be proposed by the coordinating or managing entity which shall be a project participant authorized by all participating host country DNAs involved and identified in the modalities of communication as the entity which communicates with the Board, including on matters relating to the distribution of CERs.

Project participants of the PoA shall make arrangements with the coordinator or managing entity, relating to communications, distribution of CERs and change of project participants.

**Crediting period of a CPA**

The crediting period for a CDM programme activity is the period for which reductions from the baseline or net anthropogenic GHG removals by sinks are verified and certified by a designated operational entity for the purpose of issuance of certified emission reductions (CERs) or long-term certified emission reductions (lCERs) or of temporary certified emission reductions (tCERs). A crediting period shall not extend beyond the operational lifetime of the CDM programme activity.

Starting date, type (fixed or renewable) and duration of the crediting period of the CPA shall be decided taking into account that the starting date of a crediting period of the CPA shall be the date of its inclusion in the registered PoA or any date thereafter and that the duration of the crediting period shall not exceed the end date of the PoA.

The crediting period of a CPA will be either a maximum of seven years (twenty years for A/R project activities) which may be renewed at most two times or a maximum of ten years (thirty years for A/R project activities) with no option of renewal. However, the duration of crediting period of any CPA shall be limited to the end date of the PoA regardless of when the CPA was added.

The latest version of the "Procedures for Renewal of a Crediting Period of a Registered CDM project activity" shall be applied, *mutatis mutandis*, to a PoA every seven years (twenty years for A/R project activities). Any resulting changes to the PoA shall be applied by each CPA at the time of the first renewal of its crediting period after such change to the PoA. In case of multiple host Parties, only those CPAs which can apply these changes may renew their crediting period.

**De-bundled CDM programme activity**

For the purposes of registration of a Programme of Activities (PoA)3 a proposed small-scale CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity, which:

a. Has the same activity implementer as the proposed small-scale CPA or has a coordinating or managing entity, which also manages a large scale PoA of the same sectoral scope, and;

b. The boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

2. If a proposed small-scale CPA of a PoA is deemed to be a debundled component in accordance with paragraph 1 above, but the total size of such a CPA combined with a registered small-scale CPA of a PoA or a registered CDM project activity does not exceed the limits for small-scale CDM and small-scale

Only those PoAs need to be considered in determining de-bundling that are: (i) in the same geographical area;and (ii) use the same methodology; as the PoA to which proposed CPA is being added.

**Designated operational entity (DOE)**
An entity designated by the COP/MOP, based on the recommendation by the Executive Board, as qualified to validate proposed CDM project activities as well as verify and certify reductions in anthropogenic emissions by sources of greenhouse gases (GHG) and net anthropogenic GHG removals by sinks. For the programme of activities, a DOE shall perform either validation/inclusion or verification/certification functions for a PoA, including SSC PoA and SSC-AR PoA. Upon request the Board may allow a DOE to perform all these functions within a single PoA. DOEs can be accredited by CDM EB for one or more sectoral scopes out of fifteen listed on UNFCCC website.

**Duration of the programme of activities**
The duration of the PoA, shall not exceed 28 years and 60 years for A/R project activities. The duration of the PoA shall be defined by the entity at the time of request for registration of the PoA. Any CPA can be added to the PoA at any time during the duration of the PoA by the coordinating/managing entity. The entity shall inform the CDM Executive Board of the adding of CPA(s) through a DOE using a predefined format.

**Environmental Analysis**
Environmental analysis of the PoA shall be carried out as per requirements of the CDM modalities and procedures. If this analysis is not undertaken for the PoA but is to be done at the CPA level this shall be described and reflected in the CDM programme of activities design document (CDM-POA-DD) and the CDM programme activity design document (CDM-CPA-DD).

**Monitoring plan**
Monitoring Plan shall include description of the proposed statistically sound sampling method/procedure to be used by DOEs for verification of the amount of reductions of anthropogenic emissions by sources or removals by sinks of greenhouse gases achieved by CPAs under the PoA. In case the coordinating/managing entity opts for a verification method that does not use sampling but verifies each CPA (whether in groups or not, with different or identical verification periods) a transparent system is to be defined and described that ensures that no double accounting occurs and that the status of verification can be determined anytime for each CPA.

**Operational and management arrangements**
Operational and management arrangements established by the coordinating/managing entity for the implementation of the PoA, include a record keeping system for each CPA under the PoA, a system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as CDM project activity or as a CPA of another PoA, the provisions to ensure that those operating the CPA are aware and have agreed that their activity is being subscribed to the PoA.

**Operational lifetime of a project activity or CPA**
It is defined as the period during which the project activity or CPA is in operation. No crediting period shall end after the end of the operational lifetime (calculated as from starting date).

**Programme of activities**
A programme of activities is a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to anthropogenic GHG emission reductions or net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of CPAs.

**Project boundary or boundary of CDM programme activity**
The project boundary shall encompass all anthropogenic emissions by sources of greenhouse gases (GHG) under the control of the project participants that are significant and reasonably attributable to the CDM project activity.

The Panel on methodologies (Meth Panel) shall develop specific proposals for consideration by the Executive Board on how to operationalize the terms "under the control of", "significant" and "reasonably attributable", as contained in paragraph 52 and appendix C, paragraphs (a) (iii) and (b) (vi) of the CDM modalities and procedures. Pending decisions by the Executive Board on these terms, project participants are invited to explain their interpretation of such terms when completing and submitting the CDM-NM.

**Public funding**
In case public funding is used for a PoA a confirmation that official development assistance is not being diverted to the implementation of the PoA shall be included in the PoA design document.

**Renewable Biomass**
Biomass is "renewable" if one of the following five conditions applies:

1. The biomass is originating from land areas that are forests (forest definitions as established by the country in accordance with the decisions 11/CP.7 and 19/CP.9 should apply) where:

    (a) The land area remains a forest; and

    (b) Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and

    (c) Any national or regional forestry and nature conservation regulations are complied with.

2. The biomass is woody biomass and originates from croplands and/or grasslands where:

    (a) The land area remains cropland and/or grasslands or is reverted to forest; and

    (b) Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and

    (c) Any national or regional forestry, agriculture and nature conservation regulations are complied with.

3. The biomass is non-woody biomass and originates from croplands and/or grasslands where:

    (a) The land area remains cropland and/or grasslands or is reverted to forest; and

    (b) Sustainable management practices are undertaken on these land areas to ensure in particular

4. that the level of carbon stocks on these land areas does not systematically decrease over time

5. (carbon stocks may temporarily decrease due to harvesting); and

(a) Any national or regional forestry, agriculture and nature conservation regulations are complied with.

6. The biomass is a biomass residue and the use of that biomass residue in the project activity does not involve a decrease of carbon pools, in particular dead wood, litter or soil organic carbon, on the land areas where the biomass residues are originating from. For example, if bagasse from sugar production would in the absence of the CDM be dumped or left to decay and is used for energy generation under the CDM, it can be assumed that the use of the bagasse does not affect the sugar cane cultivation practices and hence the carbon pools of the respective soils. In contrast, where a CDM project involves the collection of dead wood from a forest, which would not be collected in the absence of the CDM, the extracted biomass cannot be regarded as renewable, since it would result in a decrease of carbon stocks.

7. The biomass is the non-fossil fraction of an industrial or municipal waste.

Otherwise, where none of these conditions applies, the biomass is considered as "non renewable".

**Stakeholders**

Stakeholders mean the public, including individuals, groups or communities affected, or likely to be affected, by the proposed CDM project activity or actions leading to the implementation of such an activity.

**Starting date of a CDM programme activity**

The starting date of a CDM programme activity is the earliest date at which either the implementation or construction or real action of a programme activity begins. The starting date of the CPA cannot be before the date of registration of the PoA.