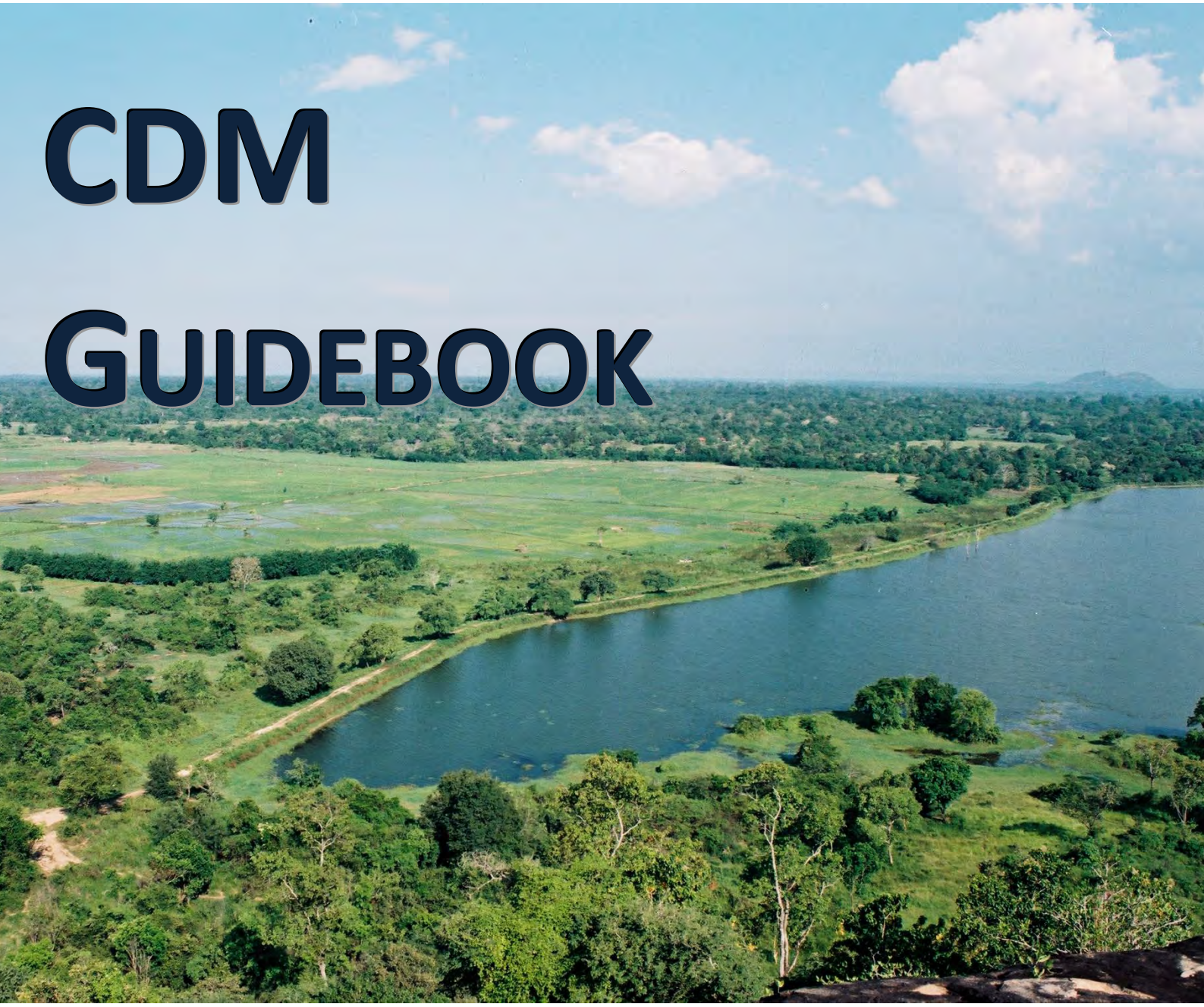


CDM GUIDEBOOK

OCTOBER 2011

CLIMATE CHANGE SECRETARIAT, MINISTRY OF ENVIRONMENT, SRI LANKA

JAPAN INTERNATIONAL COOPERATION AGENCY

Contents

1. INTRODUCTION

The Democratic Socialist Republic of Sri Lanka, located about 80 km to the southeast of the Indian sub-continent, is an island nation in the Indian Ocean, comprising of a mainland of 65,610 km^2 and a large number of small islands off the northwest coast. The island consists mostly of flat-to-rolling coastal plains, with mountains rising only in the south-central part. Along the coastline of about 1,585km, the country is blessed with various natural beauties such as sandy beaches, sand dunes, lagoons, estuaries, marshes, mangroves and deltas. Along with the other island nations, Sri Lanka is highly vulnerable to climate change having a history of fighting with natural disasters brought by extreme weather events. According to the 2nd National Communication on Climate Change prepared by the Ministry of Environment in December 2010, the potential impacts of climate change are considered significant in the four sectors, i.e. agriculture, water resources, human health and coastal zone. The tea industry, the country's major exporting industry is vulnerable to climate change as represented by the depletion of tea harvests due to a serious drought in 2009. Climate change adaptation is of the important challenge for maintaining the country's socio-economic development in Sri Lanka.

On the other hand, the global efforts of climate change mitigation provide Sri Lanka the opportunities of socio-economic growth through accelerated social infrastructure development. The Clean Development Mechanism under Kyoto Protocol of 1997 allows the so-called ANNEX I countries (mainly developed countries) to buy the amount of greenhouse gases (GHGs) reduction in the form of carbon credit or Certified Emission Reduction (CER) that is achieved by a project conducted in the non-ANNEX I countries including Sri Lanka. Utilizing this mechanism, Sri Lanka has 7 (seven) officially registered CDM projects among which 4 (five) have already obtained CER for sale in the carbon market. The types of CDM projects currently undertaken in Sri Lanka include 5 (five) small hydropower plants and 2 (two) biomass energy utilizations. Renewable energy is one of the potential sectors of development that can be promoted under the scheme of CDM in Sri Lanka. Many other development initiatives can also be boosted under CDM, i.e. fuel switch to low carbon fuels, energy efficiency improvement in various sectors (power, industry), waste management, and so forth. Many of climate change mitigation technologies and measures are expected to serve for the country's social infrastructure development.

This CDM Guidebook is prepared for the wide use by all the stakeholders involved in the process of the country's sustainable development, ranging from policy makers working in the government sector to the private sector project developers. It specifies the types of climate change mitigation projects by sectors with the guidance of how to develop them as CDM with additional financing from CERs or carbon credit. It also addresses the latest discussions in the international community over the post-Kyoto climate change mitigation regime including the new financial assistance scheme under bilateral carbon credit mechanism.

2. CDM AND POST-KYOTO MECHANISM UNDER DISCUSSION

2.1 Overview of Global GHGs Emissions

2.1.1 Global GHGs emission by types and sectors

According to the 4th IPCC assessment report published in 2007, the global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004, as shown in the figure below. Carbon dioxide (CO2) is the most important anthropogenic GHG, of which annual emissions have grown between 1970 and 2004 by about 80%, from 21 to 38 gigatonnes (Gt), and represented 77% of total anthropogenic GHG emissions in 2004. In terms of type of GHGs, CO2 from fossil fuels represents the largest percentage of global GHGs emission with 56.6%, followed by CO2 emission from deforestation, decay of biomass and other sources (20.1%). CH4 emission accounts for 14.3% of the total GHGs emission while N2O represents 7.9% in the year of 2004.

In terms of sectors, the emission from energy supply (mainly electricity) is the largest with the share of 25.9%, followed by industry (19.4%) and forestry (17.4%). The GHGs emissions from agriculture and transport are more or less 13% of the global emission respectively.

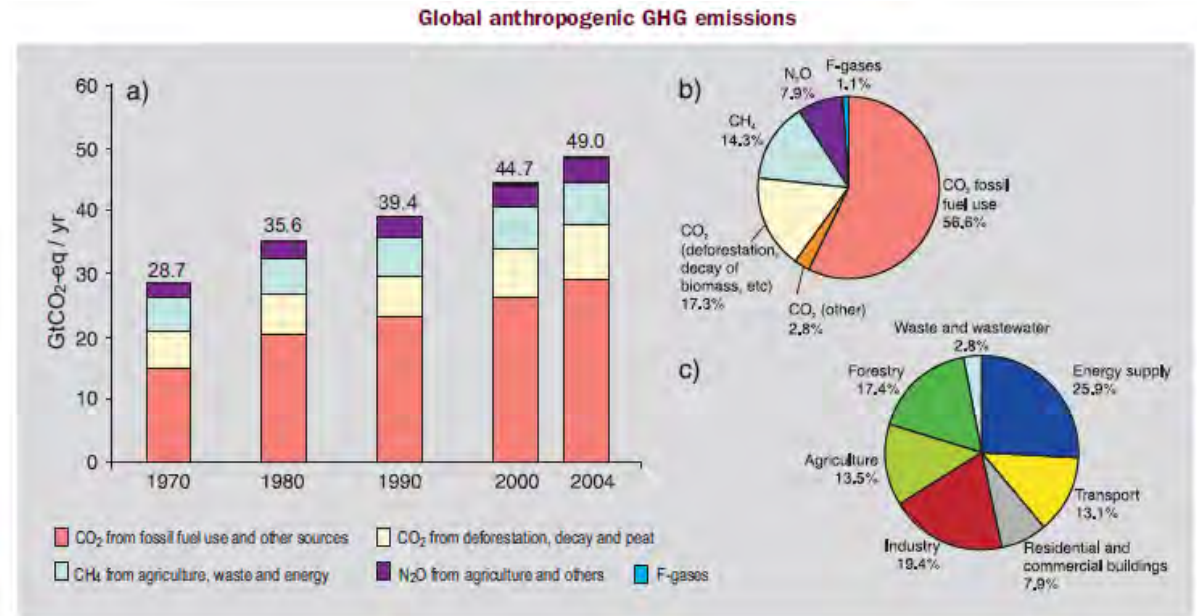


Figure 1: Global Trend of anthropogenic GHG Emissions

a) Global annual emissions of anthropogenic GHGs from 1970 to 2004
b) Share of different anthropogenic GHGs in total emission in 2004 in terms of CO_2 equivalent.
c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2 equivalent.

Source: IPCC 4th assessment report (2007)

2.1.2 Difference in per capita and GDP Emissions among the countries

Difference in per capita and GDP emissions among the countries remain significant as shown in the following 2 (two) figures. Developing countries (UNFCCC Annex I countries) hold a 20% share in the world population but account for 46.4% of global GHG emissions. In contrast, the 80% of the world population living in developing countries (non-Annex I countries) account for 53.6% of GHG emissions. Based on the metric ton of GHG emission per unit of economic output (per GDP in power purchasing parity), Annex I countries generally display lower GHG intensities per unit of economic production process than non-Annex I countries

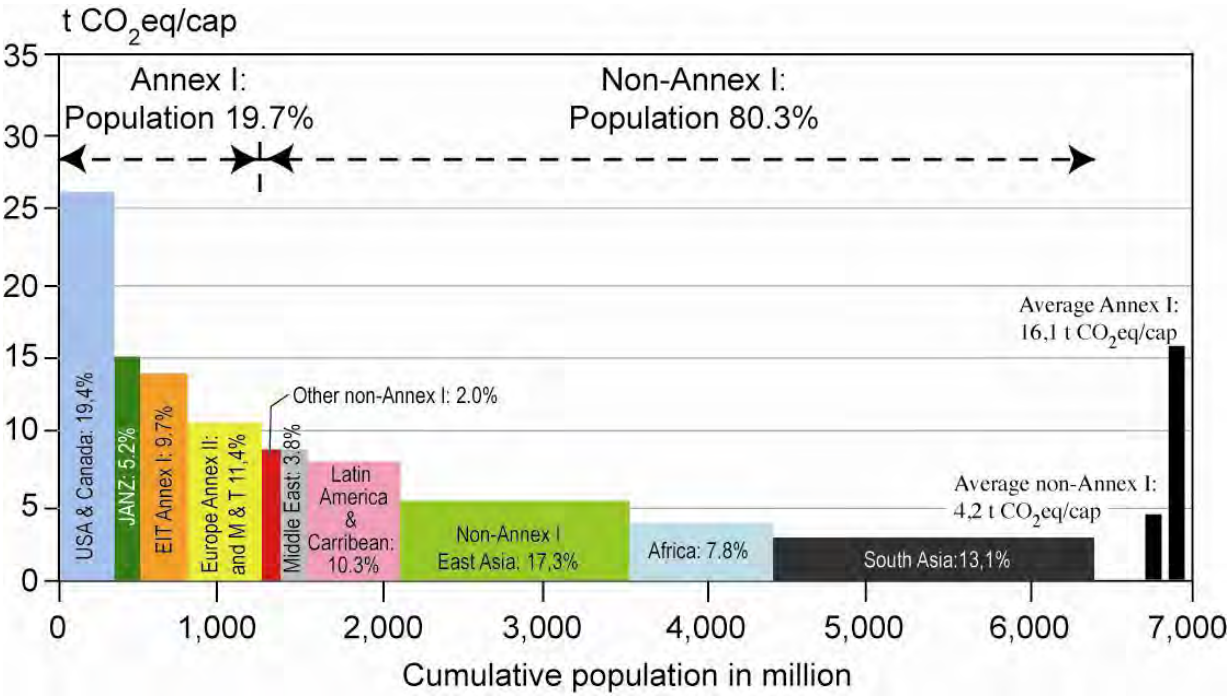


Figure 2: Difference in per Capita CO_2 Emission among the Countries

Source: IPCC 4th assessment report (2007)

As shown above, the average per capita CO_2 emission in Annex I countries is approximately fourfold of Non-Annex I countries. In terms of per GDP CO_2 emission based on PPP (Purchasing Power Parity), the average of Non-Annex I countries is larger by more or less 50% than Annex I countries.

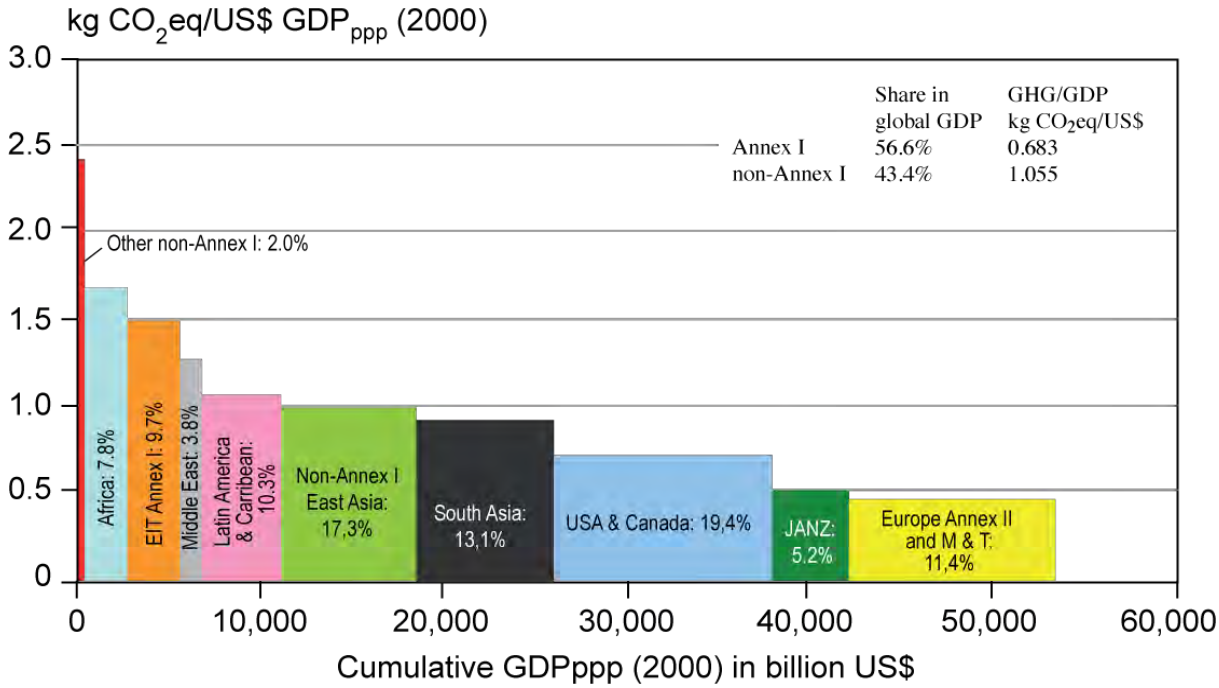


Figure 3: Difference in per GDP CO_2 Emission among the Countries

Source: IPCC 4th assessment report (2007)

According to the latest direct CO_2 emission data from human activities in ―Millennium Development Goals Indicators" of the United Nations Statistics Division, the global direct CO_2 emission has reached 30 billion tons in 2008 with the countries' share as shown in the figure below.

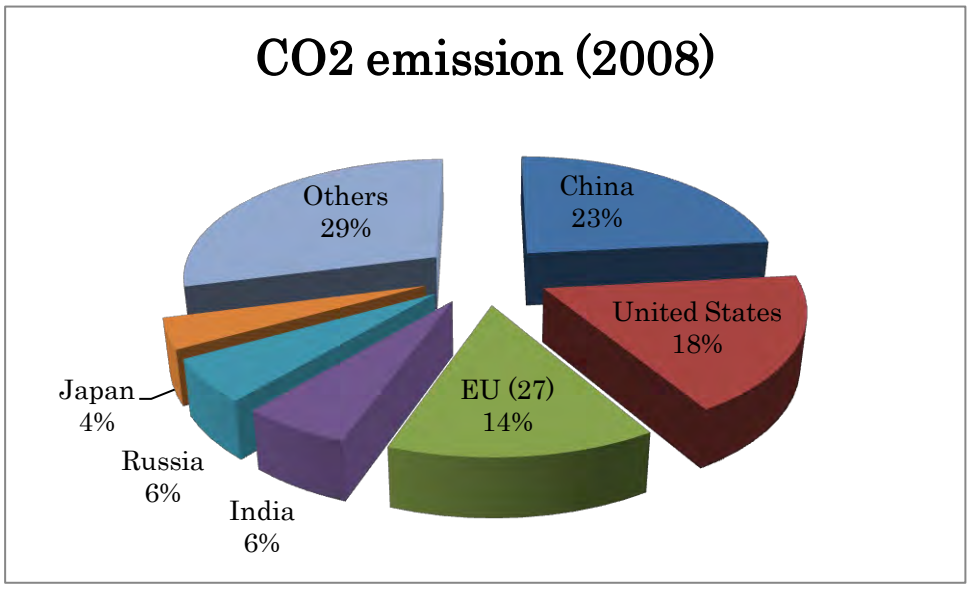
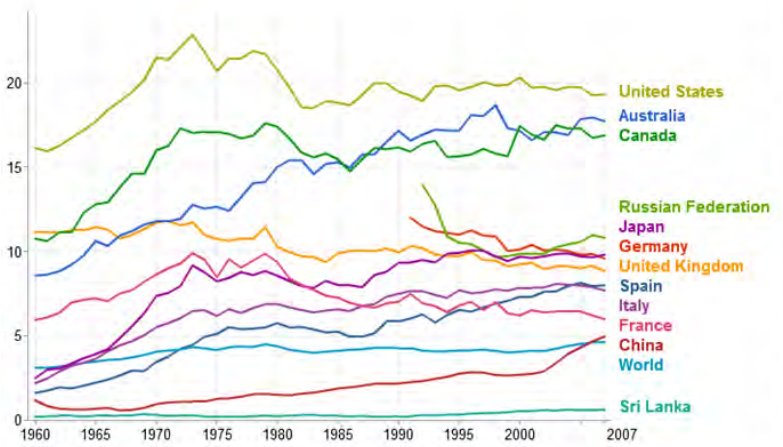


Figure 4: Shares of direct CO_2 emission by countries and regions (2008)

Source: Millennium Development Goals Indicator, United Nations Statistics Division.

On the other hand, the figure below shows the trend of CO_2 emission by countries from 1960 to 2007 according to the "World Development Indicator" of the World Bank in 2011.



USA	19.3
Australia	17.7
Canada	16.9
Russian Fed.	10.8
Japan	9.8
Germany	9.6
UK	8.8
Spain	8.0
Italy	7.7
France	6.0
China	5.0
Sri Lanka	**0.6**
World	**4.6**

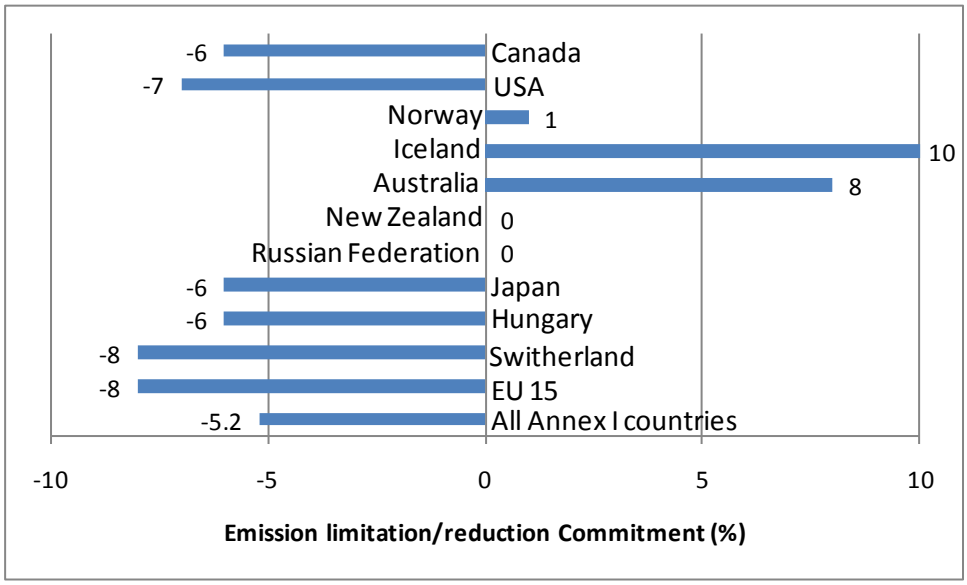
Figure 5: Trend of per capita CO_2 emission by countries (1960-2007)

Source: World Development Indicator, World Bank (2010)

The United States is the highest per capita CO_2 emission of 19.8 tonnes, followed by Australia (17.7 tonnes), and Canada (16.9 tonnes). Although China is the largest country of CO_2 emission and shows a drastic increase since 2007, its per capita emission remains at 4.6 tonnes of CO_2, slightly higher than the world average and one-fourth of the United States. The per capita CO_2 emission of Sri Lanka is about one-eighth of China and the world average, far below the Annex I countries'.

2.2 CDM and GHGs Emission Reduction Commitment in Kyoto Protocol

The Clean Development Mechanism (CDM) is one of the "flexibility" mechanisms defined in the Kyoto Protocol. It is defined in Article 12 of the Protocol, and is intended to meet two objectives: (1) to assist parties not included in Annex I (inc. Sri Lanka) in achieving sustainable development and in contributing to the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC), which is to prevent climate change; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments (greenhouse gas (GHG) emission caps). "Annex I" parties are those countries that are listed in Annex I of the Convention, with the quantified GHG emission limitation and reduction commitments as shown in the figure below.



Remark: USA is not bound by the commitment above as it does not ratify Kyoto Protocol.

Figure 6: GHG emission limitation/reduction commitment of ANNEX I countries

The next table below compiles the emission reduction commitment of the Annex I countries and their achievement until the year 2008.

Reduction commitments of the Kyoto protocol and emissions development

Party	Reduction commitments	Emissions 1990 in Mt	Emissions 2000 in Mt	Emissions 2008 in Mt	Change 1990-2008
EU	-8 %	4 245	4 114	3 970	-6.5 %
Liechtenstein, Monaco, Switzerland	-8 %	53	52	54	+0.5 %
Bulgaria, Czech Republic, Estonia, Latvia, Lithunia, Romania, Slovakia, Slovenia	-8 %	814	469	487	-40.2 %
USA	-7 %	6 112	7 008	6 925	+13.3 %
Japan	-6 %	1 269	1 344	1 282	+1.0 %
Canada	-6 %	592	717	734	+24.1 %
Poland, Hungary	-6 %	679	467	469	-30.9 %
Croatia	-5 %	31	26	31	-0.9 %
New Zealand	0 %	61	70	75	+22.8 %
Russian Federation	0 %	3 322	2 025	2 230	-32.9 %
Ukraine	0 %	928	393	428	-53.9 %
Belarus	0 %	140	79	91	-35.1 %
Norway	+1 %	50	53	54	+8.0 %
Australia	+8 %	418	496	550	+31.4%
Iceland	+10 %	3	4	5	+42.9 %
Total	**-5,2 %**	**18 717**	**17 318**	**17 383**	**-7.1 %**

Source: UNFCCC, these values refer to carbon dioxide equivalents excluding land-use change and forestry

Remark: USA is not bound by the commitment above as it does not ratify Kyoto Protocol.

Table 1: Reduction Commitment of the Kyoto Protocol and Achievement of the Annex I Countries

Source: World Development Indicator, World Bank (2010)

Although the aggregated GHGs emission reduction target of Annex I countries has been achieved in 2008, many of them actually increased their emissions except for the countries of its economies in transition at the time of UNFCCC adoption such as the countries that had been the allies of the former Soviet Union.

2.3 Basic Definition of CDM

The clean development mechanism (CDM) is a project-based mechanism under the Kyoto Protocol to the UNFCCC that enables the generation and issuance of certified emission reductions (CERs) from eligible CDM project activities. (CDM is a mechanism based on the provisions of Article 12 of the Kyoto Protocol.)

It is a scheme to support greenhouse gas (GHG) emission reduction through cooperation between developed countries (Annex I Parties to the UNFCCC), which are committed to certain GHG emission reduction targets under the Kyoto Protocol, and developing countries (Non-Annex I Parties), which do not have any commitments to reduce GHG emissions. The purpose of the CDM is to assist in accomplishing the GHG reduction targets of Annex I Parties (investing countries) under the Kyoto Protocol, as well as to contribute to the sustainable development of Non-Annex I Parties (host countries). Under the CDM, Annex I Parties implement projects resulting in reduction of GHG emissions within the territories of Non-Annex I Parties. The relationship between non-Annex I and Annex I countries in CDM project can be illustrated in the figure below.

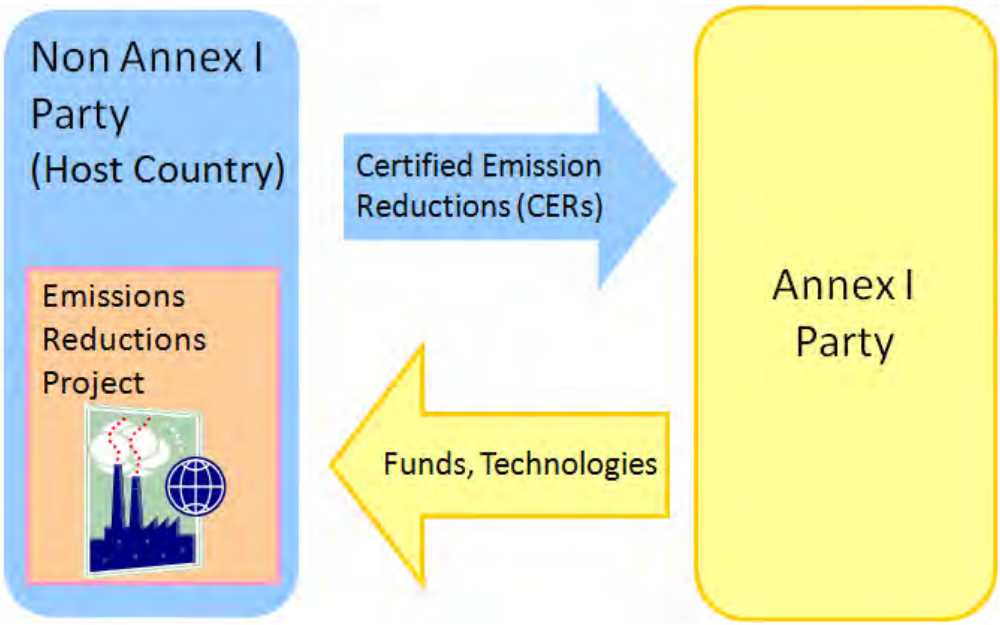


Figure 7: Relationship between non-Annex I and Annex I countries in CDM project

CDM project generally proceeds in the following way.

- Annex I Parties which have ceilings for GHG emissions (emission caps), assist non-Annex I Parties which do not have emission caps, to implement project activities to reduce GHG emissions (or remove GHGs by sinks), and credits (carbon credits) will be issued based on the amount of GHGs emission reductions (or removals by sinks) achieved by the project activities. In the project activities under CDM:
  - A Party who participates in CDM project from the country where it is implemented, is called a **Host Party**.
  - The credit given to the CDM project that achieves actual GHG emission reduction/removal is called **Certified Emission Reduction (CER)**.
  - Reductions in GHGs emissions achieved by the CDM project have to be **additional** to any that would occur in the absence of the above CDM project activity.
- Annex I Parties can use CERs to contribute to compliance of their quantified GHG emissions reduction targets of the Kyoto Protocol. As a result, the amount of emission cap of Annex I Parties will increase as shown in the figure below.

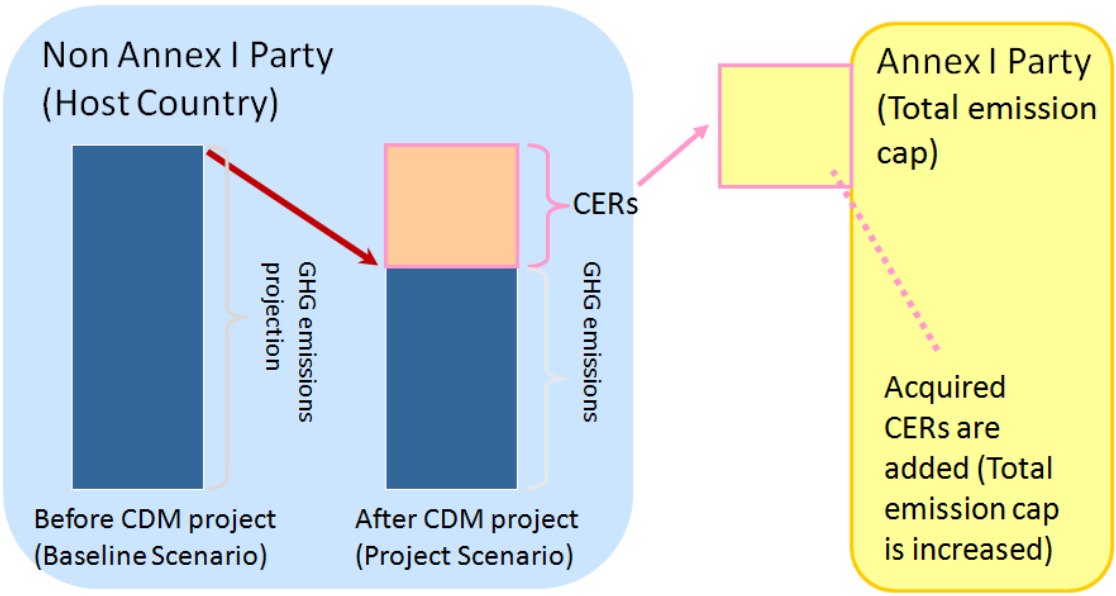


Figure 8: Basic Framework of CDM Project and CER Transaction

Every CDM project is required to comply with the following conditions:

- CDM project must be hosted by Non-Annex I Parties that have ratified the Kyoto Protocol and established a designated national authority (DNA);
- CDM project must be developed by public or private entities authorized by the relevant host Party and

Annex I Party involved in the project activity;

- CDM project must be validated by a designated operational entity (DOE) in accordance with the CDM project eligibility and participation requirements, including the use of an approved baseline and monitoring methodology;
- CDM project must be registered by the CDM Executive Board after review by a Registration and Issuance Team (RIT) to ensure compliance with the international rules; and
- Once commissioned and operational, CDM project must be verified and certified by a DOE as resulting in real, additional, measurable and verifiable reductions in greenhouse gas emissions below an approved business as usual baseline scenario.

CERs issued by the CDM Executive Board can be transferred under private commercial arrangements between the project participants to Annex I Parties. CERs can then be used along side other Kyoto credits to satisfy Parties' legally binding quantified emission limitation and reduction commitments (often referred to as ~~"K~~Kyoto Targets").

2.4 Institutional Mechanism for CDM Project Administration in the UNFCCC

To administer CDM project development procedure at global scale, UNFCCC established the institutional mechanism illustrated in the figure below.

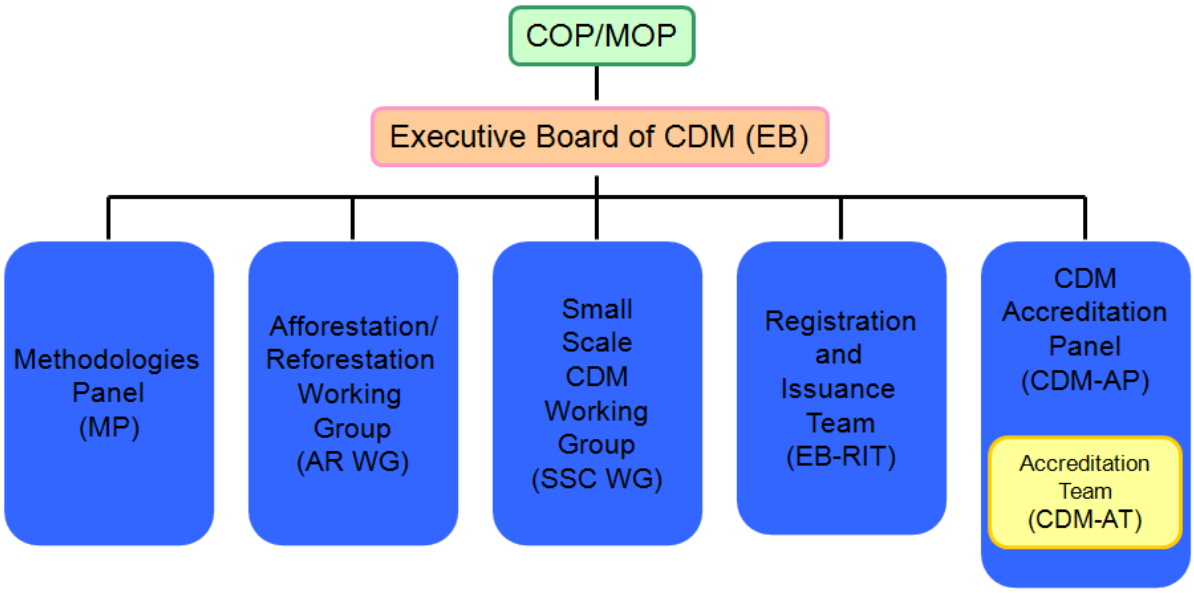


Figure 9: Instituional Mechanism for CDM Project Management in the UNFCCC

The mandates and key roles of each organization in Figure 9 are as follows.

A. COP/MOP (CMP)

The Conference of the Parties, serving as the meeting of the Parties to the Kyoto Protocol (CMP), is the ultimate CDM decision-making body under the UNFCCC [EB53, Annex38, para.3].

CMP has the authority over, and provides guidance to, EB (Executive Board of CDM) through adoption of the decisions and resolutions, published in reports of the CMP.

CMP sets direction and establishes precedents which serve as the reference for future decision making and the basis for operating procedures. CMP decisions are treated as directives—mandatory requirements or rules intended to ensure the successful implementation of the Kyoto Protocol (KP).

All decisions taken by the EB must be consistent with and not contradict decisions of the CMP.

In addition to the above, CMP also performs the following roles [CMP/2005/8/Add.1, p. 7, para.2–4]:

- To provide guidance to the EB by taking decisions on the recommendations made by the EB on its rules and procedure, and in accordance with provisions of decision 17/CP.7 [CP/2001/13/Add.2, p.20–49], the present annex, and relevant decisions of the CMP
- To provide guidance to the EB by taking decisions on the designation of operational entities (OEs) accredited by the EB
- To review annual reports of the EB
- To review the regional and sub-regional distribution of DOEs and CDM project activities

B. Executive Board of the CDM (EB)

For the actual operation of the CDM, the Executive Board of the CDM (EB) is the body that supervises the CDM, under the authority and guidance of the CMP [CDM M&P, para.5]. The EB is comprised of ten members and ten alternates from Parties to the Kyoto Protocol. Since the EB held its first meeting in November 2001, it has been holding a meeting every two to three months.

Decisions of the EB must be consistent with and support the formal decisions of the CMP, are hierarchical in nature, and are published in the meeting reports of the EB and their accompanying annexes. Taking into account both the rule-making and rule-enforcing roles of the EB, decisions of the EB can be divided into three main categories [EB53, Annex 38, para.4, 5, 7], i.e.:

- Regulatory decisions relating to the supervision of the CDM in implementing its modalities and

procedures throughout the project activity cycle;

- Rulings relating to compliance with the CDM modalities and procedures by the project participants, applicant entities (AE), and/or DOEs, including the following categories: accrediting and provisionally designating operational entities; approving methodologies; registering CDM project activities; issuing certified emissions reduction units; and
- Operational decisions relating to the functioning of the regulatory body.

Regulatory decisions are intended to ensure the successful implementation of the modalities and procedures for a CDM project. Such decisions, when not included in the main body of the EB meeting report, are published in the following categories [EB53, Annex 38, para.6].

➢ Standards

A standard provides specifications, or describes a mandatory level of performance, and as such, is used as a reference point against which attainment can be evaluated. Standards include approved methodologies with their associated tools.

➢ Procedures

A procedure contains a mandatory series of actions that must be undertaken to satisfy specific requirements of the CDM modalities and procedures. Procedures ensure that project participants and DOEs comply with the applicable decisions or standards issued by the CMP and/or EB in a uniform and consistent way. Procedures relate to processes in the project activity cycle, rules of procedure and terms of reference.

➢ Guidelines

A guideline contains supplemental information such as acceptable methods for satisfying requirements described in procedures or standards.

✓ Clarifications

A clarification is issued to alleviate confusion relating to the application of a standard or procedure published within the main body of the meeting report.

The EB may also establish committees, panels, or working groups to assist it in the performance of its functions [CDM M&P, para.18]. The EB has thus far established the following panels and working groups as described in the following sections.

C. Methodologies Panel (MP)

The Methodologies Panel (MP) was established to develop recommendations to the EB on guidelines for methodologies for baselines and monitoring plans, and prepare recommendations on submitted proposals for

new baseline and monitoring methodologies.

The MP is responsible for making recommendations to the EB on baseline and monitoring methodologies, revisions to the project design document (PDD) template, etc. [EB46, Annex12, para.2–3].

The MP is composed of 20 members, including two who come from the EB and act as chair and vice-chair of the panel, while two other members come from the EB to support the chair and vice-chair. In addition to the designated EB members, the panel is composed of 16 members [EB46, Annex12, para.5].

D. Afforestation and Reforestation Working Group (A/R WG)

The A/R WG is responsible for recommendations to the EB on baseline and monitoring methodologies for A/R CDM, revisions to the PDD for A/R CDM, etc. [EB23, Annex14, para.2–3].

The A/R WG is composed of ten members, including two who are members or alternate members of the EB and who act as chair and vice-chair of the WG, respectively.

In addition to the chair and vice-chair, the WG is composed of eight members [EB23, Annex14, para.5; EB 31, para.48].

E. Small-Scale Working Group (SSC WG)

The SSC WG was established to prepare recommendations on submitted proposals for new baseline and monitoring methodologies for small-scale CDM project activities, etc. [EB23, Annex20, para.II(1)].

The SSC WG is composed of eight members, including two who are members or alternate members of the EB and who act as chair and vice-chair of the WG, and two who are members from the Meth Panel [EB23, Annex20, para.II(3); EB38, para.38].

F. Registration and Issuance Team (RIT)

The RIT serves to prepare appraisals of requests for registration and issuance of CERs, and assessing whether their requirements are met and/or appropriately dealt with by DOEs for consideration by the EB [EB46, Annex58, para.5]. The RIT is composed of not less than 20 members [EB46, Annex58, para.7].

G. CDM Accreditation Panel (CDM-AP)

The CDM Accreditation Panel (CDM-AP) was established to prepare the decision making of the EB in accordance with the procedure [EB34, Annex1] for accrediting operational entities. The CDM-AP is composed of ten members, including two who come from the EB act as chair and vice-chair.

In addition to the designated EB members, the panel is composed of eight members [EB23, Annex1, para.13;

EB33, para.16].

The CDM-AP is responsible for recommendations to the EB on the accreditation of applicant entities (AEs), suspension, withdrawal, and/or re-accreditation of accreditation of a DOE, etc. [EB23, Annex1, para.4].

The CDM-AP carries out the selection of the members of a CDM accreditation assessment team (CDM-AT) [EB23, Annex1, para.5]. The CDM-AT, under the guidance of the CDM-AP, undertakes the detailed assessment of the AEs and/or DOEs, identifies nonconformities, and reports to the CDM-AP [EB34, Annex 1, para.3(d)].

The EB revised the "CDM accreditation standard for operational entities" [EB56, Annex1], which becomes effective on 17 March 2011 [EB56, para.12].

2.5 CDM Project Stakeholders

Outside the institutional mechanism for CDM project administration in the UNFCCC, there are various project stakeholders who are directly or indirectly involved in CDM project. It includes various stakeholders from the public as well as private sectors. The figure below illustrates the relationship among various CDM project stakeholders.

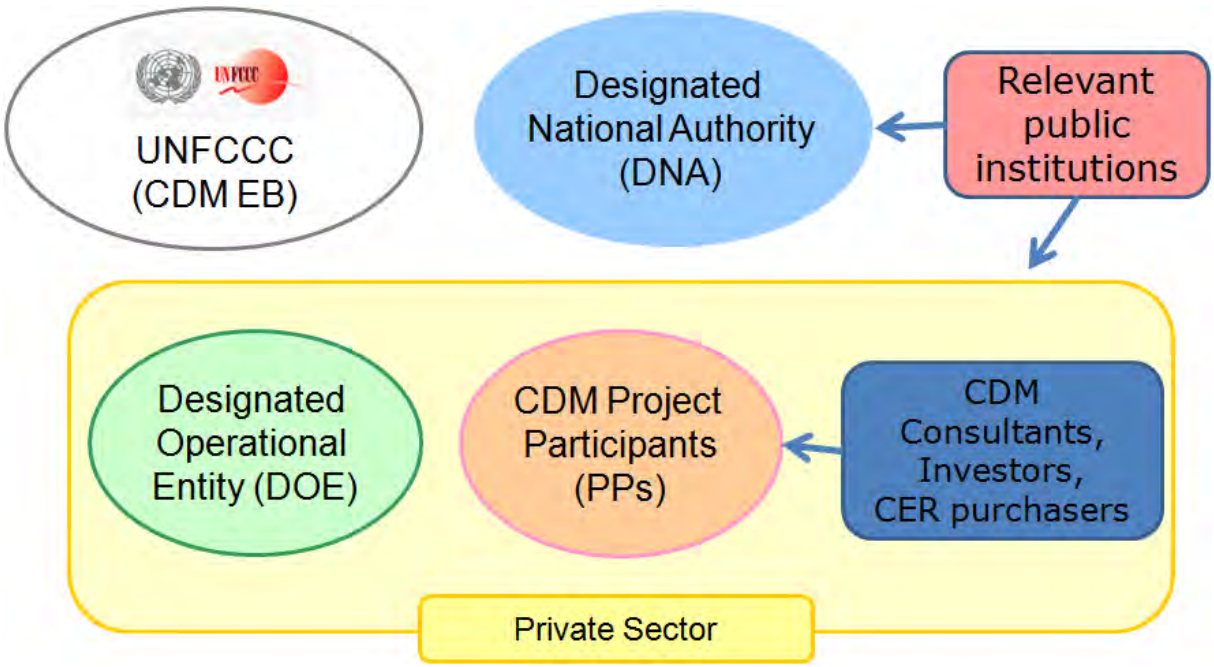


Figure 10: Relationship among various CDM project stakholders

The main functions of key CDM project stakeholders are described below.

A. CDM Project Participant (PP)

A CDM Project participant (PP) is (a) a Party involved, which has indicated to be a project participant, or (b) a private and/or public entity authorized by a Party involved to participate in a CDM project activity.

B. Designated Operational Entity (DOE)

A Designated Operational Entity (DOE) is either a domestic legal entity or an international organization accredited and designated, on a provisional basis until confirmed by the CMP, by the EB.

A DOE has the following two key functions in the CDM project cycle:

- Validation: It validates and subsequently requests registration of a proposed CDM project activity.
- Verification and Certification: It verifies the emission reduction of a registered CDM project activity, certifies as appropriate, and requests the EB to issue certified emission reductions (CERs) accordingly.

A DOE can perform either validation or verification and certification on the same CDM project activity. However, upon request, the EB may allow a single DOE to perform all these functions within a single CDM project activity [CMP/2005/8/Add.1, p.12, para.27(e)]. In the case of a small scale CDM (SSC) project activity, the same DOE may undertake validation, verification, and certification.

The EB requested AEs/DOEs to implement the Validation and Verification Manual (hereinafter referred to as VVM) [EB44, Annex3] with immediate effect and to fully integrate the requirements of VVM into their management system, and then adopted the VVM [EB51, Annex3] and approved its revised version of 1.2 [EB55, Annex1]. The EB further noted that it has been and remains essential for all AEs/DOEs to validate and verify the requirements included in the VVM [EB44, para.11–12]. The EB has adopted the guidelines for the preparation of the annual activity report by DOEs [EB53, Annex4] (this guideline will expire on 17 March 2011, to be replaced that day by the "CDM accreditation standard for operational entities" [EB56, para.12]), and has also asked the secretariat to introduce a requirement for DOEs to publish a monitoring report at least two weeks prior to undertaking a verification site visit [EB52, para.13].

C. Designated National Authority (DNA)

The designated national authority (DNA) is the body granted responsibility by a Party to authorize and approve participation is CDM projects. The CDM rules provide only limited guidance on the role of the DNA or the requirements for establishing a DNA. These issues are instead left to the Party to determine. Establishment of a DNA is one of the requirements for participation by a Party in the CDM.

The role of the DNA is to provide the letter of approval to project participants in CDM projects. In the case of the host Party DNA, this letter of approval must confirm that the project activity contributes to sustainable

development in the country:

The designated operational entity shall:

- Prior to the submission of the validation report to the Executive Board, have received from the project participants written approval of voluntary participation from the designated national authority of each Party involved, including confirmation by the host Party that the project activity assists it in achieving sustainable development (3/CMP.1, Annex, para.40(a)).

2.6 Project Types of CDM

2.6.1 Types of GHGs and Emission Sources

The 6 types of greenhouse gases are designated for their global reduction in the Kyoto Protocol, i.e. Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulfur Hexafluoride (SF_6). The table below clarifies the major emission sources and global warming potential (GWP) of each GHGs.

Table 2: Major Emission Sources and Global Warming Potential (GWP) of GHGs

Type of GHGs	GWP	Major Emission Sources
CO_2	1	▪ Fossil fuels combustion (stationary and mobile combustion and fugitive emissions) ▪ Biomass fuels combustion (However, biomass fuel is recognized as carbon-neutral as far as it is used in a sustainable manner.) ▪ Leakage from fuels ▪ Emissions from industrial process (non-energy process) ➢ Potteries/ceramic/cement industries (cement/lime production, dolomite use) ➢ Chemicals (ammonia production, carbide production, titanium dioxide production, soda ash production, petrochemical and carbon black production. ➢ Metal industry (iron & steel and metallurgical coke production, ferroalloy production, primary aluminium production, magnesium production, lead production, and zinc production) ▪ Use of non-energy products from fuels (lubricant, paraffin waxes) ▪ Waste handling and management ➢ Waste incineration (including waste-to-energy) ➢ Decomposition of surface-active agents ▪ Agriculture, forestry and other land use (Emission from agricultural soil) ▪ Emission from liming soils to reduce soil acidity and improve plant growth in managed lands (agriculture, forestry, etc.) ▪ Emission from urea fertilization. ▪ Emission from harvested woods
CH_4	21	▪ Fuel (Fossil and biomass fuels) combustion (stationary and mobile combustion and fugitive emissions) ▪ Leakage from fuels ▪ Emissions from industrial process (non-energy process)

Type of GHGs	GWP	Major Emission Sources
		➢ Chemicals (carbide production, petrochemical and carbon black production) ➢ Metal Industry (iron & steel and metallurgical coke production, ferroalloy production) ▪ Agriculture, forestry and other land use ➢ Agricultural residue burning ➢ Enteric fermentation of livestock animals ➢ Animal manure management ➢ Emission from flooded paddy fields ▪ Waste handling and management ➢ Emission from waste disposal site ➢ Bio-treatment of waste (composting, anaerobic treatment, etc.) ➢ Incineration and open burning of waste ➢ Wastewater treatment
N_2O	310	▪ Fuel (Fossil and biomass fuels) combustion (stationary and mobile combustion and fugitive emissions) ▪ Leakage from fuels ▪ Emission from industrial process (non-energy process) ➢ Chemicals (nitric acid production, adipic acid production, caprolactam, glyoxal and glyoxylic acid production, ➢ Metal industry (ferroalloy production) ▪ Solvent and other product use ▪ Agriculture, forestry and other land use (N_2O emission from soils through nitrification or denitrification.) ▪ Emission from peatlands during peat extraction. ▪ Emission from livestock manure management ▪ Emission from incineration and open burning of waste ▪ Emission from wastewater
HFCs	1,300	▪ Industrial processes ➢ Fluorochemical production (from by-products and fugitive emission) ➢ Magnesium production (primary ingot casting, other casting processes) ➢ Electronic industry (Integrated circuit/semiconductors, TFT flat panel display, photovoltaics ▪ Product use as substitutes for ozone depleting substances ➢ Refrigeration and air conditioning ➢ Foam blowing agents ➢ Fire protection ➢ Aerosols ➢ Solvents ➢ Other applications
PFCs	6,500	▪ Industrial processes ➢ Fluorochemical production (from by-products and fugitive emission) ➢ Aluminium production (during ~~–a~~node effect") ➢ Magnesium production (primary ingot casting, other casting processes) ➢ Electronic industry (Integrated circuit/semiconductors, TFT flat panel display, photovoltaics ▪ Product use as substitutes for ozone depleting substances ➢ Refrigeration and air conditioning ➢ Fire protection ➢ Aerosols ➢ Solvents ➢ Other applications ▪ Other product manufacture and use

Type of GHGs	GWP	Major Emission Sources
		➢ Manufacture of electrical equipment ➢ Use of electrical equipment ➢ Disposal of electrical equipment
SF_6	23,900	▪ Industrial processes ➢ Fluorochemical production (from by-products and fugitive emission) ➢ Magnesium production (primary ingot casting, other casting processes) ➢ Electronic industry (Integrated circuit/semiconductors, TFT flat panel display, photovoltaics ▪ Other product manufacture and use ➢ Manufacture of electrical equipment ➢ Use of electrical equipment ➢ Disposal of electrical equipment

2.6.2 Types of CDM Projects defined by CMP

CMP defines the types and categories of CDM projects as illustrated in the figure below.

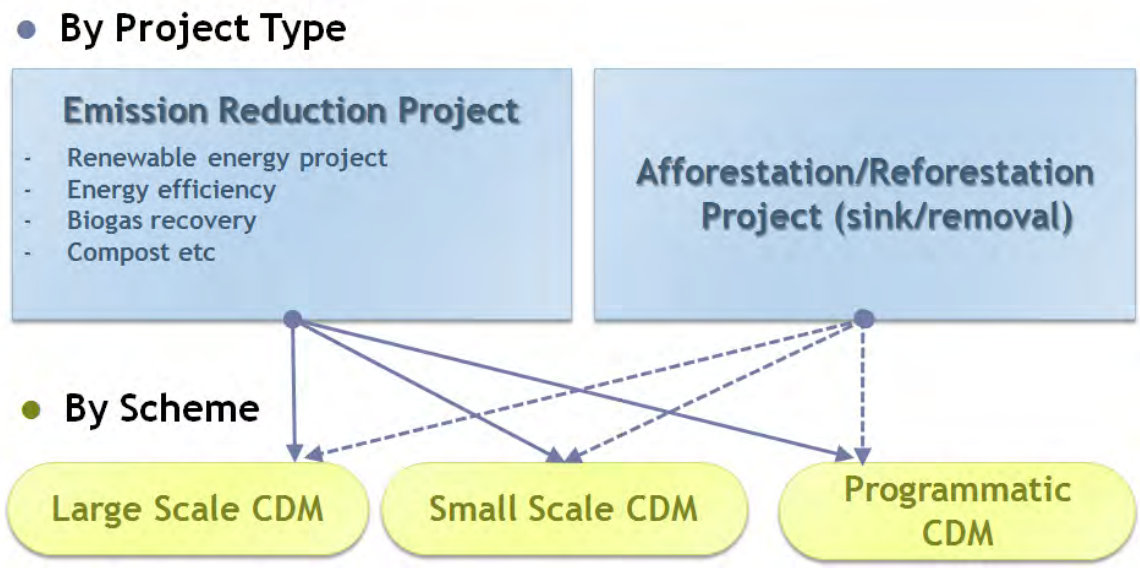


Figure 11: Definition of CDM project types by CMP

The emission reduction project is the project activity that achieves net reduction of GHGs emission through its implementation. Any types of the project activity that complies with this condition fall into this category. According to the website of CDM in the UNFCCC (URL: http://cdm.unfccc.int/index.html), the emission reduction CDM project is categorized into 14 sectoral scopes.

The afforestation/reforestation project is the project activity that produces net removal/sequestration of GHGs by carbon sink through afforestation and/or reforestation.

Both of these 2 types of projects are further categorized into 3 types in accordance with decisions by CMP

a Large scale CDM project

There is no specific definition of large scale CDM project in the decisions of CMP while other types of CDM projects, i.e. Small Scale CDM Project (SSC) and Programmatic CDM Project (CDM Programme of Activities: PoA) are specifically defined by them. Therefore, all the CDM projects that are not defined as SSC or PoA are categorized as large scale CDM project, in principle.

General CDM eligibility requirement for all types of CDM project are as follows:

- Voluntary participation: Each country may decide whether on not to participate in the CDM based on its own assessment of the pros and cons;
- Sustainable development: CDM projects must promote sustainable development in the countries in which they are located;
- Additionality: The emissions reductions from CDM projects must be real, measurable, long-term, and additional to reductions that would have occurred without the project; and
- Public funding: Funding for CDM projects must not divert funding from existing official development assistance.
- Project exclusion: Projects that sequester carbon are restricted to afforestation and reforestation. Nuclear project is excluded from CDM.

b Small-Scale CDM project (SSC)

Decisions of CMP (paragraph. 6 (c) of decision 17/CP.7 and its amendment by 1/CMP/2, paragraph 28 defines the Small-Scale CDM Project (SSC) in 3 (three) types as mentioned below.

TYPE (i): Renewable Energy Project

The renewable energy project activities with a maximum output of capacity equivalent to up to 15 megawatts or an appropriate equivalent such as 45 megawatts thermal is defined as the Type (i) SSC. The maximum output, in this case, means design or installed energy output capacity of the equipment/facility/plant to be installed in the project activities. EB defines the megawatt as megawatt in the form of electricity and agree to use the equation that 1 MW of power generation capacity equals to 3MW of thermal output capacity.

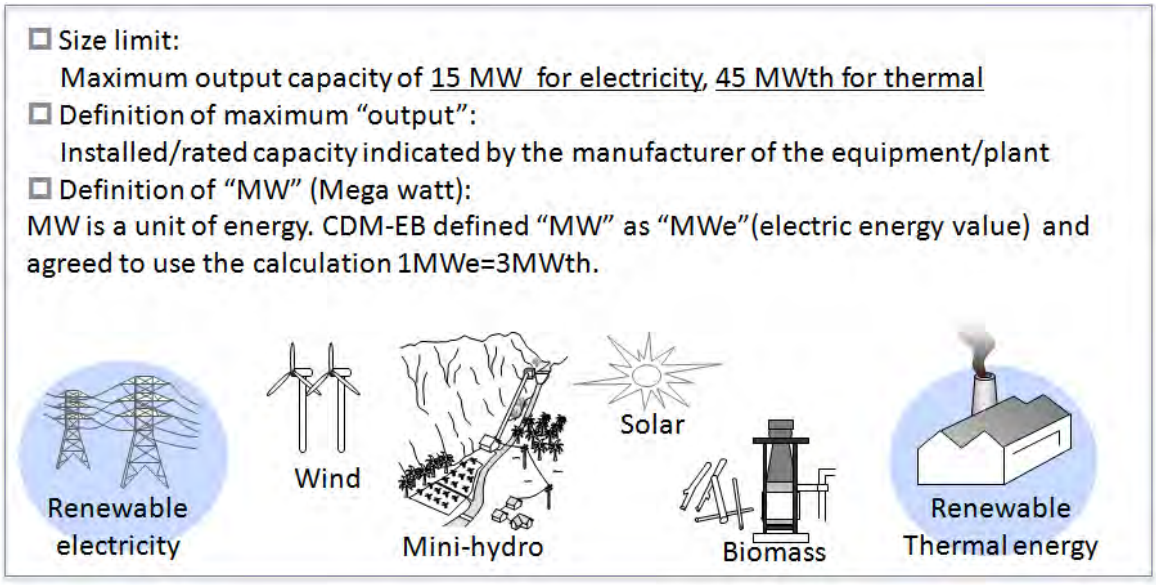


Figure 12: Outline of SSC in renewable energy sector

TYPE (ii): Energy Efficiency Improvement Project

The energy efficiency project activities with a maximum energy saving up to 60 gigawatt hours per year or an appropriate equivalent falls into this Type (ii) SSC. Both supply and demand side energy efficiency projects can be developed as SCC if it complies the conditions as illustrated in the figure below

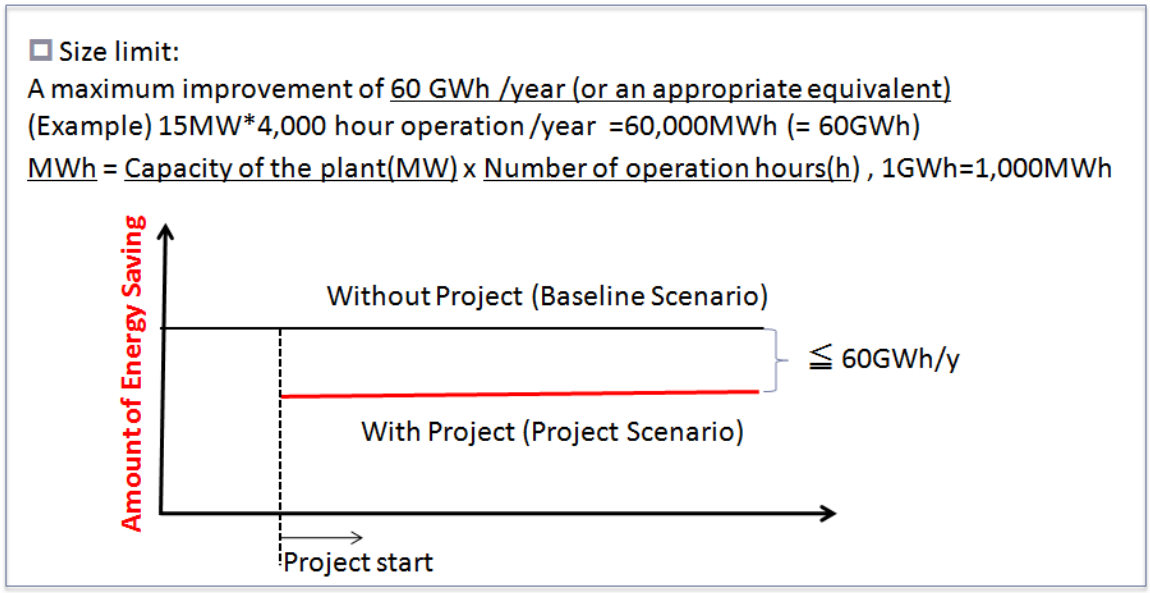


Figure 13: Outline of energy efficiency improvement project

TYPE (iii): Other Projects

The project activities that are not categorized under type (i) and (ii) above, but reduce anthropogenic GHGs emission not over 60 kilotonnes of CO_2 equivalent annually, falls into this Type (iii) category, as shown in the figure below.

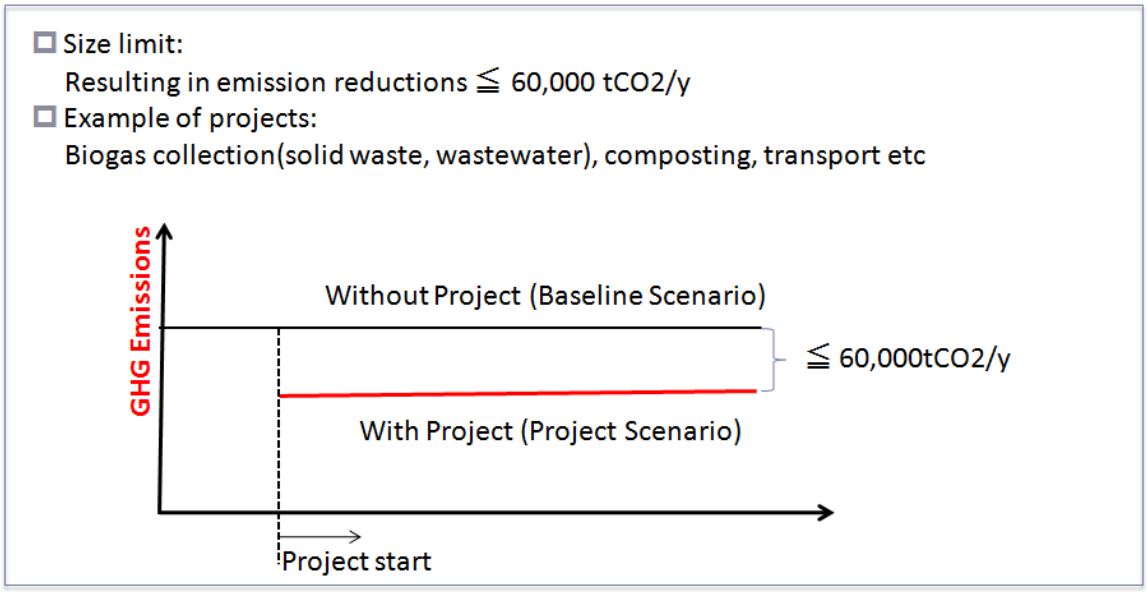


Figure 14: Outline of SSC in other sectors

c Afforestation and Reforestation CDM project (A/R)

The Decision of CMP (16/CMP.1, Annex, paragraph 1) defines the afforestation and redorestation respectively as follows:

A) "Afforestation" is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources;

B) "Reforestation" is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989 (16/CMP.1, Annex, para.1).

Therefore, the project participants in A/R CDM must demonstrate that their project activities comply with the eligibility criteria mentioned above. In addition, since A/R CDM projects involve the conversion of land that

is not forested, meaning that it is defined as non-forest land, the clear definition of forest is essential. The decision of CMP (16/CMP. 1, Annex, paragraph 1 (a)) defines the forest as follows:

- "Forest" is a minimum area of land 0.05-1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest (16/CMP.1, Annex, para.1(a)).

d Small-Scale Afforestation and Reforestation CDM project (SSC A/R)

Small-scale afforestation and reforestation project activities under the CDM (SSC A/R) are those that are expected to result in net anthropogenic greenhouse gas removals by sinks of less than 16 kilotonnes of CO2 per year and are developed or implemented by low-income communities and individuals as determined by the host Party (5/CMP.1, Annex, paragraph 1(i)). The figure below illustrates the outline of SSC A/R project.

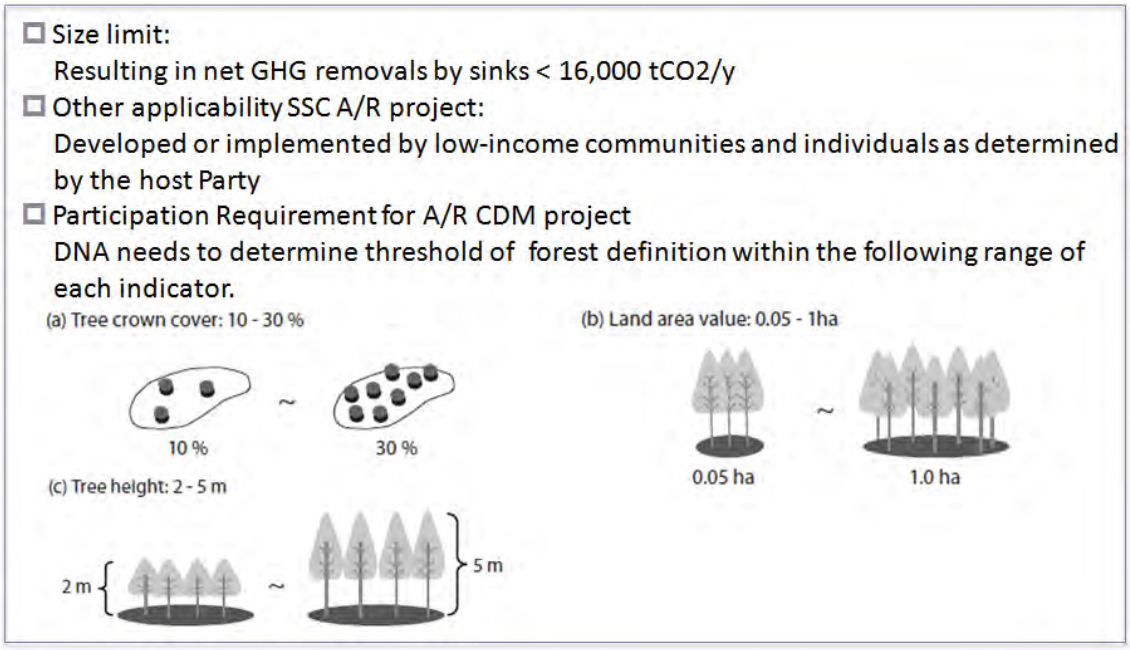


Figure 15: Outline of SSC A/R project

e CDM Programme of Activities (PoA)

(i) A programme of activities (PoA) and a CDM programme activity (CPA)

A CDM programme of activities (PoA) is a voluntary coordinated action; by a private or public entity which coordinates and implements any policy/measures or stated goal (i.e. incentive schemes and voluntary programmes); which leads to GHG emission reductions or net removals by sinks that are additional to any that would not occur in the absence of the PoA; via an unlimited number of CDM programme activities.

A CDM programme activities is a project activity under a programme of activities, i.e. a single, or a set of interrelated measure(s), to reduce GHG emissions or result in net removals by sinks, applied within a designated area defined in the baseline methodology. The important characteristics of PoA are as follows:

- PoA can start with only one CPA and increase them;
  - at any time during PoA period
  - by anybody within the PoA boundary
  - with no limit in number
  - without project registration procedures if they are consistent with PoA.
- Boundary of PoA can be beyond one country

(ii) Requirement for PoA

The eligibility requirement for PoA are as follows:

- PoA is not applicable for ―mandated policy/measure" unless the PoA leads to greater enforcement;
- PoA must determine a coordinating management entity (CME) who is in charge of;
  - communication with CDM Executive Board (EB)
  - coordinating the PoA framework
  - management of the monitored data
  - Ensuring no double counting
- A CPA under a PoA must use same technology to reduce GHG emission specified in the PoA

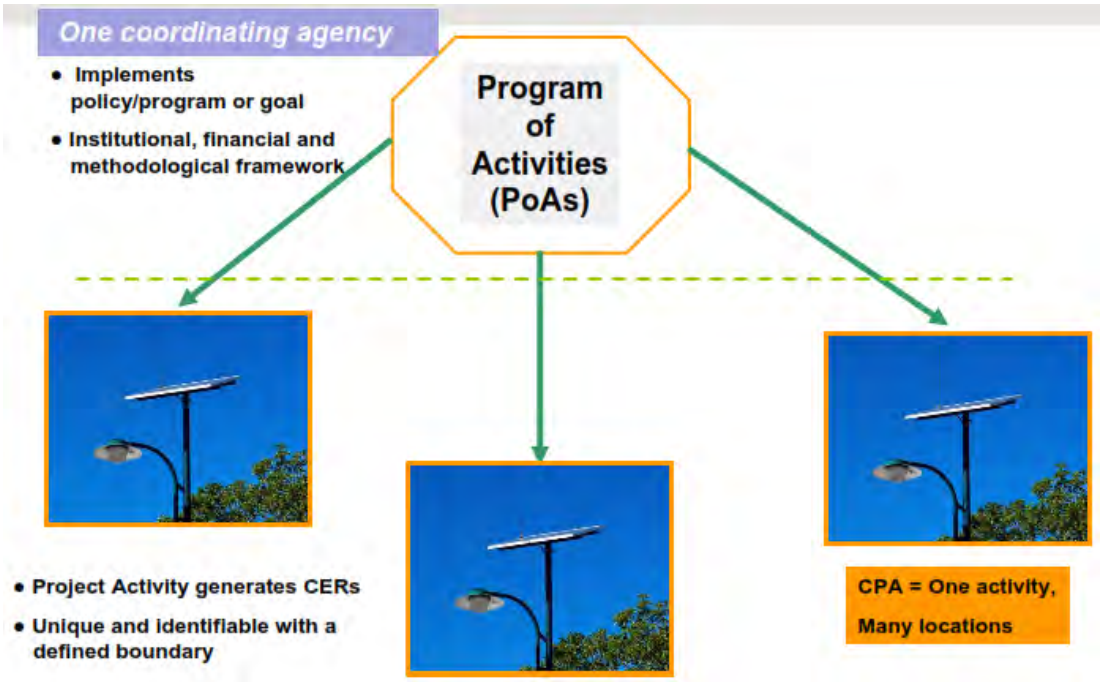


Figure 16: Basic framework of a CDM Programme of Activities (PoA)

As of 8 of September, there are 12 CDM PoA has been registered as shown in the table below.

Table 3: List of Registered CDM PoA

Project Title	Host Country	Date of Registration	Estimated Reduction (ton CO_2/year)
Improved Cooking Stoves in Bagladesh	Bangladesh	08 Sep 2011	50,233
Efficient Lighting Initiative of Bangaladesh (ELIB)	Bangladesh	06 Aug 2011	17,540
Solar Water Heater Programme in Tunisia	Tunisia	02 Jul 2011	7,242
Egypt Vehicle Scrapping and Recycling Program	Egypt	30 Jun 2011	20
SASSA Low Pressure Solar Water Heater Programme	South Africa	12 Apr 2011	76,945
SGCC In-advance Distribution Transformer Replacement CDM Programme	China	12 Feb 2011	4,079
Promotion of Biomass Based Heat Generation System in India	India	12 Jan 2011	400,000
Masca Small Hydro Programme	Honduras	21 Aug 2010	4,395
CFL Lighting scheme- –Bachat Lamp Yojana"	India	29 Aug 2010	34,892
Uganda Municipal Waste Compost Programme	Uganda	12 Apr 2010	83,700
Methane capture and combustion from Animal Waste Management System (AWMS) of the 3S Program farms of the Instituto Sadia de Sustentabilidade	Brazil	29 Oct 2009	591,418
CUIDEMOS Mexico (Campana De Uso Intelegente De Energia Mexico) – Smart Use of Energy Mexico	Mexico	31 Jul 2009	520,365

Source: CDM-Home, UNFCCC (URL: http://cdm.unfccc.int/index.html)

2.7 Development of CDM Project

As of the 1st of September 2011, about 3,387 CDM projects have been registered all over the world under the UNFCCC with the expected CO_2 emission reduction of approximately 2.1 billion tones by the year 2012, 5.9 billion by 2020 and 9.2 billion by 2030. The total amount of CERs issued as of the date above reached 707.8 million tones of CO_2. This section discusses the major characteristics of CDM projects from several viewpoints.

2.7.1 CDM projects by types

In terms of the types of GHGs targeted in CDM projects, CO_2 holds the most number of registered projects (2,940), followed by CH_4 (295) and N_2O (65). The number of CDM projects targeting CO_2 emission reduction shares 88% of the total number of CDM projects.

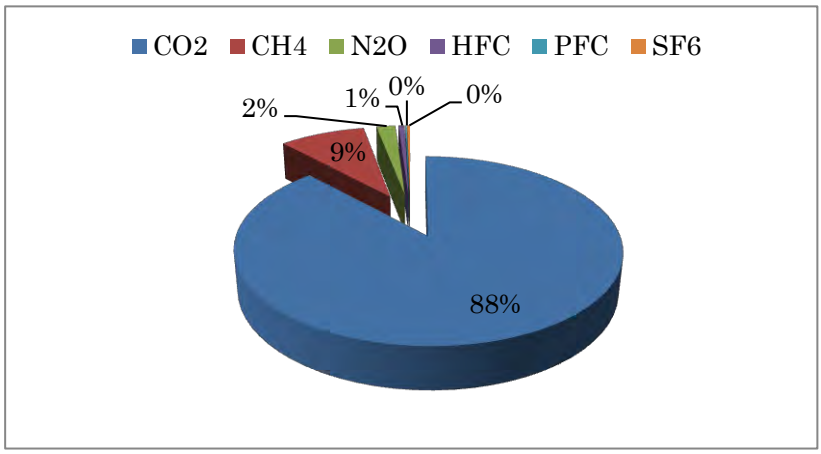


Figure 17: Proportion in Number of Registered CDM Projects by Types of GHGs Targeted

Source: IGES CDM Project Data Analysis and Forecasting CER Supply (1. AUG 2011 updated)

On the other hand, the share of the expected CERs from the registered CDM projects by types of GHGs is illustrated in the figure below.

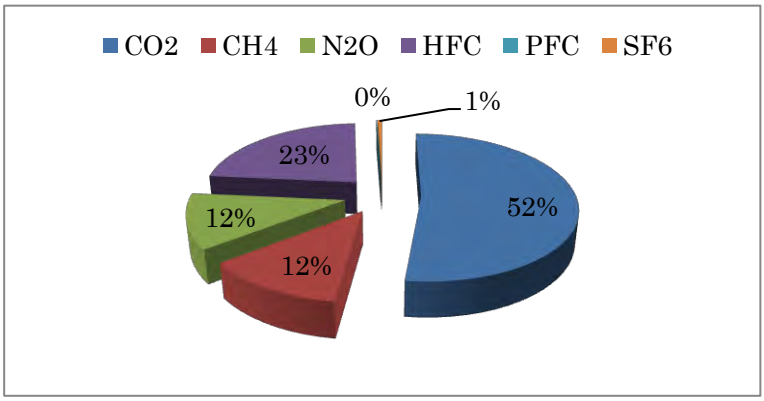


Figure 18: Proportion in the Expected CERs produced by 2012 by Types of GHGs Targeted

Source: IGES CDM Project Data Analysis and Forecasting CER Supply (1, AUG 2011 updated)

Difference in proportion of GHGs between figure 8 and 9 comes from the distinction of global warming potential among types of GHGs (see Table 2). Figure 9 clearly shows the efficiency of GHGs emission reduction in the CDM projects that target non-CO_2 types of GHGs.

With regard to the distribution of CDM projects by sector, renewable energy projects represent 74% of the total number of registered CDM projects followed by methane recovery/avoidance projects with 7%.

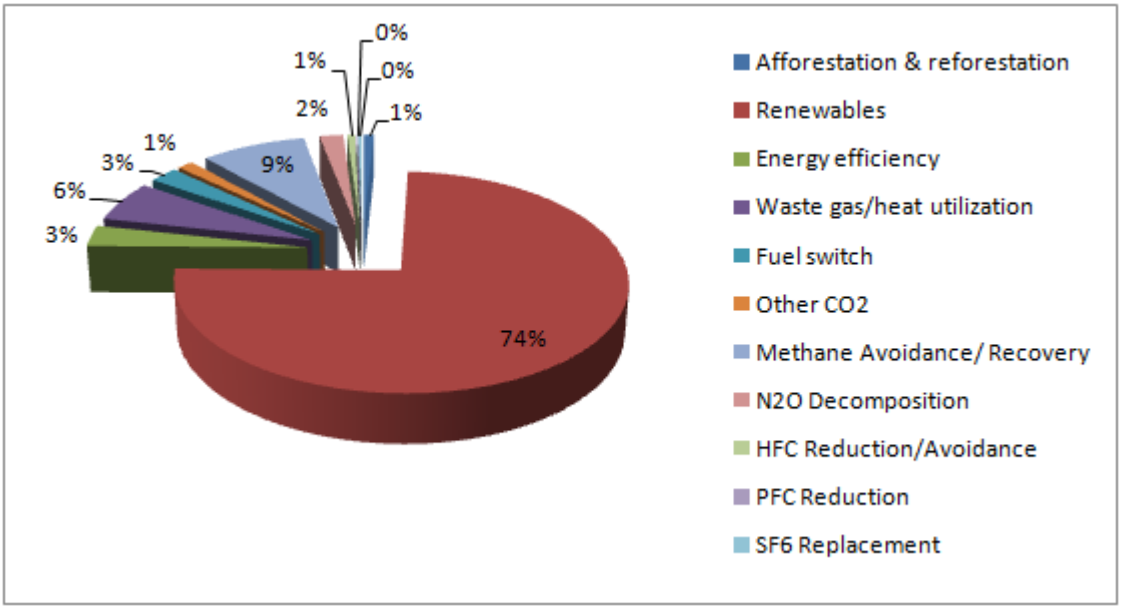


Figure 19: Percentage Distribution of the Number of Registered CDM Projects by Types of Projects

Source: IGES CDM Project Data Analysis and Forecasting CER Supply (1, AUG 2011 updated)

In terms of the expected CERs produced by the year 2012, the sectoral percentage distribution is somewhat different as shown in Figure 11. The expected CERs produced from renewable projects remains at 34% while HFC reduction shares 23% of the total expected CERs with the limited number of registered projects. It also reflects the big difference in GWP among the types of GHGs. Methane avoidance/recovery and N_2O decomposition respectively share 12% of the total expected CERs, while the expected carbon sequestration by afforestation/reforestation projects is very limited (There is no CERs issued from registered A/R CDM projects so far.).

Taking the data of the CERs that have already been issued as of 1st of August 2011, HFC reduction/avoidance projects produced the most CERs, followed by N_2O decomposition projects. Renewable projects only remains at the third place with the CERs issuance of 116 million tons of CO_2 (see table xx).

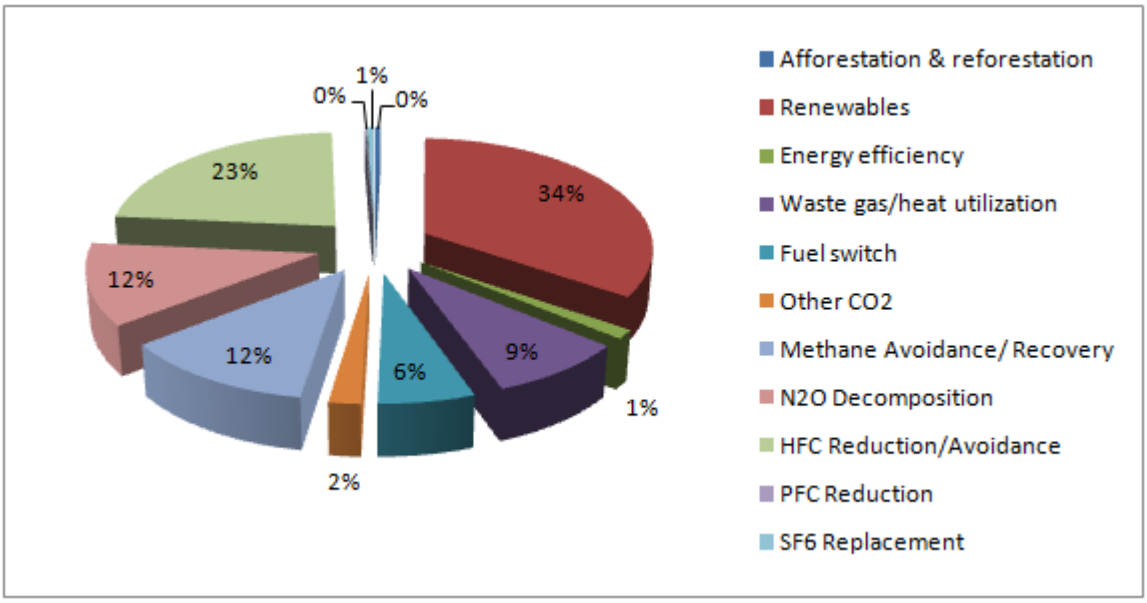


Figure 20: Percentage Distribution of the Expected CERs by Types of Projects

Source: IGES CDM Project Data Analysis and Forecasting CER Supply (1, AUG 2011 updated)

Table 4: Percentage Distribution of Registered CDM Projects by Types

Project Type	Registered		Issued	
	Num. projects	ERs by 2012 (kt-CO2e)	Num. projects	Total issued CERs (kt-CO2e)
Afforestation & reforestation	28	9,233	0	0
Renewables	2,481	721,981	803	115,922
Energy efficiency	106	28,591	36	2,951
Waste gas/heat utilization	205	182,392	88	38,588
Fuel switch	80	126,084	41	17,215
Other CO2	45	41,814	19	2,931
Methane Avoidance/ Recovery	290	256,458	92	23,943
N2O Decomposition	65	253,615	33	152,282
HFC Reduction/Avoidance	21	484,593	19	315,892
PFC Reduction	4	2,051	1	34
SF6 Replacement	10	11,025	3	371
Total	3,335	2,117,838	1,135	670,128

Source: IGES CDM Project Data Analysis and Forecasting CER Supply (1, AUG 2011 updated)

More detailed data on CDM projects are available in the CDM project database of IGES (Institute for Global Environmental Strategies of Japan) and UNEP RISO Centre with the following URL.

IGES: http://www.iges.or.jp/en/index.html

UNEP RISO Centre: http://www.uneprisoe.org/

2.7.2 CDM Projects by Countries

There is a significant difference in CDM project development among Annex I as well as non-Annex I countries. Some of the host countries are very active in CDM project development while many others have only a few CDM project registered so far. The figure below shows the percentage distribution of registered CDM projects by host countries.

In terms of the number of registered CDM projects, China registered the most number of registered CDM projects, accounting for 45.7% of the total registered CDM. The second largest is India (21%), followed by Brazil (5.7%). Top 5 countries of CDM project development with Mexico and Malaysia represents 75% of the registered CDM projects in terms of the number of projects.

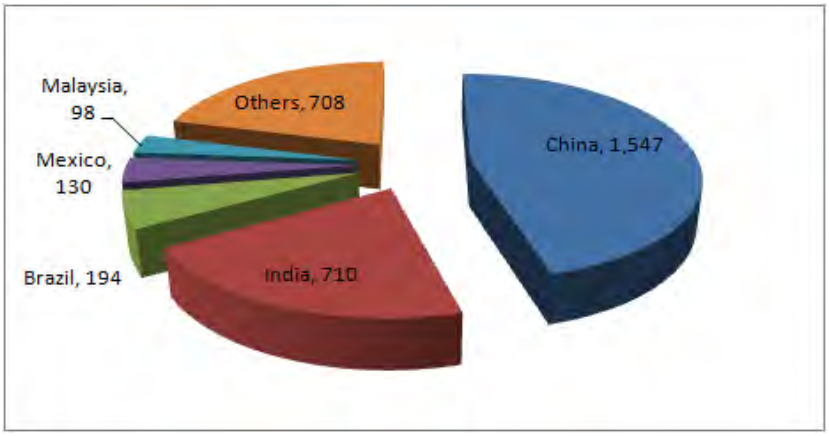


Figure 21: Number of Registered CDM Projects by Host Countries

Source: IGES CDM Project Data Analysis and Forecasting CER Supply (1, AUG 2011 updated)

In terms of the CERs issued from the CDM projects, China is still the largest producer, but the order of the other countries is slightly different from the figure 12 above.

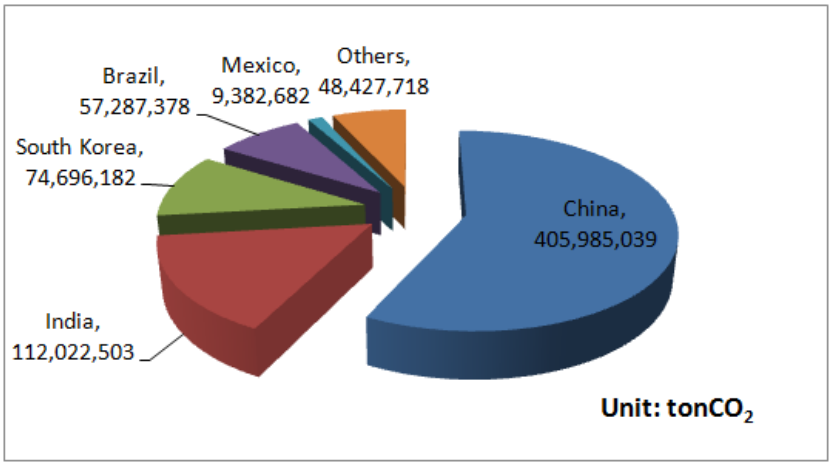


Figure 22: Issued CERs from CDM projects by Host Countries

Source: IGES CDM Project Data Analysis and Forecasting CER Supply (1, AUG 2011 updated)

2.8 Current Discussions over Post-Kyoto International Framework for Climate Change Mitigation

2.8.1 Key milestones of the negotiation for Post-Kyoto Framework

A. Copenhagen Accord (COP 15)

Copenhagen Accord (CA) is an important achievement of the 15th Conference of the Parties (COP15) held in December 2009 although it could not be announced as the COP Decision due to some countries' objection. The key contents of the Copenhagen Accord can be summarized as shown in the table below.

Table 5: Key Contents of the Copenhagen Accord

Item	Contents (Extract from the CA Text)
Long-term target	▪ Agreeing with the recognition of the science with a view to reduce global emission so as to hold the increase in global temperature below 2 degrees Celsius. ▪ Parties should cooperate in achieving the peaking of global and national emissions as soon as possible. (Peaking out GHGs emission at the earliest possible time.)
Reduction Targets and Mitigation Actions by the Parties	▪ Annex I Parties commit to implement individually or jointly the quantified economy-wide emissions targets for 2020, to be submitted in the format given in Appendix I of this Accord by Annex I Parties to the secretariat by 31 January 2010. (15 countries and EU from Annex I countries have submitted their own reduction target to the Secretariat.) ▪ Non Annex I Parties will implement mitigation actions, including those to be submitted to the secretariat by non Annex I Parties in the format given in Appendix II by 31 January 2010. ▪ Least developed countries and small island developing States may undertake actions voluntarily and on the basis of support.
MRV (Measurement, Reporting, and Verification)	▪ Delivery of reductions and financing by developed countries will be measured, reported and verified in accordance with existing and any further guidelines adopted by the Conference of the Parties, and will ensure that accounting of such targets and finances is rigorous, robust and transparent. ▪ Mitigation actions taken by Non-Annex I Parties will be subject to their domestic measurement, reporting and verification the result of which will be reported through their national communications every two years. ▪ Nationally appropriate mitigation actions (NAMAs) seeking international support will be recorded in a registry along with relevant technology, finance and capacity building support. ▪ Those supported nationally appropriate mitigation actions will be subject to international measurement, reporting and verification in accordance with guidelines adopted by the Conference of the Parties.
Market Mechanism	▪ The Parties decide to pursue various approaches, including opportunities to use markets, to enhance cost-effectiveness of, and to promote mitigation actions. ▪ Developing countries, especially those with low emitting economies should be provided incentives to continue to develop on a low emissions pathway.
Financial Mechanism	▪ The collective commitment by developed countries is to provide new and additional resources, including forestry and investment through international institutions, approaching US$ 30 billion for the period 2010-2012 with balanced allocation between adaptation and mitigation. ▪ Funding for adaptation will be prioritized for the most vulnerable developing countries, such as the least developed countries, small island developing states and Africa. ▪ In the context of meaningful mitigation actions and transparency on implementation, developed countries commit to a goal of mobilizing jointly US$ 100 billion a year by 2020 to address the needs of developing countries. This funding will come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance. ▪ New multilateral funding for adaptation will be delivered through effective and

Item	Contents (Extract from the CA Text)
	efficient fund arrangements, with a governance structure providing for equal representation of developed and developing countries. A significant portion of such funding should flow through the Copenhagen Green Climate Fund.
Adaptation	▪ Developed countries shall provide adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation action in developing countries.
REDD+	▪ Recognizing the crucial role of reducing emission from deforestation and forest degradation and the need to enhance removals of greenhouse gas emission by forests, the Parties agree on the need to provide positive incentives to such actions through the immediate establishment a mechanism including REDD-plus, to enable the mobilization of financial resources from developed countries.
Technology development and transfer	▪ The Parties decide to establish a Technology Mechanism to accelerate technology development and transfer in support of action on adaptation and mitigation that will be guided by a country-driven approach and be based on national circumstances and priorities.

A.1 Difference in the framework of the commitment by the Parties between Kyoto Protocol and Copenhagen Accord

There are some significant differences in the framework of commitment by the Parties between Kyoto Protocol and Copenhagen Accord. The figure below illustrates such differences.

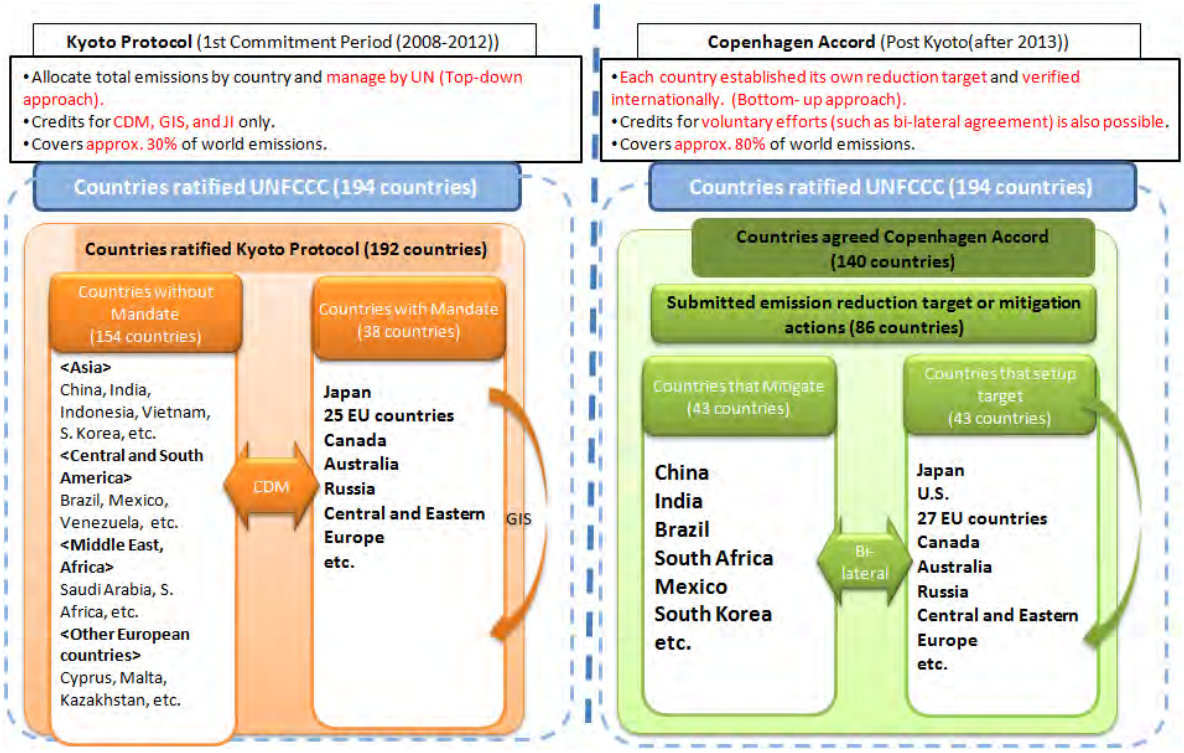


Figure 23: Framework of the Commitment of GHG Emission Reductions by the Parties in Kyoto Protocol and Copenhagen Accord

In Kyoto Protocol, there is no obligation of GHGs emission reduction for non-Annex I countries while Annex I countries have their own legally binding emission reduction targets. On the other hand, in Copenhagen Accord, Annex I countries commit to implement individually or jointly the quantified emissions targets for

2020 while non-Annex I countries also voluntarily commit to implement mitigation actions.

As clearly shown in the figure below, the global share of CO_2 emission in the Annex I countries which have their own legally binding emission targets is only 27% in accordance with the "IEA report on CO_2 emission from fuel combustion 2010" (The data compiled is for 2008.). Although the global share of CO_2 emission in the Annex I countries was estimated as 58% at the time of adopting the Kyoto Protocol, it was almost decreased by half, due to no ratification of the protocol by the United States, drastic growth of economy in China accompanying with increased CO_2 emission, and other non-Annex I countries' increase in CO_2 emission.

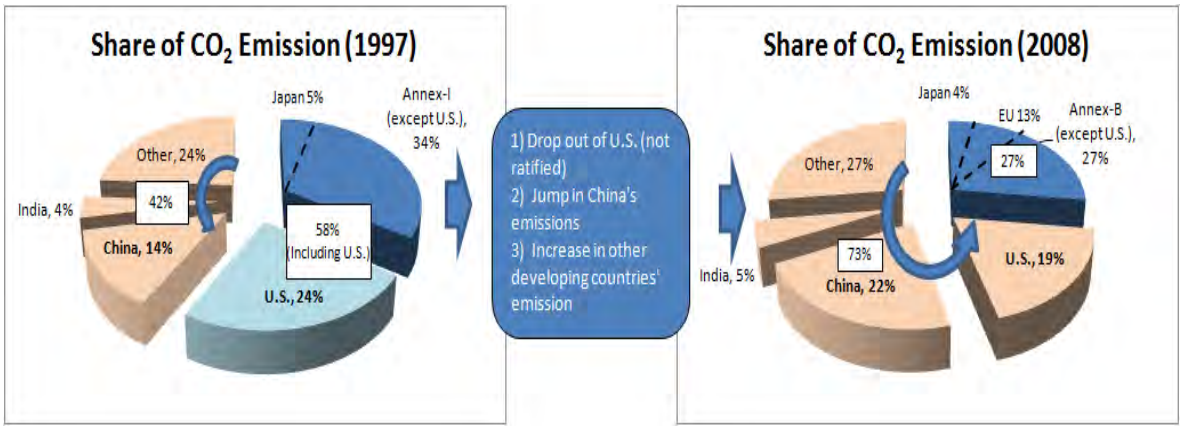


Figure 24: Changes in share of CO2 emission during 1997-2008

The original purpose of Copenhagen Accord was to establish a new framework that involves more countries to make a collective effort of GHGs emission including major CO_2 emission countries such as the United States and China. Although the Copenhagen Accord could not be formally agreed as a COP decision, 140 countries including the United States and China agreed with the Accord and submitted to the UNFCCC Secretariat their voluntary commitment of emission reduction or mitigation actions. The share of CO_2 emission from the countries who agrees with the Accord have reached 85% according to the CO2 emission from fuel combustion in 2008 (IEA Statistics), which is far larger than the share of CO_2 emission from the Annex I countries who have their own legally-binding targets of GHG emission reduction under Kyoto Protocol (see the figure on next page.).

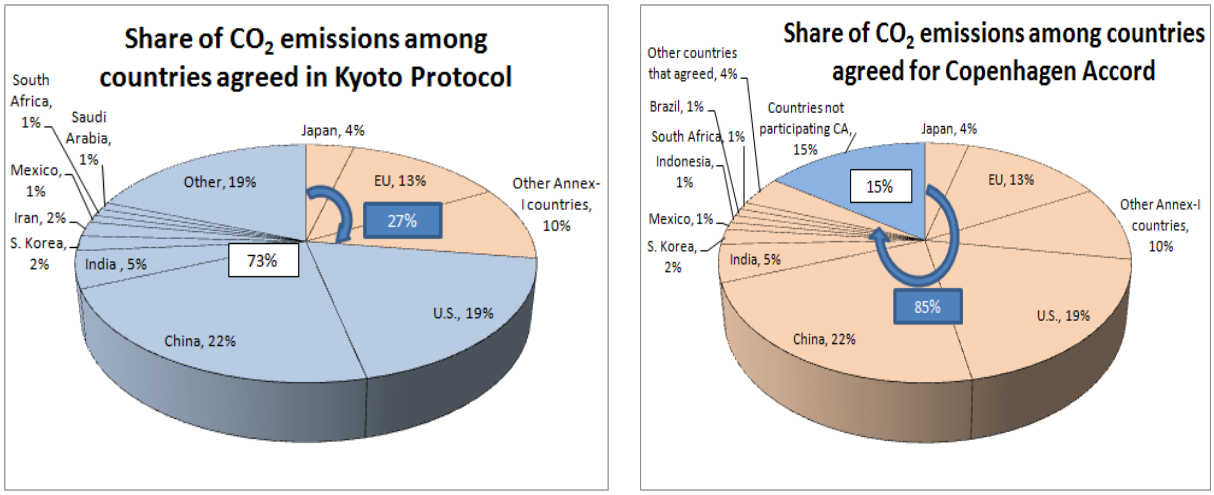


Figure 25: Difference in the share of CO_2 between Kyoto Protocol and Copenhagen Accord

A.2 Establishment of New Market and Financial Mechanism

Copenhagen Accord pledged provision of the additional financial resources from developed countries, with the total of amount of 30 billion US dollars during 2010-2012. Developed countries also committed themselves to a goal of mobilizing jointly US$ 100 billion a year by 2020 to address the needs of developing countries. The financing coverage was also extended to include the efforts of reducing emissions from deforestation and forest degradation under the scheme of REDD and REDD-plus, to establish a sustainable fund to support the implementation of adaptation action in developing countries, and to expand the financial and market mechanisms for promotion of mitigation actions by the developing countries. These new market and financial mechanisms defined in the Copenhagen Accord are currently under further discussion for their official establishment.

B. Cancun Agreement (COP 16)

B.1 Highlights of International Discussions and Negotiations between COP 15 and COP 16

After the COP 15, the positions of the Parties against Copenhagen Accord showed significant changes. One of the important changes is the setback of establishing a new framework that involves more countries to make a collective effort of GHGs emission, including major CO_2 emission countries, i.e. the United States and China. The United States reaffirmed not to join the Kyoto Protocol while most of the non-Annex I countries including China refused to commit themselves to any quantified emission reduction target. On the other hand, the establishment of the 2nd commitment period with new GHGs emission reduction targets for Annex I countries became the center of the discussions in the negotiation under the AWG-KP (Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol).

The positions of the Parties before COP16 can be illustrated as shown in the figure below.

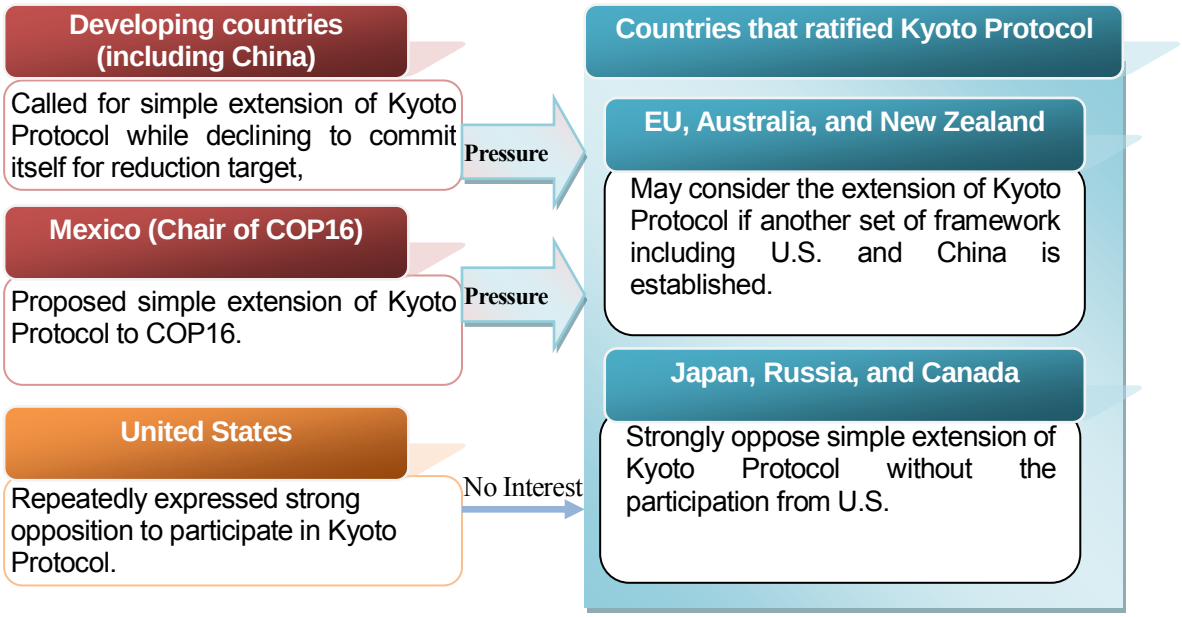


Figure 25: Position of the Parties before COP16

Just before the COP 16, the predicted view of the 2nd commitment period under Kyoto Protocol were as shown in the figure below.

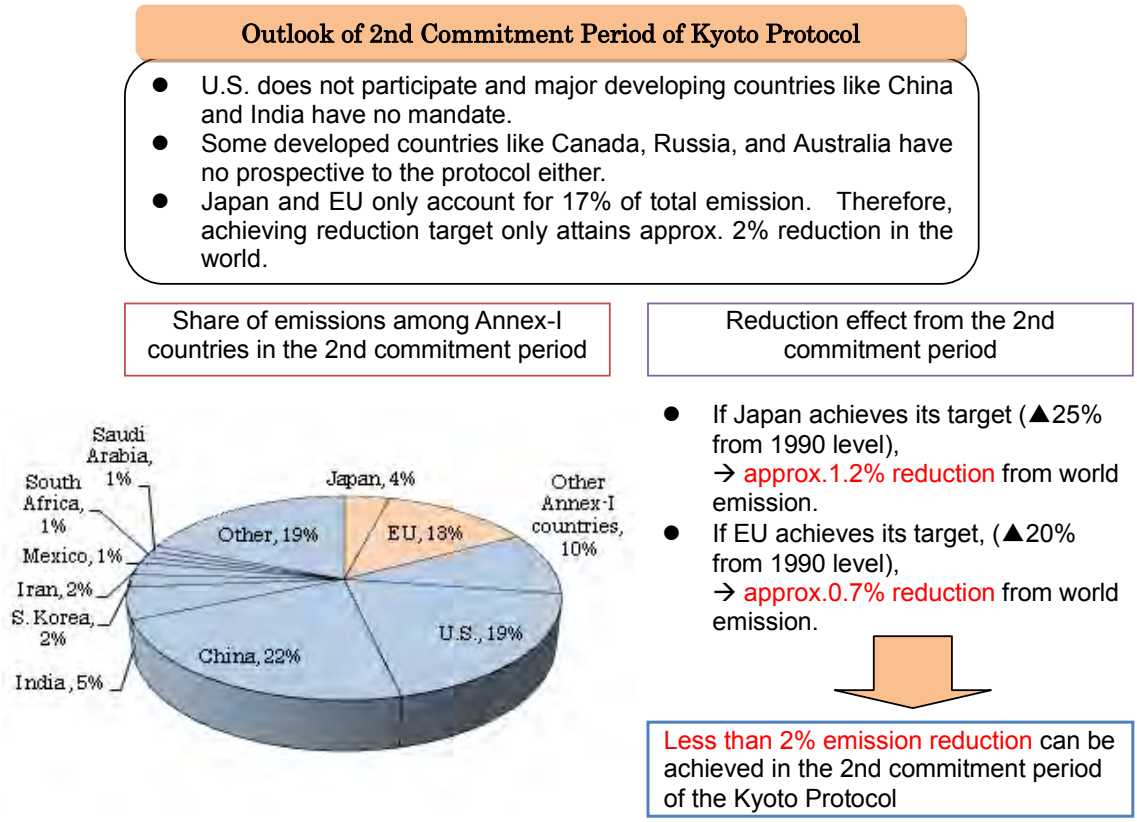


Figure 26: Predicted Consequence of the 2nd Commitment Period before COP16

B.2 Cancun Agreement

COP 16 in November 2010 started with the serious confrontation between developed countries that defend establishment of new framework of emission reduction commitment based on Copenhagen Accord and the developing countries that insist on continuation of the current Kyoto Protocol with the new GHGs emission reduction commitment for the Annex I countries. Finally, two decisions were collaterally made from the Conference of the Parties (COP) and Conference of the Parties serving as the Meeting of the Parties to Kyoto Protocol (CMP) as the Cancun Agreement, as shown in the figure below.

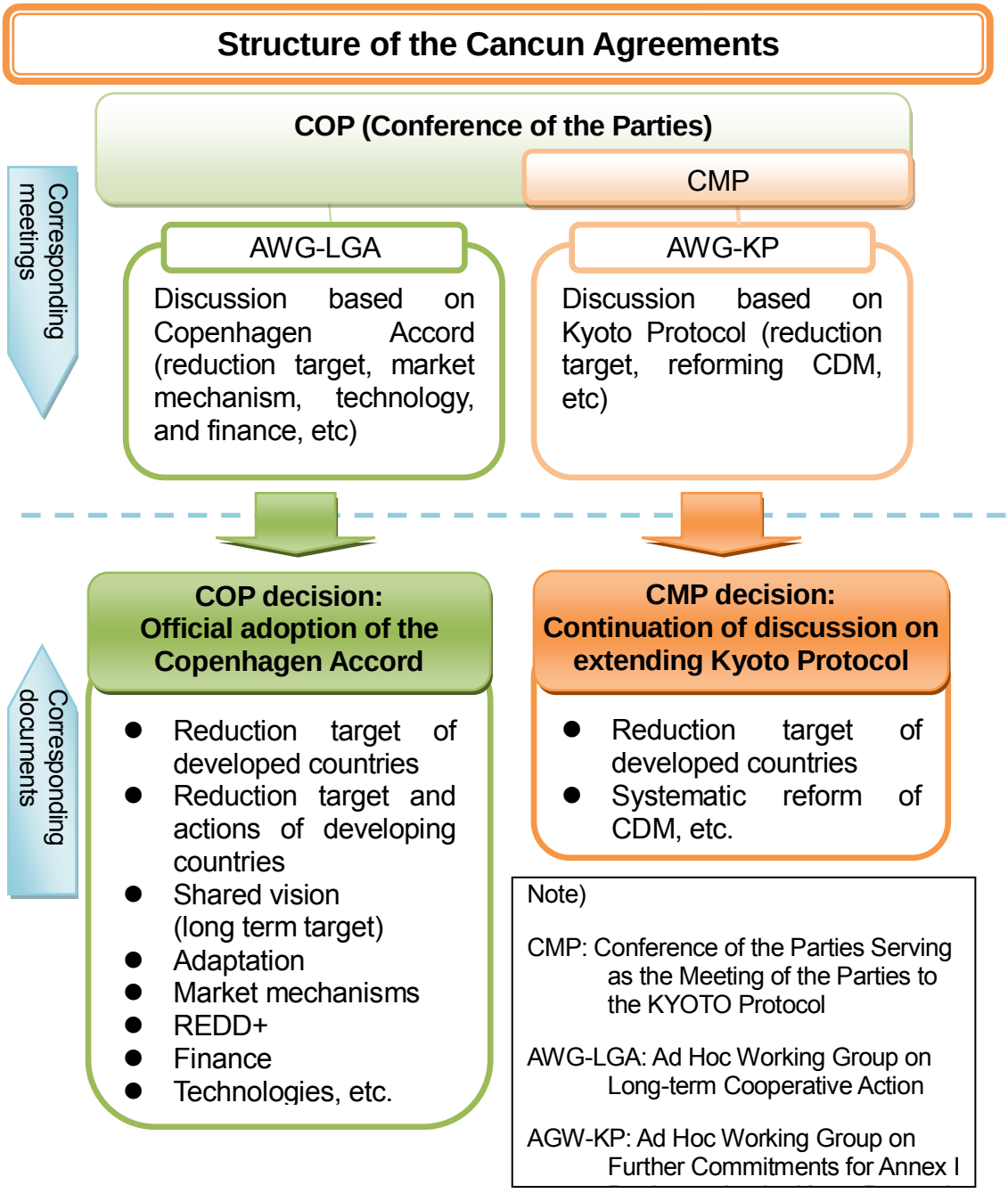


Figure 27: Structure of Cancun Agreement

The key decisions made in Cancun Agreement are as follows:

(i) New quantified GHGs emission reduction targets for Annex I countries (developed countries) in the 2nd commitment period

Both the decisions of CMP 6 and COP 16 take note of quantified economy-wide emission reduction targets to be implemented by Annex I Parties as communicated by them in determining the new quantified GHGs emission reduction targets for Annex I countries. The new GHGs emission targets submitted by Annex I countries to the UNFCCC Secretariat are outlined in the table below.

Table 6: Quantified Economy-Wide Emissions Targets for 2020 by Annex I Parties

Annex I Parties	Emission Reduction in 2020	Base Year
Australia	5% up to 15% or 25%	2000
Belarus	5 to 10%	1990
Canada	17%	2005
Croatia	5%	1990
EU and its member states	20% or 30%	1990
Iceland	30%	1990
Japan	25%	1990
Kazakhstan	15%	1992
Liechtenstein	20% to 30%	1990
Monaco	30%	1990
New Zealand	10 to 20%	1990
Norway	30 to 40%	1990
Russian Federation	15 to 25%	1990
Switzerland	20% or 30%	1990
Ukraine	20%	1990
United States of America	17%	2005

Source: UNFCCC website (http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5264.php)

However, the above emission reduction targets in 2020 set by Annex I countries are all conditional; therefore they cannot be directly translated to emissions reduction commitment by Annex I countries in the 2nd commitment period of Kyoto Protocol. The United States clearly states that the emission reduction target above is the voluntary target submitted in accordance with the decision in Copenhagen Accord and it has nothing to do with the commitment under Kyoto Protocol. Japan and Russia also clearly mentions that their targets do not mean their agreed new GHGs emission reduction targets in the 2nd commitment period under Kyoto Protocol. On the contrary, they officially states not to agree with simple extension of Kyoto Protocol without participation of major GHGs emitting countries such as the United States and China. The united States refuses to join Kyoto Protocol as well.

As a result, Cancun Agreement aims at two ways in parallel as to the new emission reduction target after 2013, i.e. setting the new GHG emission reduction target for Annex I countries in the 2nd commitment period under Kyoto Protocol and development of a new framework of GHG emission reduction commitment involving

more parties including the United States, China and other countries with no legally binding emission reduction commitment under Kyoto Protocol.

(ii) Kyoto Mechanism

Under the decision of CMP 6, it is agreed that emission trading and the project-based mechanisms (CDM and JI) under the Kyoto Protocol shall continue to be available to Annex I Parties as a means to meet their quantified emission limitation and reduction objectives. As to the CDM, the following decisions are made in relation to the improvement of the current mechanism.

CDM Loan Scheme

To promote CDM especially in the countries with smaller number of registered projects, a special loan scheme is to be established for the purpose of providing financial assistance in CDM project development. The basic conditions of the CDM loan scheme are as shown in the table below.

Table 7: Basic Conditions of CDM Loan Scheme

Loan coverage	From PDD development to the 1st CER issuance (including validation and the 1st verification cost)
Eligible host countries	The countries with fewer than 10 registered projects as of 1 January (each year)
Eligible projects	The projects with the GHGs emission reduction not exceeding 15,000 tCO_2e per year (not exceeding 7,500 tCO_2e per year for LDC and SIDS
Loan conditions	Free of interests with loan repayment starting only after 1st CER issuance

LDC: Least developed country
SIDS: Small Island Developing States

The figure below illustrates the currently planned CDM loan application procedure although the implementing agency of CDM loan scheme is not yet determined.

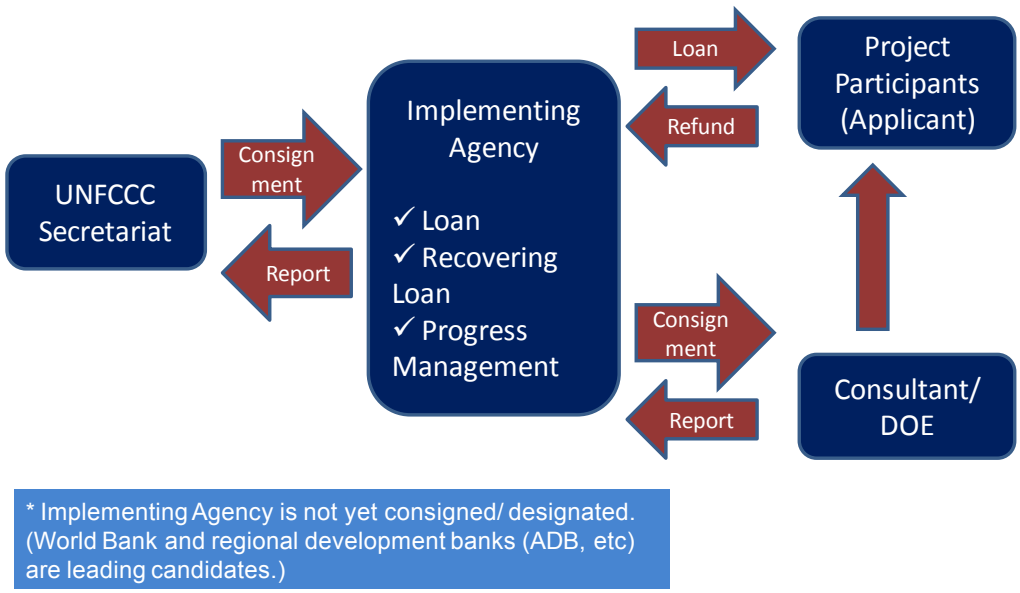


Figure 28: Planned Procedure for Implementing CDM Loan Scheme

Standardized Baseline

Whilst the Clean Development Mechanism (CDM) has had substantial success in terms of numbers of projects and quantity of emissions reductions it has mobilized, it has also faced criticisms, in particular, for lengthy, costly and subjective procedures for determining baseline emissions and additionality of projects. The concept of "Standardized Baseline" is built for the purpose of facilitating project development, increasing the credibility of the CDM and reducing inconsistency of decisions on project registration. This builds upon a trend to introduce standardized elements in approved CDM baseline methodologies.

A standardized baseline is not calculated on a project-by-project basis by applying the relevant baseline methodology, but is a single, standard estimation of the greenhouse gases that would have been emitted if certain types of CDM projects were not implemented. The aim of standardizing baselines is to reduce the time and costs associated with designing CDM projects and preparing the PDD.

At the sixth meeting of the conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP 6) in Cancun, Parties agreed on the implementation of standardized baselines under the CDM. Subsequently at 62nd meeting of the CDM Executive Board (EB 62), Guidelines for the establishment of sector specific standardized baselines are approved, which provides guidelines for the development and assessment of standardized baselines including additionality demonstration baseline scenario identification and baseline emission determination. This framework allows for setting baselines that are not necessarily specific to one type of project activity in a sector, but can be applicable to most of the possible project activities in a sector. Additionality is not to be demonstrated for each individual project activity ex-post (after its formulation) but rather for types of measures and ex-ante.

The basic steps for establishing standardized baselines are as follows:

Step 1: Identify host country(ies), sectors, output(s) and measures;

Step 2: Establish additionality criteria for the identified measures (e.g. positive lists of fuels/feed stocks and technologies);

Step 3: Identify the baseline for the measures (e.g. baseline fuel, technology, level of GHG destruction)

Step 4: Determine the baseline emission factor where relevant

The guidelines above currently covers, but are not limited to, the following 4 (four) types of emission reduction activities:

- Fuel and feedstock switch;

- Switch of technology with or without change of energy source (including energy efficiency improvement);
- Methane destruction;
- Methane formation avoidance

The examples of standardized baselines mentioned in the guidelines are as shown in the table below.

Table 8: Examples of Standardized Baselines in the Guidelines

Types of Emission Reduction Measures	Examples of Standardized Baselines
Fuel and feed stock switch	(a) In country C, fuel switches to diesel, natural gas or biomass for the production of clinker are additional. The baseline fuel for clinker production in country C is coal.
Switch of technology with or without change of energy sources (including energy efficiency improvement)	(a) In country C1, a switch to electricity generation from mini or micro hydro technology is additional: (i) To displace diesel generation in off-grid locations with corresponding emission factor of X tCO_2/MWh; (ii) To displace grid electricity in other locations with corresponding emission factor. (b) In country C2, technology switches to improved cook-stoves with efficiency higher than P% are additional. The baseline cook-stoves is a cook-stove with efficiency of Q%.
Methane destruction	(a) In Country C1, the regulation requires the capture and destruction of A1 % of the landfill gas and is enforced. Any capture and destruction of methane emitted from landfill above A1% is additional.
Methane formation avoidance	(a) In country C, avoiding methane emission through composting of green waste is additional. (b) The baseline disposal and treatment method for green waste is landfilling. The related methane emission factor is determined from first order decay model of IPCC.

The currently planned procedure for proposing standardized baselines is shown in the figure below.

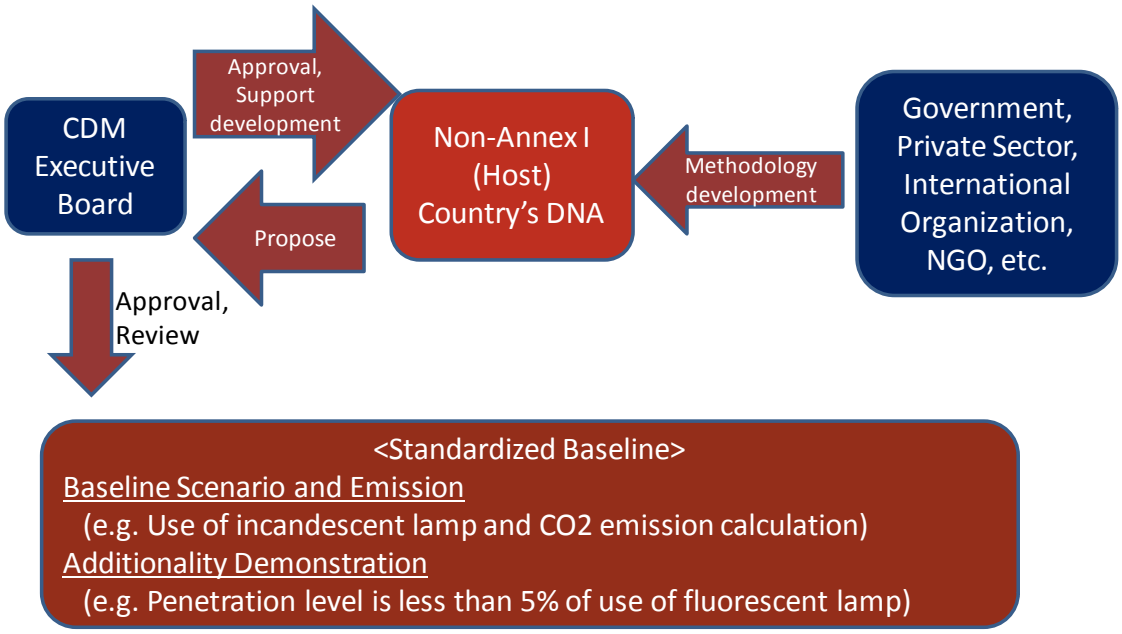


Figure 29: Planned procedure for proposing standardized baselines

Eligibility of Carbon dioxide capture and storage in geological formation as CDM project activities

CMP 6 decides that carbon dioxide capture and storage in geological formation is eligible as project activities under the CDM, provided that the issues identified in decision 2/CMP 5 are addressed and resolved in a satisfactory manner. In this case the identified issues are:

(a) Non-permanence, including long-term permanence;

(b) Measuring, reporting and verification;

(c) Environmental impacts;

(d) Project activity boundaries;

(e) International law;

(f) Liability;

(g) The potential for perverse outcomes;

(h) Safety; and

(i) Insurance coverage and compensation for damages caused due to seepage or leakage.

(iii) Other important decisions

The table below summarizes the other important decisions made in Cancun Agreement.

Table 9: Other Important Decisions in Cancun Agreement

Issues	Summary of Decisions
Adaptation	▪ To establish the Cancun Adaptation Framework; ▪ To establish a process to enable least developed country Parties to formulate and implement national adaptation plans; ▪ To establish an Adaptation Committee to promote the implementation of enhanced action on adaptation in a coherent manner under the Convention. ▪ To establish a work programme in order to consider approaches to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change.
New Market Mechanism	▪ To consider the establishment, at COP17, of one or more market mechanisms to enhance cost-effectiveness of, and to promote, mitigation actions (including the support for nationally appropriate mitigation actions by developing country Parties).
REDD-plus	▪ To encourage developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities: ➢ Reducing emissions from deforestation; ➢ Reducing emissions from forest degradation; ➢ Conservation of forest carbon stocks; ➢ Sustainable management of forest; ➢ Enhancement of forest carbon stocks. ▪ To decide that the mitigation actions in the forest sector should be implemented in phases, beginning with the development of national

	strategies or action plans, policies and measures, and capacity-building, followed by the implementation of national policies and measures and national strategies or action plans that could involve further capacity-building, technology development and transfer and results-based demonstration activities, and evolving into results-based actions that should be fully measured, reported and verified (MRV). ▪ To urge Parties, in particular developed country Parties, to support, through multilateral and bilateral channels, the mitigation actions in the forest sector by the developing country Parties.
Finance	▪ To establish a Green Climate Fund, to be designated as an operation entity of the financial mechanism of the Convention. ▪ The Green Climate Fund shall be designed by a Transitional Committee organized by 40 members with 15 members from developed country Parties and 25 members from developing country Parties.
Technology development and transfer	▪ To establish a Technology Mechanism to facilitate the implementation of actions for technology development and transfer with the following components: ➢ A Technology Executive Committee; and ➢ A Climate Technology Centre and Network
Capacity-building	▪ Capacity-building support to developing country Parties should be enhanced with a view to strengthening endogenous capacities at the subnational, national or regional levels. ▪ The financial resources for enhanced action on capacity-building in developing country Parties should be provided by Parties included in Annex II to the Convention and other Parties in a position to do so through current and any future operating entities of financial mechanism, as well as through bilateral, regional and other multilateral channels.

2.8.2 Remaining Issues for the Decisions in COP 17 (December 2011 at Durban, South Africa

There are many issues remaining unsolved for the Decisions in COP 17. The table below summarizes such issues to be solved and decided in COP 17 in December 2011 at Durban, South Africa.

Table 10: The remaining issues for the decisions in COP 17

Issues	Contents
Legally binding new targets of emission reduction	▪ Establishment of the new emission reduction targets for 2nd commitment period of the Kyoto Protocol. ▪ Establishment of the new framework of emission reduction targets involving major economies (USA and China). ▪ Establishment of the legally-binding targets for developed and developing countries in accordance with the common but differentiated responsibilities.
Market mechanism	▪ Extension and/or improvement of the current market mechanism (Clean Development Mechanism, Joint Implementation, Emission Trading, etc.) ▪ Introduction of new mechanism (Bilateral Offset Credit Mechanism, etc.) ▪ Use of market mechanism for LULUCF (Land Use, Land Use Change and Forestry) including REDD-plus.
Financial mechanism	▪ Identifying the source finance for long term addressing climate change mitigation and adaptation measures in developing countries, including the operation and management of Green Climate Fund.

Issues	Contents
Adaptation, technology development and transfer, capacity-building	▪ Materialization of the decisions in Cancun Agreement regarding adaptation, technology development and transfer, and capacity-building

Although all the above remaining issues are somehow interlinking with each other, how the decision regarding the legally-binding new targets of emission reduction is to be made influences all other decisions and the future of international collaborative actions against climate change.

[BOX: Proposed New Market Mechanism for GHG mitigation activities]

(1) Nationally Appropriate Mitigation Actions (NAMAs)

At the COP13 in Bali, Indonesia, the two Ad-hoc Working groups were created to establish new emission reduction targets for developed countries for 2013 and beyond (Ad-hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol: AWG-KP), and to conduct international negotiations for long term actions of climate change measures (Ad Hoc Working Group on Long-term Cooperative Action under the Convention: AWG-LCA).

NAMAs are actions based on a call for action in the Copenhagen Accord. 44 countries have submitted information to the UNFCCC about NAMAs (as of July 2011). This information includes mitigation actions and targets, by sector, and several developing countries have already submitted them with a variety of contents and details (http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php).

(2) Reducing Emissions from Deforestation and Forest Degradation (REDD+)

Deforestation and forest degradation, through agricultural expansion, conversion to pastureland, infrastructure development, destructive logging, fires etc., account for nearly 20% of global greenhouse gas emissions, more than the entire global transportation sector and second only to the energy sector.

Reducing Emissions from Deforestation and Forest Degradation (REDD) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

Maintaining forest ecosystems can contribute to increased resilience to climate change. To achieve multiple benefits, REDD+ will require the full engagement and respect for the rights of Indigenous Peoples and other forest-dependent communities.

[Reference]

UN-Redd Programme (http://www.un-redd.com/AboutREDD/tabid/582/Default.html)

(3) Sectoral Crediting Mechanisms (SCMs)

Sectoral crediting is envisaged as expanding the coverage of the CDM from a project-by-project level to a sector-wide level.

An international sectoral mechanism could help address competitiveness concerns and mitigate leakage risks, as developed countries engage on more ambitious mitigation objectives. Sectoral approach could provide an opportunity to promote investment in GHG-friendly technologies and further development/environment issues in some countries.

Sectoral crediting mechanisms (SCMs) may be designed in different ways. Three potential design of sectoral crediting mechanism are as follows:

- Policy-based crediting: where credits would be generated by adopting and implementing GHG-friendly policies in particular sectors;
- Rate-based (indexed) crediting: where GHG emissions below a certain intensity level (e.g. per

product output or per value of output) would generate emission credits;
- Fixed sectoral emission limits: where emission ―credits" could be generated if a sector or company emits at a lower level than an agreed, fixed, limit.

*SCMs matters are under discussion at international negotiations.
[Reference]
IEA report
http://www.iea.org/papers/2006/greenhouse.pdf
OECD report
http://www.oecd.org/dataoecd/55/61/34902644.pdf

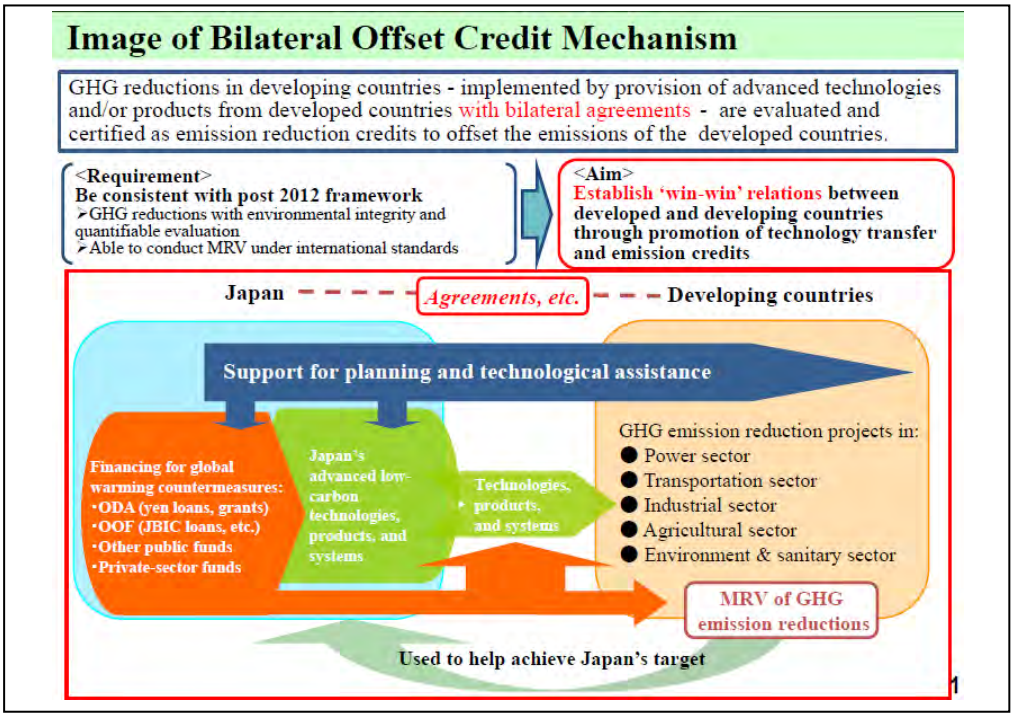
(4) Bilateral Offset Credit Mechanism (BOCM)

The Cancun agreement adopted at COP16 in Cancun, Mexico, included text on the topic of new credit mechanisms, saying that the meeting ―decides to consider the establishment … of one or more market-based mechanisms," at COP17, to be held in 28 November to 9 December 2011 in Durban, South Africa.

In response to these developments, Government of Japan decided to propose the creation of the Bilateral Offset Credit Mechanism (BOCM), in order to properly recognize as climate change countermeasures the contribution of corporations that offer clean technologies, products infrastructure, manufacturing facilities, etc.

To elaborate the mechanism, Japanese Ministry of the Environment and Ministry of Economy, Trade and Industry implemented 33 feasibility study programmes in fiscal year (FY) of 2010. Both ministries will continue the feasibility studies in FY2011 for accumulation of knowledge and experiences, in order to design mechanism which is consistent with an international framework.

Japan seeks cooperation on the feasibility studies and exchange views on its proposal of the new market mechanism with countries where the studies are carried out. In addition, with India and Vietnam, arrangements at Prime-Ministers' level were reached on pursuing the possibility for bilateral cooperation about climate change between Japan and these countries.

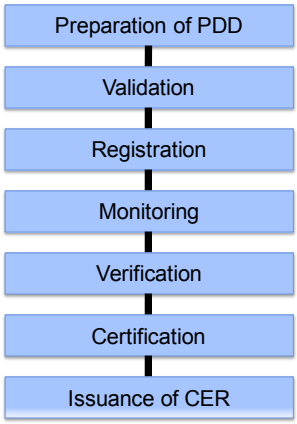


*BOCM matters are under discussion at international negotiations.
[Reference]
http://www.env.go.jp/en/earth/ets/mkt_mech/bilateral_moej1105.pdf
http://www.mmechanisms.org/e/index.html

3. BASIC PROCEDURE FOR CDM PROJECT DEVELOPMENT

3.1 CDM Project Cycle and Parties Involved in The Process

The CDM project cycle is common to all CDM project types as shown in the figure below.



Preparation of PDD	All the project proponents to conduct CDM projects must prepare the Project Design Document (PDD) to start the process of CDM project registration. PDD is the key document that the host country, investors, stakeholders and designated operation entities will use to evaluate the project's potential and judge its merits. No project can earn CER without the development, validation and CDM Executive Board acceptance of the PDD. PDD needs to clearly demonstrate that the project will create additional greenhouse gas emissions beyond what would have occurred in its absence, and that the project will support the host country's sustainable development path.
Validation	Validation is the process of independent evaluation of a proposed project activity by a designated operation entity against the requirement of CDM.
Registration	Registration is the formal acceptance by the Executive Board of a validated project activity as a CDM project activity. Registration is the prerequisite for the verification, certification and issuance of CERs related to that project activity.
Monitoring	Monitoring refers to the collection and archiving of all relevant data necessary for determining the baseline, measuring anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary of a CDM project activity and leakage, as applicable.
Verification	Verification is the periodic independent review and ex post determination by a designated operational entity of monitored reductions in anthropogenic emissions by sources of greenhouse gases (GHG) that have occurred as a result of a registered CDM project activity during the verification period. There is no prescribed length of the verification period. It shall, however, not be longer than the crediting period.
Certification	Certification is the written assurance by the designated operational entity that, during a specified time period, a project activity achieved the reductions in anthropogenic emissions by sources of greenhouse gases (GHG) as verified.
Issuance of CER	Issuance of CERs refers to the instruction by the Executive Board to the CDM registry administrator to issue a specified quantity of CERs for a project activity into the pending account of the Executive Board in the CDM registry. Upon issuance of CERs, the CDM registry administrator shall promptly forward the CERs to the registry accounts of project participants involved, in accordance with their request, having deducted the quantity of CERs corresponding to the share of proceeds to cover administrative expenses for the Executive Board and to assist in meeting costs of adaptation for developing countries vulnerable to adverse impacts of climate change, respectively to the appropriate accounts in the CDM registry for the management of the share of proceeds.

Figure 30: Basic CDM Project Cycle

The Parties involved in the CDM project cycle are shown in the figure below.

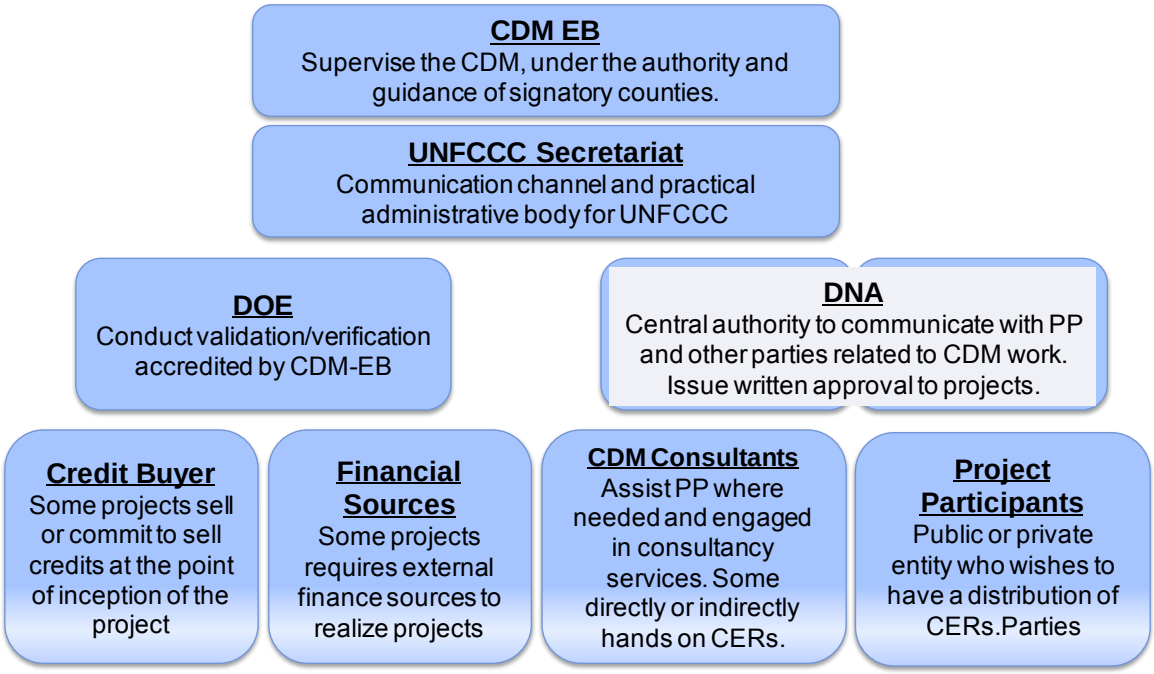


Figure 31: The Parties involved in the CDM Project Cycle

The involvement of the Parties above in the CDM project cycle can be illustrated as shown in the figure below.

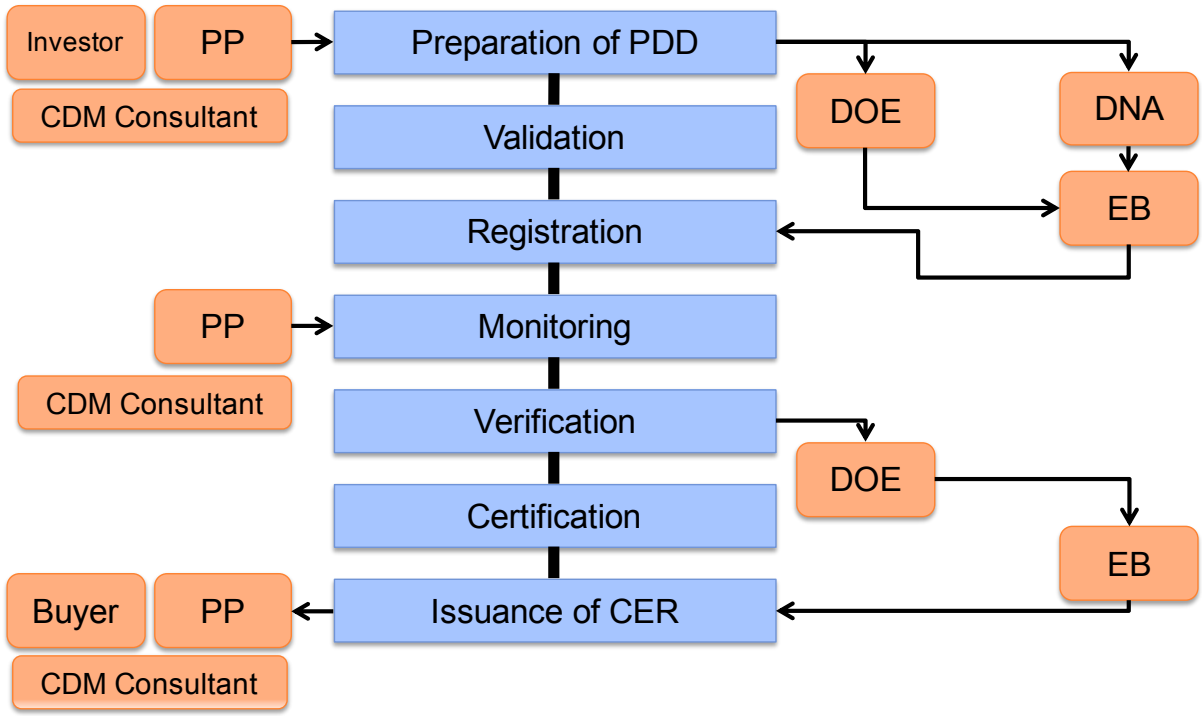


Figure 32: Involvement of the Key Parties/Stakeholders in CDM Project Cycle

(Outline of the key steps in CDM Project Cycle)

(1) Preparation of PDD (Project Design Document)

As the first step of CDM project, the project proponent, working together with its investment partners and CDM consultant, will prepare the Project Design Document.

(2) Acquisition of host country approval and Validation by DOE

Once the PDD is prepared, the project proponent will select a Designated Operation Entity for its validation while submitting the PDD to the Designated National Authority of CDM in the host country to obtain host country approval. A list of accredited DOEs is available at UNFCCC CDM website (http://cdm.unfccc.int/DOE/list/index.html) with the types of sectors covered by each DOE. As to the host country approval, the project proponent is required to comply with the requirement set by each host country. In the case of Sri Lanka, the following requirements are provided.

(a) Sri Lanka's Host Country Approval Criteria

Project Participants are required to comply with the following approval criteria.

Table 11: Sri Lanka's Host Country Approval Criteria

Category	Criteria	Example/Indicator
Economic Criteria	Improving quality of life (Project should not lower the quality of life of the community)	▪ Better housing ▪ Electrification of households ▪ Better education ▪ Secure access for safe water
	Alleviation of poverty (project should not lower the income of the community)	▪ Increase income of the community households
Social Criteria	Participation of the community	▪ Section E of proposed PDD (–Stakeholders' comments") ▪ Promote social interactions, Activities relating to the Corporate Social Responsibility (CSR)
Technological Criteria	Transfer of appropriate technology include know-how and method (Obsolete technologies should not be used in the project. The technology applied in the project should not continuously depend on the external knowledge)	▪ Low GHG technologies replace high GHG technologies
Environmental Criteria	Conservation of Natural Resources (Water, Soil, Biodiversity, Air, Minerals, Forest and Natural habitats, etc.)	▪ Impact on the Natural Resources ▪ Planting trees ▪ Conforming to emission standards
	Sustainable use of land	▪ Impact on land resources
	Contribution to the GHG Reduction	▪ The amount of GHG reduction

(b) Documentary requirements of Sri Lanka's Host Country Approval Procedure

- Mandatory Document
  - Project Design Document (PDD)
  - Proof of Legal Capacity of Project Participants
  - Other Documents required in respect of the type of project
- Supporting Documents

The availability of following document (where applicable) will help facilitate the approval process.

- Validation Report from DOE
- Local Gov't approval letter (for construction plan)
- Environmental Impact Assessment (EIA) Report or Initial Environmental Examination (IEE) Report
- Feasibility Study (FS) Report
- Copy of the approval letter for project investment
- Copy of the Emission Reduction Purchase Agreement (ERPA) or the Letter of Intent (LOI) for the credit purchase
- Section A2 of the PDD (Description of the project activity) written in local language (Sinhalese and/or Tamil)
- Recommendation letter from the Forestry Department (only for A/R CDM project proposal)

(3) Registration

After validation with the validation report by a DOE and acquisition of host country approval, the PDD will be officially submitted to the CDM Executive Board of UNFCCCC with all the necessary document attached. The CDM Executive Board will review the project with these document as well as communication with the DOE for further clarification and/or correction of the document and finally register the project under CDM if the project complies with the all requirements.

(4) Monitoring

Monitoring is the collection and archiving of all relevant data necessary for determining the baseline, measuring anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary of a CDM project activity and leakage, as applicable. The project proponent, in cooperation with CDM consultant may conduct this work to prepare a Monitoring Report for verification by a DOE.

(5) Verification and Certification

Verification is the periodic independent review and ex post determination by a designated operational entity of

monitored reductions in anthropogenic emissions by sources of greenhouse gases (GHG) that have occurred as a result of a registered CDM project activity during the verification period. There is no prescribed length of the verification period. It shall, however, not be longer than the crediting period. Certification is the written assurance by the designated operational entity that, during a specified time period, a project activity achieved the reductions in anthropogenic emissions by sources of greenhouse gases (GHG) as verified.

(6) Issuance of CER

Based on the review by the CDM Executive Board of a verification/certification report of the DOE of the project activity, CER will be issued into the pending account of the Executive Board in the CDM registry.

(7) Trading of CER

Once a CER is officially issued by the CDM Executive Board, the project proponents can trade it in the carbon market through brokers or buyers of carbon credit based on the conclusion of a "Emission Reduction Purchase Agreement".

3.2 Key Issues in Major Phase of CDM Project Cycle

3.2.1 Project Inception

Before making decisions on applying for CDM, the project proponent should check at least the following points as to the project activity that it is going to propose:

A. Eligibility of the project for CDM

First of all, the project proponent should check the eligibility of the project for CDM from the viewpoints of project types, applicability of approved methodologies, and additionality.

a Identification of project types

Based on typology of the CDM project category as previously mentioned in Section 2.6 Project Types of CDM, the project proponent is required to identify the types of CDM project that it is going to develop. Whilst identifying the types of GHGs and emission sources or sinks to be targeted, it also has to clarify which category the proposed project falls into in accordance with the definition of the CDM Executive Board. The project proponent must be cautious about what type of PDD is to be prepared as its requirement is different between types of CDM projects. The next figure illustrates the procedure for categorization of a CDM project.

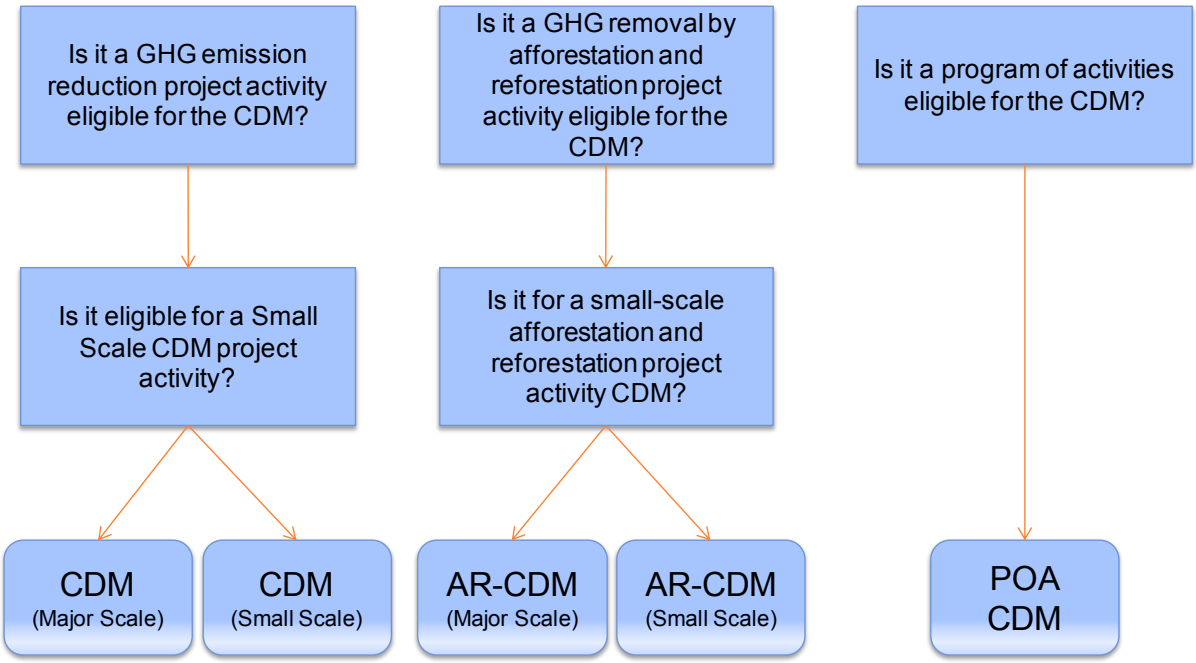


Figure 33: Procedure for identifying the types of a CDM Project

As shown in the figure above, CDM project basically falls into 5 categories with five different types of PDD with different requirement.

b Applicability of the Approved Methodologies

Once the project proponent identifies the types of CDM project it is going to develop, the next important step is to check applicability of the approved baseline and monitoring methodologies that the project can utilize in preparation of a PDD. A list of approved methodologies is available at UNFCCC CDM website (http://cdm.unfccc.int/methodologies/index.html). Every approved methodology has a section of "Applicability" in the document. The project proponent must go through this section to check whether the proposed project complies with the applicability conditions mentioned in the relevant approved methodology.

If the project proponent cannot identify the applicable approved methodology for the proposed project, it has to establish a new methodology in accordance with the procedure required by the CDM Executive Board. Taking into account the complicated and time-consuming procedure for obtaining the approval of new methodology, however, it is strongly suggested that the project proponent should utilize approved methodologies (in a single or combined manner) or reconsider the design of the proposed CDM project if it still needs to develop the project under CDM (with carbon credit).

Once the project proponent succeeds in identifying the approved methodologies that it can utilize for PDD preparation, it must be very careful in obtaining their latest versions as the approved methodologies are frequently renewed with additions and revisions.

c Additionality of the Project

–Additionality" is a unique concept developed under CDM. To make the proposed project under CDM, the project proponent must prove and demonstrate this –Additionality" of the project.

The concept of –Additionality" comes from answering a very simple question of –Would the project have happened anyway regardless of whether there is CER under CDM or not?". If the answer is –Yes" the proposed project is definitely not additional. If the answer is –No", the proposed project may be able to demonstrate its additionality.

The tools for demonstrating additionality of the CDM project are available in UNFCCC CDM website such as http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf. Table below illustrates the steps of demonstrating the project additionality.

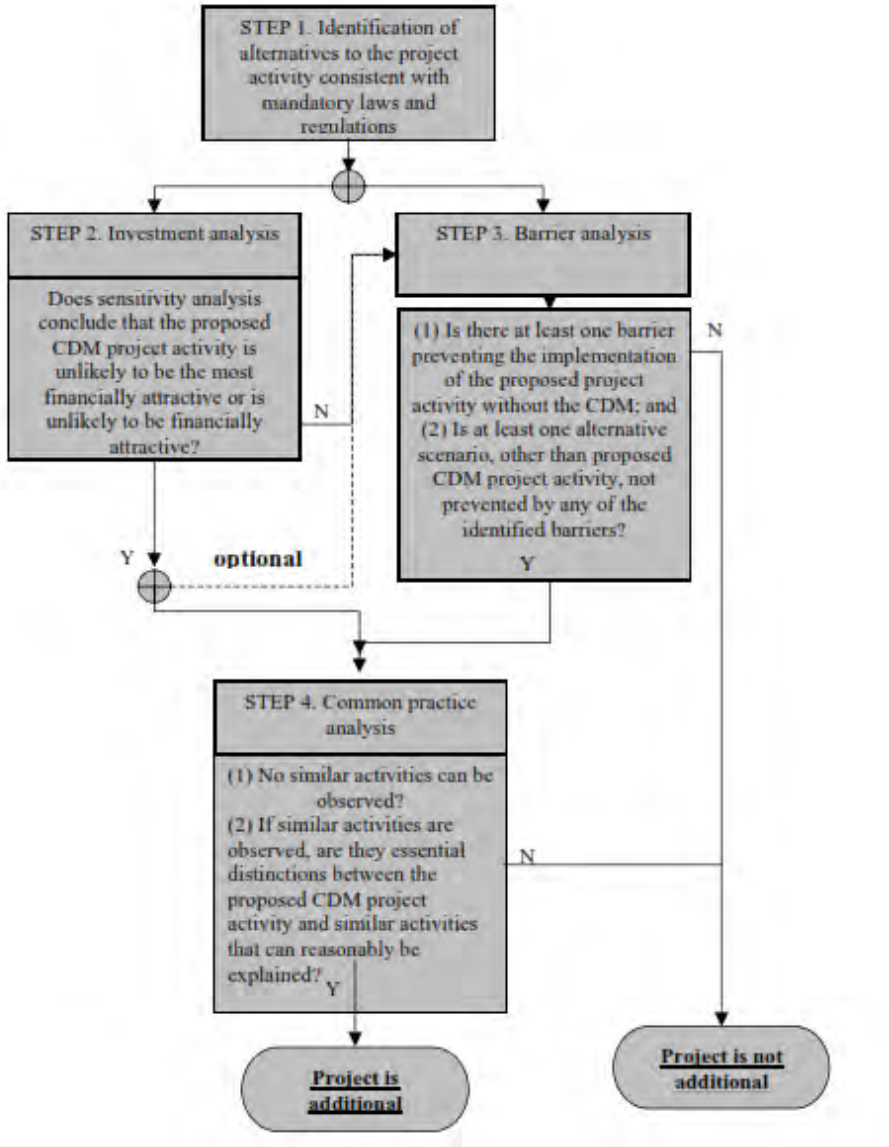


Figure 34: Basic Steps of Demonstrating the Project Additionality

STEP1: Identification of alternatives to the project activity consistent with mandatory laws and regulations

First step is to identify realistic and credible alternative scenarios to the project activity consistent with mandatory laws and regulations. These alternative scenarios are to include:

a) The proposed project activity undertaken without being registered as a CDM project activity;

b) Other realistic and credible alternative scenario(s) to the proposed CDM project activity scenario that deliver outputs (e.g., cement) or services (e.g. electricity, heat) with comparable quality, properties and application areas, taking into account, where relevant, examples of scenarios identified in the underlying methodology;

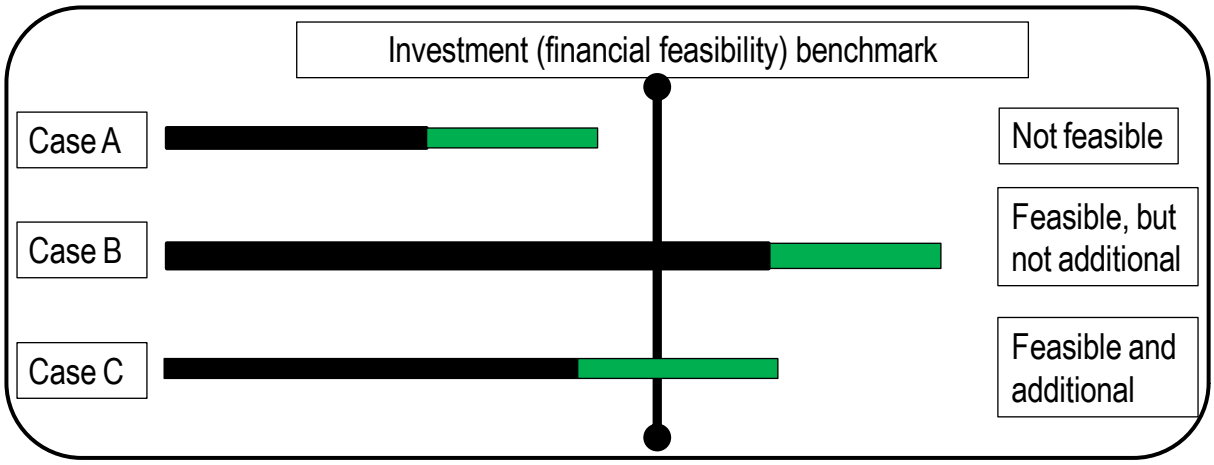
c) If applicable, continuation of the current situation (no project activity or other alternatives undertaken).

STEP2: Investment analysis

In this step, it is required to prove that the revenue from the CER is a decisive reason for implementation of the proposed project.

In general, this investment analysis is conducted through estimation of the Internal Rate of Return (IRR) and net present value (NPV) of the project based on the discounted cashflow analysis. Therefore, it is necessary to conduct full cost estimation of the project for the total project period. Detail cost estimation of CAPEX (Capital Expenditure) and OPEX (Operation Expenditure) is required.

Specifically, the project proponent is required to compare feasibility between the project with and without CER income as shown in the figure below.



Remark: Black bar above indicates the financial feasibility gained without CER income while green bar represents the additional feasibility gain with CER income. In this case, Case C can demonstrate the aditionality of the project.
Investment benchmark is the benchmark for the project proponents to decide the investment in terms of financial feasibility.

STEP 3: Barrier analysis

Although the previous figure (Figure 34) indicates that it is not necessary to conduct barrier analysis if investment additionality is proved, the validator of the proposed CDM project usually requires to conduct all the analysis. Therefore, barrier analysis has to be conducted as well. In the barrier analysis, the project has to prove that it faces barriers that:

a) Prevent the implementation of this type of proposed project activity; and
b) Do not prevent the implementation of at least one of the alternatives.

STEP 4: Common practice analysis

This step will complement the additionality of the project activity if the technologies or measures applied in the project activity are the first of its kind in the host country. It is enough to mention that similar technology has not been introduced and applied so far in the host country.

d Official recording of the project starting date

To prove additionality of the proposed project, the project proponent must officially record and hold documented proof(s) of the actual starting date of the project. The CDM Executive Board defines the starting date of a CDM project activity as the earliest date at which either the implementation or construction or real action of a project activity begins.

In light of the above definition, the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project. For those project activities which do not require construction or significant pre-project implementation (e.g. light bulb replacement) the start date is to be considered the date when real action occurs. In the context of the above definition, pre-project planning is not considered ~~"r~~eal action".

3.2.2 PDD Development

If the project proponent is confident enough to develop the proposed project under CDM after the project inception activities conducted in the previous section 3.2.1, it is time now to develop a Project Design Document. First of all, the project proponent must properly select the PDD template in accordance with the type of project that it is going to develop. The table below shows the types of PDD templates in accordance with the project categories.

Table 12: PDD Templates and relevant document forms by CDM project categories

		Normal-scale CDM project activity		Small-scale CDM project activity	
Emission Reduction	PDD	CDM-PDD ver.3 (Att.1)	CDM Project Design Document	CDM-SSC-PDD ver.3	CDM Project Design Document for Small-Scale project activities
				CDM-SSC-Bundle ver.2	Form for submission of bundled Small Scale project activities form
		CDM-PoA-DD ver.1	Programme of Activities Design Document	CDM-SSC-PoA-DD ver.1	Small-Scale CDM Programme of Activities Design Document
		CDM-CPA-DD ver.1	CDM Programme Activitiy Design Document	CDM-SSC-CPA-DD ver.1	Small-Scale CDM Programme Activity Design Document
	Methodology	F-CDM-AM-Subm ver.1	Form for submission of queries from DOEs to the MP regarding the application of approved methodologies	F-CDM-SSC-Subm ver.3	Form for Submissions on Small Scale Methodologies and Procedures
		F-CDM-AM-Rev ver.1	Form for submission of requests for revisions of approved methodologies to the MP		
		CDM-NM ver.3.1	CDM Proposed New Methodology: Baseline and Monitoring	F-CDM-SSC-NM ver.1	Form for proposed New Small-Scale Methodologies
A/R (chap.19)	PDD	CDM-AR-PDD ver.5	CDM Project Design Document for A/R project activities	CDM-SSC-AR-PDD ver.2	Project Design Document Form for Small-Scale A/R project activities
		CDM-PoA-DD-AR ver.1	Programme of Activities Design Document Form for A/R project activities	CDM-PoA-DD-SSC-AR ver.1	Programme of Activities Design Document Form for SSC-AR project activities
		CDM-CPA-DD-AR ver.1	CDM Programme Activity Design Document Form for A/R project activities	CDM-CPA-DD-SSC-AR ver.1	CDM Programme Activitiy Design Document form for SSC-AR project activities
	Methodology	F-CDM-AR-AM-Subm ver.1	Form for submission of queries from DOEs to the AR WG regarding the application of Approved A/R Methodologies	F-CDM-SSC-AR-Subm ver.2	Form for Submission on Small Scale A/R Methodologies and Procedures
		F-CDM-AR-AM-Rev ver.1	Form for submission of requests for revisions of Approved Methodologies to the AR WG		
		CDM-AR-NM ver.4	CDM Proposed New Methodology: Baseline and Monitoring for A/R		

Source: CDM in Charts (Ver. 13.1), IGES.

The project design document, or PDD, is the central component in the CDM project cycle, and its preparation is a complex task. This section details the information, analysis and procedures required in creating a comprehensive project design document consisting of the following contents:

A.	GENERAL DESCRIPTION OF PROJECT ACTIVITY
B	APPLICATION OF BASELINE AND MONITORING METHODOLOGY
B.1	Title of employed methodology
B.2	Justification of methodology application
B.3	Description of project boundary
B.4	Description of baseline scenario identification
B.5	Assessment and demonstration of additionality
B.6	Emission reductions
B.7	Application of the monitoring methodology and description of the monitoring plan
C	DURATION OF THE PROJECT ACTIVITY/CREDITING PERIOD
D	ENVIRONMENTAL IMPACTS
E	STAKEHOLDERS' COMMENTS

A. GENERAL DESCRIPTION OF PROJECT ACTIVITY

The first part of the project design document is a description of the project. While some of this information can be taken from the project idea note (PIN), the PDD requires some additional information as well. At the very minimum, the following project information is required:

- Title of the project activity;
- Purpose of the project;
- List of project participants;
- Technical description of the project, including location, category, technical performance information, description of opportunities for technology transfer, and explanation of how the reduction in greenhouse gas emissions is to be achieved; and
- Justification that public funding, if used, is not being diverted from other uses.

Additional recommended information preferably included are:

- Project background;
- Problems and barriers being addressed by the project;
- Project planning (timetable);
- Description of the key issues and stages in project development (milestones); and
- Any other information deemed relevant within reason – lengthy documents generally do not receive extra attention.

B. APPLICATION OF BASELINE AND MONITORING METHODOLOGY

This section is the core part of PDD, in which the emission reduction by the project activity is estimated in accordance with the baseline and project emission, as well as the additionality of the project activity is assessed and demonstrated. The project monitoring plan to determine the ex-post emission reduction is also to be clarified in this section.

B.1 Title of employed methodology

If the project proponent uses an approved methodology, it must be accurately described here in reference with the latest version. If a new methodology is going to be proposed, the project proponent must create the title of the methodology, which is strongly not recommended in this guidebook.

B.2 Justification of methodology application

Once the project proponent determines the approved methodology to be utilized for the proposed project activity, it has to justify its applicability by demonstrating that the proposed project activity fully complies with the applicability conditions described in the approved methodology. The project proponent must check one by one of the applicability conditions with the description of why the proposed project complies with each condition.

B.3 Description of project boundary

In order to determine which greenhouse gas emissions need to be estimated and calculated for establishing the emission baseline and project emissions, the project boundary has to be defined. A project boundary comprises all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonable attributable to the CDM project activity. The activities and greenhouse gas emissions that are included in the project boundary reflect:

- Activities that will be included in the emission baseline and baseline calculations; and
- Activities and greenhouse gas emissions that will be monitored once the project is operational.

Setting a project boundary will take into account:

- Geographic factors should respond to the questions as to over what activities and in which geographical area should a project be compared? For example, against all similar activities in a country, in a specific region, at one specific location, across national borders, or at another level?
- Activity level pertains to the activities whose emissions should be included in the baseline. For example, should emissions related to the construction of a facility be included or not, should upstream and downstream emissions be included?

It is recommended that the project boundaries should be drawn in the form of a flowchart that clearly shows included and excluded emission sources. The emission sources that are included should be those that are considered to be within the control of the project. On next page, some examples of the project boundary is shown from the registered projects in Sri Lanka (–Coconut shell charcoaling and power generation at Badalgama, Sri Lanka" and –Adavikanda, Kuruwita Division Mini Hydro Power Project").

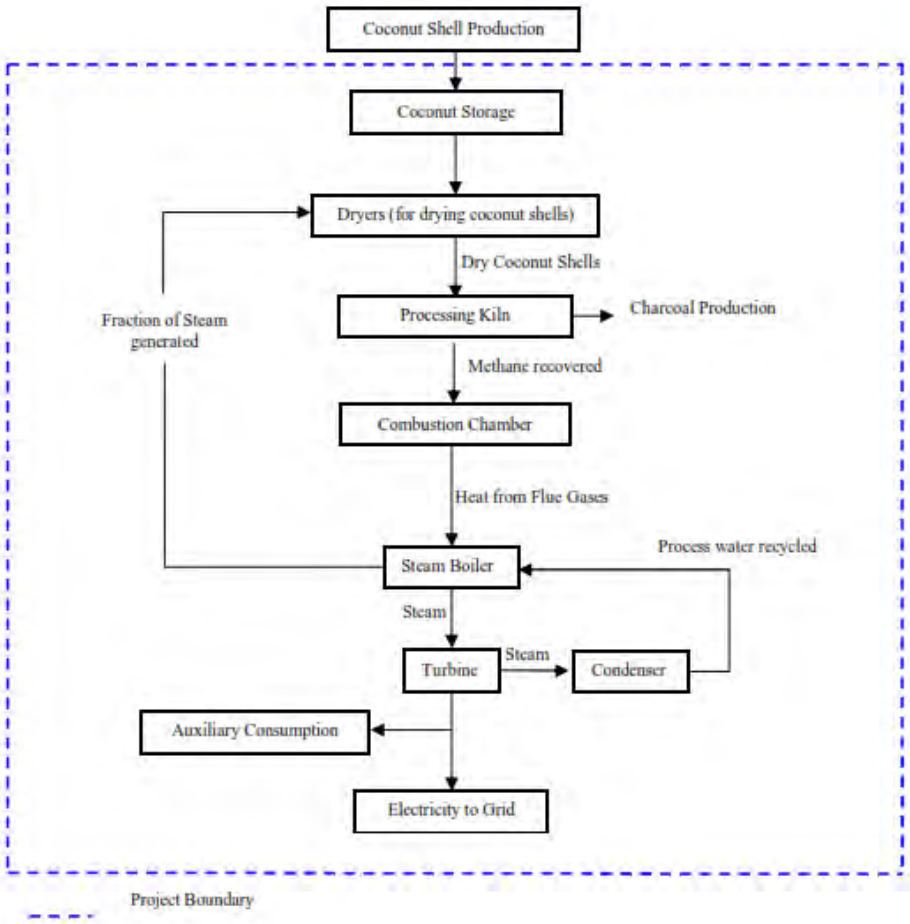


Figure 35: An example of project boundary with system flow chart

Source: PDD of Coconut shell charcoaling and power generation at Badalgama, Sri Lanka

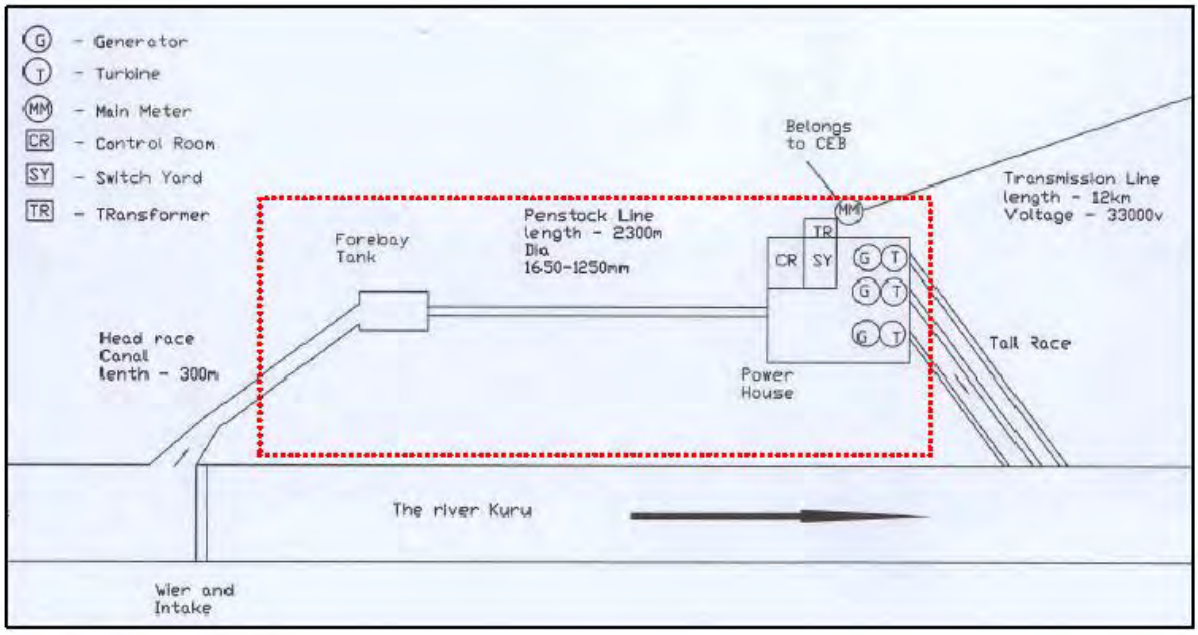


Figure 36: An example of project boundary with facility layout

Source: PDD of Adavikanda, Kuruwita Division Mini Hydro Power Project

B.4 Description of baseline scenario identification

Identification of baseline emission scenario serves to:

- Confirm the project's additionality;
- Estimate the amount of greenhouse gas emissions that would occur without the project, and estimate the amount of emissions that will occur with the project.

The development of an emission baseline is based on assumptions regarding future activity and performance –and should be based on the most credible assumptions possible. Some projections can be quite robust, whereas others are more nebulous. The assumptions underpinning the baseline can often be interpreted in different ways and can result in different conclusions among different observers.

In any case, the emission baseline has to be established in a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and other key factors.

Emission baselines have to take into account relevant national and sectoral policies and circumstances such as sectoral reform initiatives, local fuel availability, power sector expansion plans and the economic situation in the project sector. All these factors should be addressed when setting the emission baseline and then translated in the calculation of the baseline emissions.

The baselines assumptions and study are validated by an operational entity to ensure that the analysis is undertaken within all the relevant guidelines of the approved methodology. Members of the international CDM community also may comment and raise concerns about the baseline to the Executive Board during the 30-day commenting period.

B.5 Assessment and demonstration of additionality

With the tools, previously mentioned in –Section 3.2.1 Project Inception" of this chapter, the project proponents must assess and demonstrate step by step the additionality of the proposed project activity.

The issue of additionality is particularly important to prevent benefits from the CDM process going to projects that would have happened anyhow or have already been undertaken.

Not all projects that appear to have positive greenhouse gas impacts are additional. For example, renaming an existing hydroelectric plant as a CDM project will not result in additional greenhouse gas mitigation. Projects that are undertaken to meet legal or policy obligations also would have a difficult time demonstrating additionality. Eligibility demands that a project developer clearly demonstrate that the project's practices are additional to what would otherwise have occurred (that is, compared to the business-as-usual or baseline scenario).

B.6 Emission reductions

The net emission reductions generated by a project is calculated by subtracting the total project emissions from the baseline emissions and adjusting for leakage. Calculations should be made for each year of the crediting period and expressed in tons of CO_2 equivalent. As with the other calculations, all numbers and assumptions must be transparent.

As is the case of establishing baseline emission scenario mentioned in B.4 above, emissions, project emissions need to be estimated and calculated in a transparent manner for each year during the crediting period. For purposes of the project design document, emissions have to be projected from the project startup to the end of the crediting period.

In most cases, the project boundary selected for the emission baseline will also apply to measuring greenhouse gas emissions resulting from the project.

For energy supply projects, direct on-site emissions can be calculated from the estimated project output and the emission factor for the project. The direct off-site emissions are calculated in a similar way.

For demand side management projects, project emissions can be calculated by multiplying the various activity level changes (i.e. reduction in energy used, reduction in transmission and distribution losses, etc.) with the appropriate and defined emission factors for those activities.

Special attention must be given to indirect on-site emissions, which constitute the ~~"r~~ebound effect". The rebound effect occurs when lower marginal costs of energy or increased energy capacity stimulate higher energy use. Additional emissions from the rebound effect should be included in the calculation to give the total project emissions.

(Accounting for Leakage Emission)

Leakage refers to indirect and off-site greenhouse gas emission flows that are outside the project boundary and thus not accounted for in the baseline. It can be extremely difficult to identify and/or control leakage. If the quantity or leakage is significant, the project boundary should probably be redrawn to capture it so that the emissions become a part of the baseline calculation. In any case, the project developer should assess, account for and calculate potential points of leakage, and the same should subsequently be a part of the monitoring plan.

Possible effects from the project activity that can be considered when assessing leakage are:

- **Activity shifting** means that emissions are not permanently avoided, but simply displaced to another area. This has been a particular concern in regards to conservation based forestry projects

(currently not applicable under the CDM) that seek to slow or stop logging in a particular zone, but whose net effect may be to push logging activities into more remote areas. In energy projects, these issues are largely covered under outsourcing.

- **Outsourcing** is the purchase or contracting of services or commodities that were previously produced or provided on-site. The greenhouse gas emissions that took place within the project boundary prior to the outsourcing would be classified as leakage, and the emissions from the outsourced activities should be accounted for. For example, if a company simply outsourced its transportation needs to another concern, the emissions associated with the transportation would be considered leakage.

Leakage does not disqualify a project's validity, unless the projected values of emissions under leakage are potentially significant and cancel out a sizeable percentage of the projected greenhouse gas emission reductions from the project. In such a case, as noted above, all attempts should be made to formally incorporate the source of the leakage into the project boundaries (and therefore into the baseline and emission scenarios).

B.7 Application of the monitoring methodology and description of the monitoring plan

A monitoring plan is a required element of the project design document. The plan outlines how data will be collected from the project once it is operational. Although the monitoring plan is supplied to the designated operation entity for validation (and must be validated as part of the project design document), the project developer is responsible for implementation of the monitoring plan and sending the results to the designated operation entity for future verifications of CER production.

Information required in the monitoring plan includes:

- The boundaries of what will be monitored are defined;
- The means by which relevant data will be collected and archived. (Monitored data should be kept for two years after the end of the last issuance of CERs.);
- The frequency of data collection;
- How future leakage may be assessed and estimated;
- What the control procedures are, and how quality control for the monitoring process is dealt with;
- How the data on non greenhouse gas environmental impacts will be collected and archived; and
- A justification of the choice of monitoring methodology.

Other information that can be helpful in preparing the complete PDD are:

- Specifications of verification activities that will take place;
- Method of measurements and calibration methods;
- If applicable, explanation on how to deal with missing data;
- Duration of the measurements;
- Who is responsible for collection of the data;
- Who is responsible for archiving the monitoring data;
- Backup system for data collection; and
- Who has the ultimate responsibility for carrying out all stages of monitoring process?

The data collected as specified in the monitoring plan form the basis for verification of emission reductions as a result of the CDM project activity.

The monitoring plan should provide for the collection and archiving of all relevant data necessary for measuring project-specific greenhouse gas emissions within the defined project boundary and over the appropriate crediting period.

The monitoring plan must describe the relevant data characteristics of the project to be measured. The plan may also indicate who is responsible for the measurements, as well as protocols for the collection and reporting of the monitoring activities. The monitoring should be carried out in such a way that the indicators of project performance and emissions can be readily compared with the baseline scenario. From the perspective of keeping future expenditure under control, it is important that the monitoring plan be developed in a manner to making future verification as simple and cost-effective as possible. The verifying designated operation entity closely monitors the data collected under the monitoring plan.

C. DURATION OF THE PROJECT ACTIVITY/CREDITING PERIOD

The project design document must define the period that the project developer seeks to earn credits. The crediting period is an important determinant of emission reductions that can be generated from and claimed for a CDM project. The crediting period thus has a direct impact on the value of the project.

During the crediting period the defined emission baseline cannot be adjusted or revised. The crediting period will often differ from the project lifetime. The project lifetime is, in general, longer than the period over which carbon credits can be claimed. For the CDM, project developers have two options to determine the

crediting period. They are:

- A crediting period for a maximum of seven years, which may be renewed at most two times; or;
- A maximum crediting period of ten years with no option for renewal.

An important consideration in selecting the crediting period for a CDM project is the period over which the emission baseline (against which emission reductions are measured) is fixed. A fixed emission baseline is set and agreed upon when the project is designed (ex-ante). Once validated it cannot be renewed. This issue should be reviewed during project development. Choice of crediting period is a strategic decision that involves consideration of the emissions trajectory of the sector in question.

D. ENVIRONMENTAL IMPACTS

The project design document should include an assessment of the environmental impacts of the project. This includes an assessment of non-greenhouse gas related impacts. If there are significant negative environmental impacts, these can disqualify the project from participation in the CDM, particularly if local or international stakeholders raise significant objections. For example, large-scale hydropower projects involving significant flooding and dislocations.

The developer should consider whether the project may have significant impact on one or more of the variables listed below.

- Biodiversity;
- Local air quality;
- Water resource availability;
- Water resource quality;
- Soil contamination;
- Soil erosion;
- Noise level;
- Use of natural resources;
- Chemical usage and disposal;
- Landscape pollution (such as wind farms); and
- Overall process efficiency and waste management.

Any mitigation efforts to address such impacts should be clearly stated in the project design document. The

developer should expect that the designated operational entity and third party observers will give close consideration to these issues.

If potential environmental impacts of the project are considered significant, or if an environmental impact assessment (EIA) or review is legally required by the host country, this has to be conducted and documented in the project design document. There are no specific indicators for determining what is considered a –significant impact".

This will have to be assessed on a case-by-case basis. Sustainable development criteria can also provide guidance for determining the environmental impact.

E. STAKEHOLDERS' COMMENTS

A final requirement of the project design document phase is that local stakeholders be invited to comment on it. Stakeholders include individuals, communities, or other groups, such as NGOs, who may be affected by the project. The project design document must include a description of the process for public comments. A specific format for submitting contacts and results of the stakeholder sessions is included in the project design document template, in annex 1.

Stakeholder participation and public meetings are critical to maintaining transparency in the CDM process.

Indeed, the CDM requires that project developers:

- Invite local stakeholders to comment on the project design document;
- Provide a summary of the comments received; and
- Review comments received and provide a report, demonstrating how relevant concerns were addressed. This report has to be submitted for validation by the designated operational entity.

This local stakeholders consultation process is distinct from the invitation for comments from stakeholders by the designated operational entity during the project validation phase. At that time, international stakeholders,such as NGOs, have an opportunity to provide their comments regarding the specific CDM components of the activity. In contrast to local stakeholders, the international stakeholders are not actively approached. They are simply given the opportunity to review the project design document on the web. The rationale is that concerned members of the international and/or national community, especially NGOs, will take on the task of monitoring proposed CDM projects. Incorporating two rounds of stakeholder consultations is intended to promote democratization of the CDM process and allow both local and international stakeholders to express their concerns regarding the efficacy and appropriateness of the selected

projects.

The Marrakech Accords refer to accredited NGOs, and clearly some NGOs will be more competent than others to provide a valuable feedback to the CDM activity in the host country.

In host countries with a clear project planning process in place, a project developer can follow that country's established guidelines for public consultation and participation. However, the project developer is advised to check with the designated national authority whether the existing rules apply to the project type and the CDM process. Project developers are also advised to verify the rules for public consultation, discuss with the relevant authorities and invite comments from civil society on the project design document. In cases where the public consultation procedures are not established, the project developer should design its own consultative exercise.

3.2.3 Validation

After the development of a complete PDD of the proposed project activity, the contents of PDD is to be validated by a Designated Operation Entity (DOE). The basic procedure for validation is illustrated in the figure below.

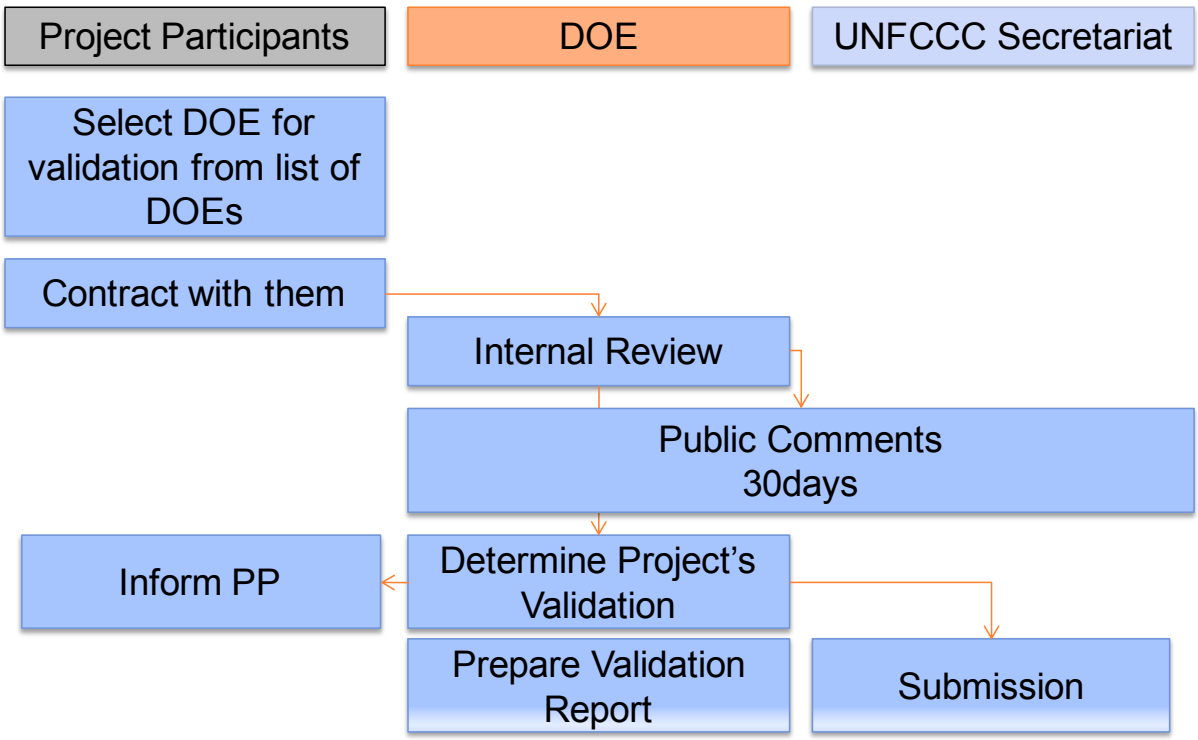


Figure 37: Basic Procedure for Validation

First of all, the project proponent will select a DOE to contract on validation. Based on the contract, DOE will conduct a comprehensive internal review of the PDD and communicate with the project proponent to refine its contents with corrections, revisions and additions of data and information. In this process, the validator is required to establish its confidence over PDD in accordance with the accounting principle mentioned in the table below

Table 13: Accounting Principle in PDD Validation

Principles	
Relevance	Use data, methods, criteria, and assumptions that are appropriate for the intended use of reported information
Completeness	Consider all relevant information that may affect the accounting and quantification of GHG reductions, and complete all requirements
Consistency	Use data, methods, criteria, and assumptions that allow meaningful and valid comparisons
Transparency	Provide clear and sufficient information for reviewers to assess the credibility and reliability of GHG reduction claims
Accuracy	Reduce uncertainties as much as is practical

Source: The GHG Protocol, Chapter 4. GHG Accounting Principles.

This internal review by the DOE usually takes time with a series of communication with the project proponent and PDD revisions. The more incomplete the PDD is, the more time required to complete the internal review by the DOE.

Once the internal review is completed, the PDD is submitted to the UNFCCC Secretariat for the open comments by external experts. If there is any comment that is necessary to consider and incorporate into PDD, the project proponent will revise the PDD to answer the comments raised by external experts. After the ending the period of open comments at the UNFCCC Secretarait, the DOE will finalize the validation with preparation of a validation report for submission to the UNFCCC Secretariat.

In fact, a considerable number of CDM project proposals are canceled and/or denied in this validation process due to incomplete examination of their compliance or eligibility under CDM. To avoid such risks, it strongly suggested that the project proponent at the time of project inception, should consult with the CDM consultants and/or DOEs about the eligibility of the proposed project under CDM.

3.2.4 Registration

Once the PDD of the proposed project is submitted to the UNFCCC Secretariat with the validation report by a DOE, it is to be reviewed for final decision on registration or no-registration. The basic procedure for registration is as shown in the figure below.

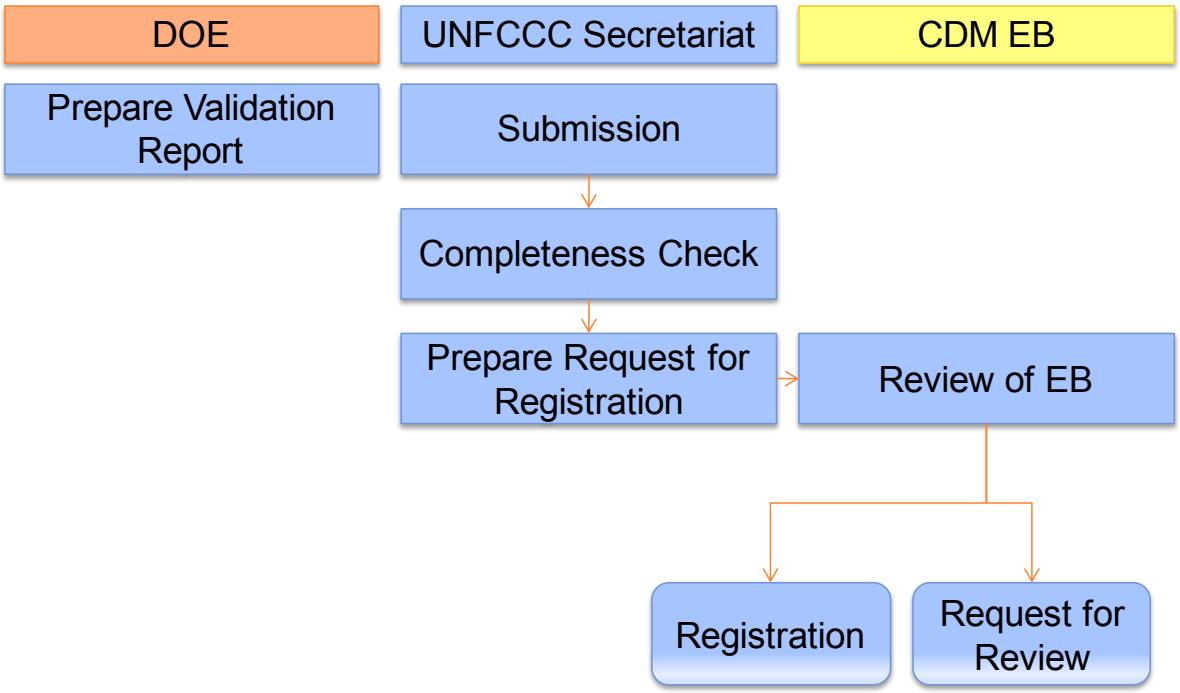


Figure 38: Basic procedure for CDM project registration

A. Completeness Check

The UNFCCC Secretariat conducts a so-called completeness check of each submitted CDM project activity. The Document subject to this completeness check includes:

- CDM-PDD;
- Vaidation Report;
- Valid letters of approval from each party involved;
- Registration request form;
- Letters of authorization for each project participant;
- Modalities of communication

If the Secretariat finds any incompleteness in the document, it will be informed to DOE for correction. The project proponent is required to resubmit the document in accordance with the request made by the Secretariat.

Once the Secretariat finds the CDM project proposal complete, it prepares the request for registration for submission to the CDM Executive Board. The CDM Executive Board will again review the request with the submitted document and decide either to register the project under CDM or to request for review.

It is very difficult to predict the time required for this registration process. It depends upon the completeness of PDD and other relevant document, as well as the number of PDD submissions to the Secretariat, and so forth.

B. Payment of Share of Proceeds

Share of Proceeds (SOP) is charged to each of the registered CDM projects for covering administrative expenses (SOP-Admin) applied to the expected average annual emission reductions. SOP Admin is USD 0.1/CER and USD 0.2/CER issued for any amount in excess of 15,000tCO_2. The maximum registration fee is no more than USD 350,000 per project.

3.2.5 Verification

Verification is a process to decide emission reduction amounts that are actually produced from the implementation of the registered CDM project activity. The basic procedure for verification is as shown in the figure below.

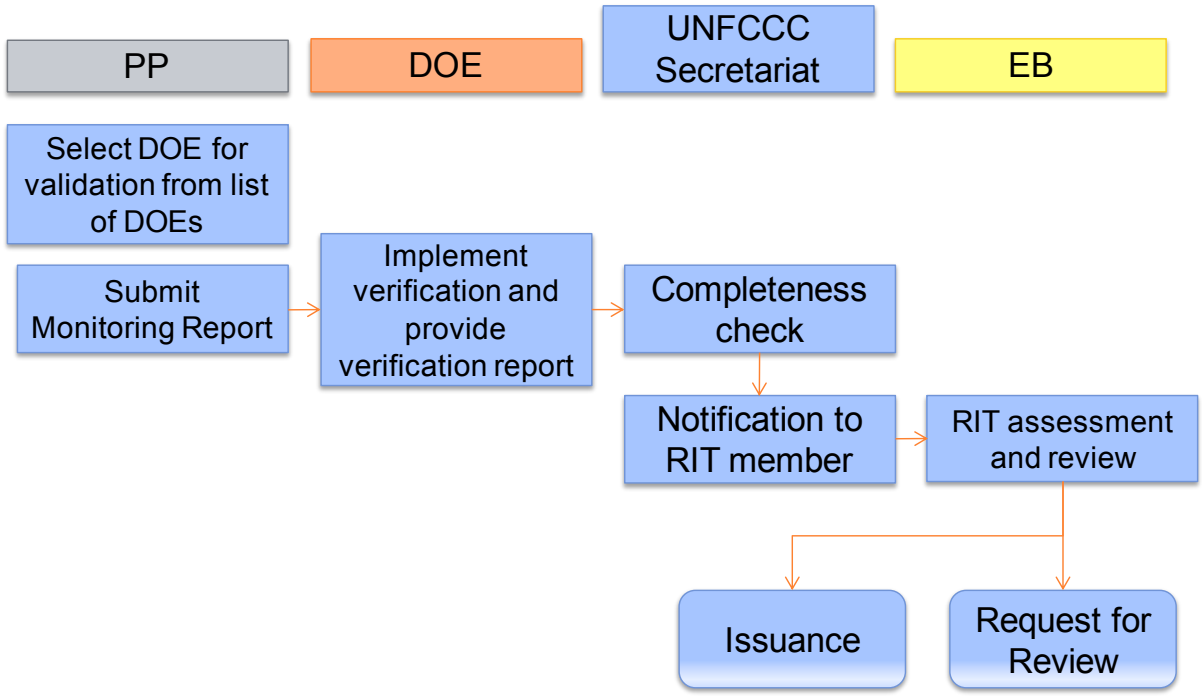


Figure 39: Basic procedure for verification

Once the project proponent starts its registered CDM project, it must conduct the project monitoring in accordance with the monitoring plan specified in the PDD. Difference between the actual monitoring and monitoring plan will result in serious consequence at the time of verification and CER issuance including no issuance of CERs. DOE is required to officially notify to the CDM Executive Board before conducting verification if there are any changes in the registered CDM project activity.

The monitoring report prepared by the project proponent is to be verified by a DOE selected by the project proponent. The DOE will produce a verification report for submission to the UNFCCC Secretariat. The UNFCCC Secretariat subsequently conducts the completeness check of the verification report and make a notification to the Registration and Issuance Team (RIT) for their assessment review. With the notification by the UNFCCC Secretariat, RIT will review and assess the verification report to decide the issuance of CER or request for review by the DOE.

4. PROJECT FORMULATION GUIDANCE BY TYPES OF CLIMATE CHANGE MITIGATION PROJECTS (BY SECTOR)

4.1 Renewable Energy

4.1.1 Principle of Emission Reductions

Renewable energy projects achieve reduction of GHG emission by displacing fossil fuel with renewable energy sources such as hydro power, wind power, solar p and biomass fuels.

Fossil fuels such as coal, oil and natural gas have made immense contribution to various human activities, especially since the industrial revolution of the eighteenth century. However, excavation and utilization of fossil fuels for human activities has resulted in emission into the atmosphere of organic materials which were stocked for millions of years deep under the ground. This is considered as a significant contributing factor of climate change. On the other hand, unlike fossil fuels, renewable energy generally do not cause GHG emissions. In the case of biomass, carbon dioxide is emitted when biomass fuel is combusted, but the emitted carbon dioxide is not considered as contributing factor that increases GHG emissions to the atmosphere because it is originally absorbed from the atmosphere by plants through photonic synthesis process during their growth. Carbon dioxide emissions from biomass resources offset the absorbed carbon dioxide, and therefore do not increase the concentration of carbon dioxide in the atmosphere. It is thus referred to as "carbon neutral".

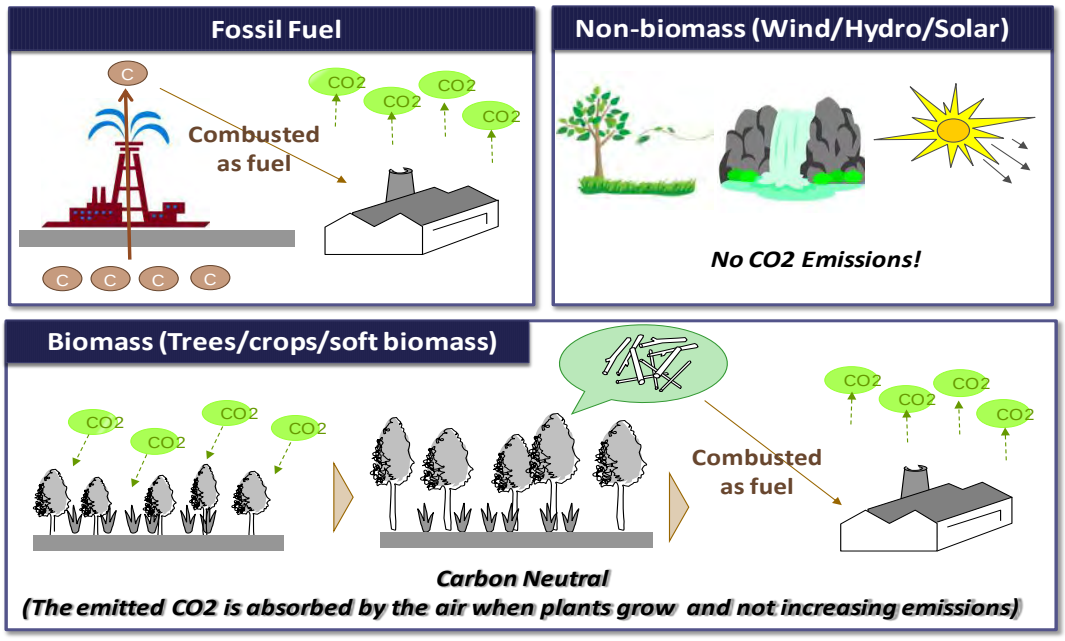


Figure 40: GHG Emissions From Fuel Combustion

4.1.2 Emission Reduction Calculations

The following is the basic equation for emission reduction calculations for any emission reduction project:

Emission Reduction (tCO2)	=	Baseline Emissions (tCO2)	−	Project Emissions (tCO2)	+	Leakage Emissions (tCO2)

Based on the equation above, emission reduction by renewable energy projects is calculated by using the following steps:

A. Baseline Emissions

Baseline emissions are the emissions from consumption of fossil fuel which would have been used without the project activity. The basic formula is [A] "Amount of energy to be replaced" multiplied by [B] "Emission factor of energy to be replaced".

Baseline Emissions (tCO2/year)	=	Amount of energy to be replaced [A]	×	Emission factor of energy to be replaced [B]

Parameters applicable to [A] and [B] are different depending on the project activity. There are two types of calculations, Replacement of Grid Electricity and Replacement of Fossil Fuel.

A.1 Replacement of Grid Electricity

In the case of replacement of grid electricity, baseline emissions from consumption of grid electricity is calculated by "Amount of electricity to be replaced" multiplied by "Grid emission factor" as shown below:

Baseline Emissions (tCO2/year)	=	Amount of electricity to be replaced (MWh/year) [A]	×	Grid emission factor (tCO2/MWh) [B]

a Amount of electricity to be replaced [MWh/year]

Amount of electricity to be replaced is generally obtained from the electricity consumption of the past years. In case of a new power generation project which will supply electricity to the grid, the amount of electricity to be supplied to the grid by the project activity is considered as the amount of electricity to be replaced.

b Grid emission factor [tCO2/MWh]

Grid emission factor needs to be calculated according to CDM Methodological Tool: "Tool to calculate the emission factor for an electricity system". The basic equation to obtain grid emission factor is as follows:

$$\text{Grid Emission Factor in year y [tCO2/MWh]} = \frac{\text{Total CO2 emission from all the power plants that are connected to the grid in year y if the CDM project activity did not take place [tCO2/y]}}{\text{Total MWh of electricity produced by all the power plants that are connected to the grid in year y if the CDM project activity did not take place [MWh/y]}}$$

Grid emission factor can be determined by calculating "operating margin (OM)" and "build margin (BM)" as well as "combined margin (CM) ".

- Operating Margin (OM) :
  Grid emission factor that refers to the group of existing power plants **whose current electricity generation would be affected** by the proposed CDM project activity.
- Build Margin (BM) :
  Grid emission factor of the group of prospective power plants **whose construction and future operation would be affected** by the proposed CDM project activity.
- Combined Margin (CM) :
  Weighted average of OM & BM of the electricity system.

Figure 41 on next page shows the concept of Operating Margin. Low-cost/must-run resources are power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. For grid emission calculation for CDM projects, in principle, only renewable power plants and nuclear power plants are included in this category. In case of Sri Lanka, only renewable power plants are the low-cost/must-run resources as nuclear plants do not exist. Since they are low-cost/must-run, operation of these plants are not affected by newly operating power plants. Therefore, only power plants other than low-cost/must-run resources are included for calculation of Operating Margin.

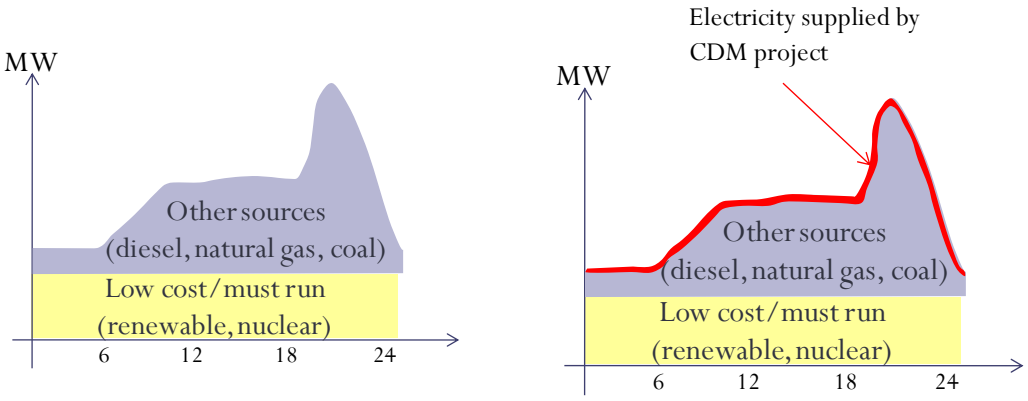


Figure 41: Concept of Operating Margin Calculation

Steps of calculation of grid emission factor are shown in the figure below. Yellow boxes in the figure show the options applicable to Sri Lankan case.

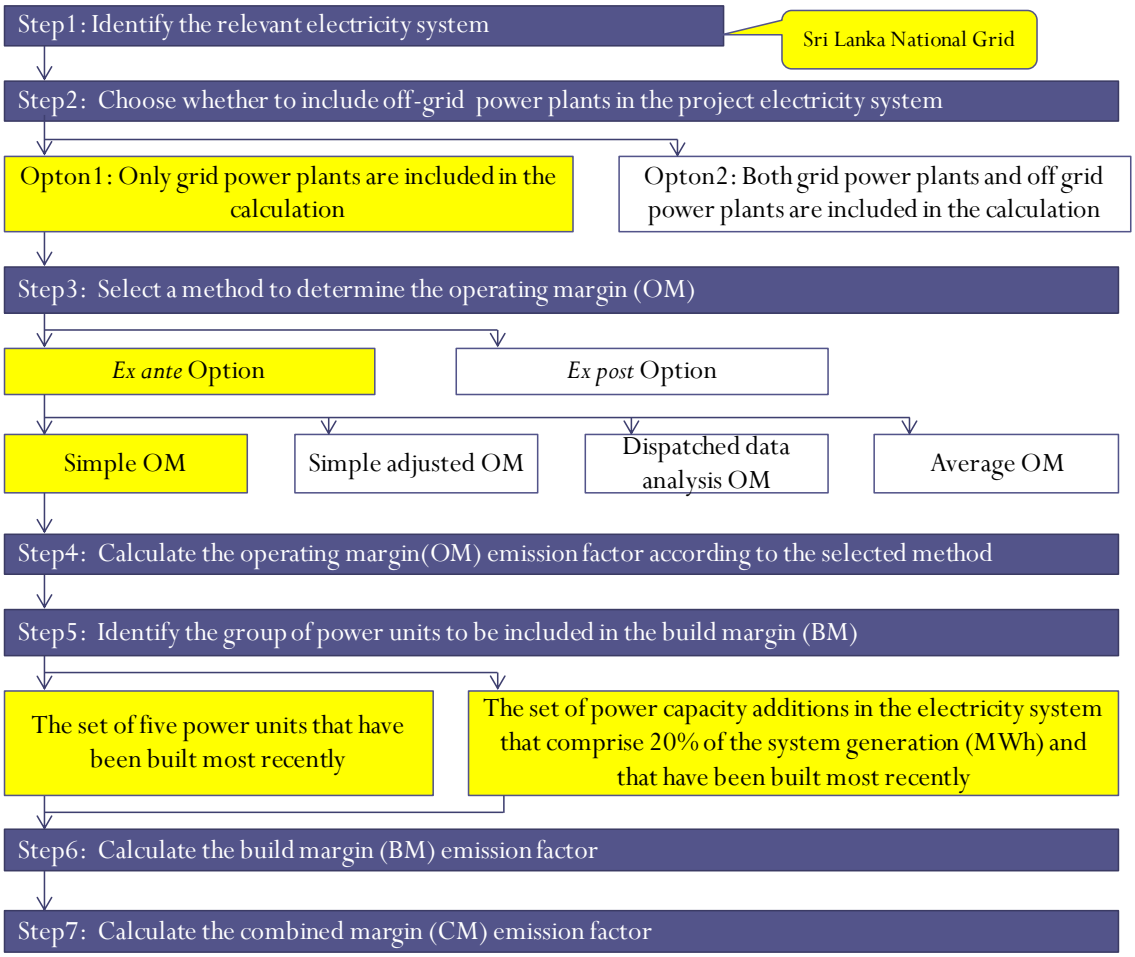


Figure 42: Steps of Calculation of Grid Emission Factor

Project owners need to calculate grid emission factor based on the steps mentioned above as the Sri Lankan DNA has not formulated an official figure for grid emission factor as of date. The emission factors of the Sri Lankan registered CDM projects are shown in the table below.

Table 14: Emission factors of the registered CDM projects

Project title	Grid Emission Factor (kgCO2/kWh)	Year of data
Adavikanda, Kuruwita Division Mini Hydro Power Project	0.7073	2005-2007
10 MW Biomass Power Generation Project - Tokyo Cement, Trincomalee	0.6816	2002-2004
Coconut shell charcoaling and power generation at Badalgama, Sri Lanka	0.6151	2004-2006
Sanquhar and Delta Small Hydro Power Projects	0.6816	2002-2004
Hapugastenne and Hulu Ganga Small Hydropower Projects.	0.8496	2003
Small Hydropower Projects at Alupola and Badulu Oya	0.8496	2003
Magal Ganga Small Hydropower Project	0.8496	2003

A.2 Replacement of Fossil Fuel

Baseline emissions from fossil fuel consumption are calculated by "Amount of fuel to be replaced" multiplied by "Emission factor of fuel to be replaced" as shown below:

Baseline Emissions (tCO2/year)	=	Amount of fuel to be replaced (ton_fuel/year) [A]	×	Emission factor of fuel to be replaced (tCO2/ton_fuel) [B]

This category includes the following cases:

- fossil fuel consumption for on-site electricity
- fossil fuel consumption for industrial heat
- fossil fuel consumption for other thermal purposes

a Amount of fuel to be replaced [ton_fuel/year]

In cases where a new power generation project is in an unelectrified area and will supply electricity to the users, a different assumption is made to calculate the amount of fuel replaced. A calculation is done to find out the equivalent amount of fossil fuel required to generate the amount of electricity that is actually produced by the project (from non fossil fuel sources) and supplied to the users. This calculated amount of fossil fuel is considered as the amount of fuel to be replaced.

b Emission factor of fuel to be replaced [tCO2/ton_fuel]

Emission factor of fuel to be replaced is obtained by the equation below:

CO2 emission factor [by weight] (tCO2/ton_fuel)	=	Net Calorific Value (TJ/t_fuel)	×	CO2 Emission Factor [by calorific value] (tCO2/TJ)	×	Oxidation factor

The parameters for CO2 emission factor calculation and CO2 emission factors of the respective fuel types are shown in the table below.

Table 15: Parameters for CO2 emission factor calculation

Fuel Type	Net Calorific Value [a]	CO2 Emission Factor (by calorie) [b]	Oxidation factor [c]	CO2 emission factor (by weight) [a]*[b]*[c]
Unit	TJ/t_fuel	tCO2/TJ	-	tCO2/t
Furnace Oil	0.041	77.4	1.0	3.173
Gas/Diesel Oil	0.0433	74.1	1.0	3.209
Naphtha	0.0456	73.3	1.0	3.342
Residual Oil	0.041	77.4	1.0	3.173
Source	Energy Data 2007, SEA	2006 IPCC Guidelines for National GHG Inventories, vol.2		

[UNIT CHECK]

Units of both the sides of the equation must be the same. Unit check is useful to identify the mistakes in calculations.

i) Grid electricity replacement

Unit of the left side: tCO2

Unit of the right side:

$$\cancel{\text{Ton}} \times \frac{\text{tCO2}}{\cancel{\text{Ton}}} = \text{tCO2}$$

ii) Replacement of Electricity Generated On-site

Unit of the left side: tCO2

Unit of the right side:

$$\cancel{\text{MWh}} \times \frac{\text{tCO2}}{\cancel{\text{MWh}}} = \text{tCO2}$$

iii) Emission Factor of fuel to be replaced

Unit of the left side: tCO2/ton_fuel

Unit of the right side:

$$\frac{\cancel{\text{TJ}}}{\text{ton\_fuel}} \times \frac{\text{tCO2}}{\cancel{\text{TJ}}} = \frac{\text{tCO2}}{\text{ton\_fuel}}$$

B. Project Emissions

Project emissions of renewable energy projects are emissions associated with fossil fuel usage in the project activities including electricity usage of fossil fuel origin. In principle, the equations are the same as baseline emission calculations.

Project Emissions (tCO2/year)	=	Amount of electricity used (MWh/year) [A]	×	Grid emission factor (tCO2/MWh) [B]

Project Emissions (tCO2/year)	=	Amount of fuel used (ton_fuel/year) [A]	×	Emission factor of fuel used (tCO2/ton_fuel) [B]

C. Leakage Emissions

Leakage emissions are emissions which occur outside the project boundary and which are measurable and attributable to the CDM project activity. Generally hydro power, wind power and solar energy do not cause leakage emissions unless they use the facilities that are transferred from other activities. However, in the case of biomass energy, following leakage emissions must be considered. Leakage of CDM biomass projects can be referred to in the CDM Guidance: "General guidance on leakage in biomass project activities(ver03) ".

C.1 Leakage emissions associated with biomass competition

If the biomass to be used in the project activity could potentially be used elsewhere for a similar or different purpose in the absence of the project activity, it needs to be considered as leakage emission associated with biomass competition. However, when the biomass to be used in the project activity has been generated for the sole purpose of using in the particular project activity (e.g. new forests or cultivations), the consideration of leakage emission associated with biomass competition is not required.

[Example]

The following is the example to explain the leakage of biomass competition.

<Case A>

In Case A, there is a sufficient supply of biomass fuel which is equivalent to four drums of furnace oil hourly, compared to the requirement of the area (two bunches of biomass equivalent to two drums of fossil fuel in figure 43 on next page, Case A). Factory A uses one bunch of biomass fuel hourly which is equal to one drum of furnace oil. On the other hand, Factory B uses two drums of furnace oil hourly. Factory B replaced

two drums of furnace oil by biomass fuels. But as there are enough of biomass fuel in the area, no leakage is occurred by the fuel conversion activity by Factory B.

<Case B>

In Case B, available biomass fuel is equivalent to only two drums of furnace oil hourly, which is under supply for the requirement of the area. Factory A uses one bunch of biomass fuel per hour which is equal to one drum of furnace oil. On the other hand, Factory B uses two drums of furnace oil hourly. Factory B replaced two drums of furnace oil by biomass fuels. However, as biomass fuel is insufficient in the area, Factory A has to convert the fuel from biomass to furnace oil. The GHG emission from consumption of one drum of furnace oil at Factory A is considered as leakage emission.

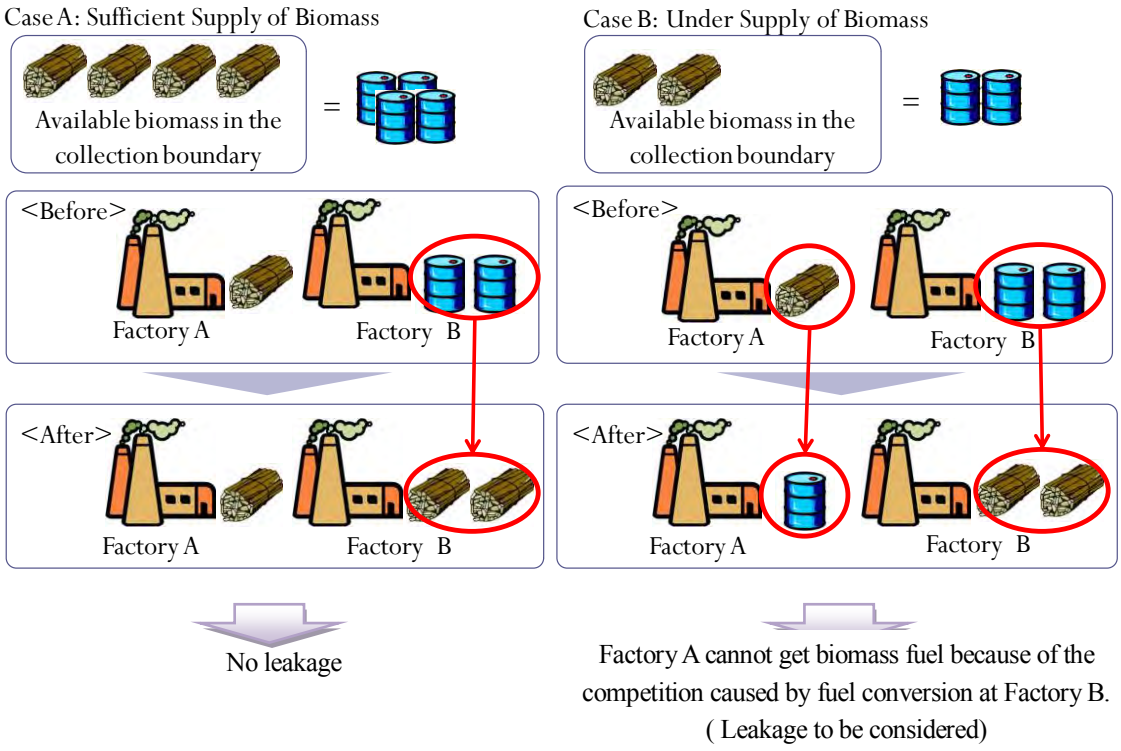


Figure 43: Leakage Emissions Associated with Biomass Competition

Like Case B, for biomass fuels for which sufficient availability within the project boundary cannot be proven, leakage emissions associated with biomass competition can be obtained by the following equation:

Leakage associated with biomass competition (tCO2/y)	=	Quantity of biomass used by the project which cannot be ruled out from leakage calculation (t/y)	×	Net calorific value of Biomass fuel (TJ/t)	×	CO2 emission Factor of most carbon intensive fuel (tCO2/TJ)

According to CDM Guideline:"General guidance on leakage in biomass project activities(ver03)", the project participant shall evaluate ex ante if there is a surplus of the biomass in the region of the project activity. If it is demonstrated (e.g., using published literature, official reports, surveys etc.) that the quantity of available biomass in the region (e.g., 50 km radius), is at least 25% larger than the quantity of biomass that is utilised including the project activity, then this source of leakage can be neglected otherwise this leakage shall be estimated and deducted from the emission reductions.

C.2 Leakage emissions associated with land use change

Decreases of carbon stocks, for example as a result of deforestation, outside the land area where the biomass is grown, due to shifts of pre-project activities are considered as leakage sources that need to be considered as leakage emissions. Shifts of pre-project activities are relevant where in the absence of the project activity the land areas would be used for other purposes such as agriculture. Deforestation on other land areas as a result of shift of pre-project activities also needs to be considered as leakage source. For the assessment of whether a project activity results in deforestation elsewhere, it can be necessary to evaluate whether there is significant land pressure in the area.

According to "General guidance on leakage in biomass project activities(ver03)", project participants should assess the possibility of leakage from the displacement of activities or people considering the following indicators:

- Percentage of families/households of the community involved in or affected by the project activity displaced (from within to out of the project boundary) due to the project activity;
- Percentage of total production of the main produce (e.g., meat, corn) within the project boundary displaced due to the generation of renewable biomass.

If the value of these two indicators is lower than 10%, then leakage from this source is assumed to be zero. If the value of any of these two indicators is higher than 10% and less than or equal to 50%, then leakage shall be equal to 15% of the difference between baseline emissions and project emissions. If the value of any of these two indicators is larger than 50%, then the existing methodology is not applicable and a new procedure must be submitted for the approval of the CDM Executive Board.

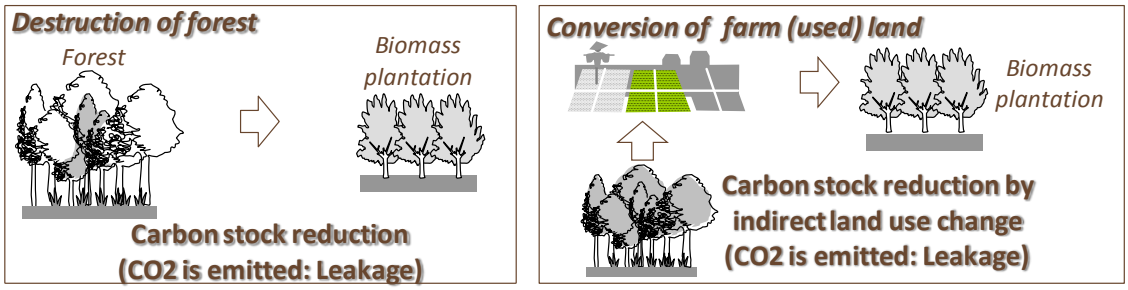


Figure 44: Leakage Emissions Associated with Land Use Change

C.3 Leakage emissions associated with biomass production (chemical fertilizer use/vehicle use)

According to " General guidance on leakage in biomass project activities(ver03) ", the potentially significant emission sources to be considered as leakage sources from the production of renewable biomass are as follows:

- Emissions from application of fertilizer
- Project emissions from clearance of lands.

All other emission sources are likely to be smaller than 10% (each) - including transportation of raw materials and biomass, fossil fuel consumption for the cultivation of plantations - and can therefore be neglected in the context of small scale CDM project activities.

Further details can be referred to in the "General guidance on leakage in biomass project activities(ver03)", AM0042"Grid-connected electricity generation using biomass from newly developed dedicated plantations", and AM0017 "Production of biodiesel for use as fuel".

C.4 Leakage emission associated with biomass transportation

According to "General guidance on leakage in biomass project activities(ver03)", leakage emission associated with biomass transportation can be neglected for small scale CDM projects. However, for large scale projects it can be calculated by the following equation.

Emissions Associated with Transportation (tCO2/y) = **Fuel Consumption (t/y)** × **Net Calorific Value of Fuel (TJ/t)** × **CO2 Emission Factor of Fuel (tCO2/TJ)**

Number of trips (no.of trip/y) × Distance (round trip) (Km/trip) × Fuel Efficiency (L/km) × Specific Gravity of diesel (kg/L) ÷1,000

4.1.3 CDM Methodologies

Renewable energy projects are the most widely developed category in CDM. UNEP/Reso's statistics shows that renewable energy projects occupy 63.7%1 of total CDM projects (at validation, request registration and registered) and 65.3% for small scale CDM.

Approved CDM methodologies applicable to renewable energy projects are listed in the table below. Methodologies are mainly classified into three categories; renewable electricity, renewable energy (thermal or mechanical energy) and biofuels.

Table 16: Methodologies for Renewable Energy Projects

Category			Name of Methodology
Renewable Electricity			
	Biomass electricity		
		AM0007	Analysis of the least-cost fuel option for seasonally-operating biomass cogeneration plants
		AM0042	Grid-connected electricity generation using biomass from newly developed dedicated plantations
		AM0085	Co-firing of biomass residues for electricity generation in grid connected power plants
		ACM0006	Consolidated methodology for electricity and heat generation from biomass residues
		ACM0018	Consolidated methodology for electricity generation from biomass residues in power-only plants
	Grid electricity		
		AM0019	Renewable energy projects replacing part of the electricity production of one single fossil fuel fired power plant that stands alone or supplies to a grid, excluding biomass projects
		AM0026	Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid
		ACM002	Consolidated baseline methodology for grid-connected electricity generation from renewable sources
		AMS-I.D.	Grid connected renewable electricity generation
	Offgrid electricity		
		AMS-I.A.	Electricity generation by the user
	Enhanced generation		
		AM0052	Increased electricity generation from existing hydropower stations through Decision Support System optimization
	Captive power		
		AMS-I.F.	Renewable electricity generation for captive use and mini-grid
Renewable energy (thermal or mechanical energy)			
	Renewable thermal energy		
		AM0036	Fuel switch from fossil fuels to biomass residues in heat generation equipment
		AM0072	Fossil Fuel Displacement by Geothermal Resources for Space Heating
		AM0075	Methodology for collection, processing and supply of biogas to end-users for production of heat
		AM0082	Use of charcoal from planted renewable biomass in the iron ore reduction process through the establishment of a new iron ore reduction system
		ACM0003	Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement or quicklime manufacture
		AMS-I.C.	Thermal energy production with or without electricity
		AMS-I.E.	Switch from Non-Renewable Biomass for Thermal Applications by the User
	Renewable mechanical energy		
		AMS-I.B.	Conversion from single cycle to combined cycle power generation
Biofuel			
	Plant Oil		
		AMS-I.G	Plant oil production and use for energy generation in stationary applications
		AMS-III.T	Plant oil production and use for transport applications
	Biodiesel		
		AM0089	Production of diesel using a mixed feedstock of gasoil and vegetable oil
		ACM0017	Production of biodiesel for use as fuel
		AMS-I.H	Biodiesel production and use for energy generation in stationary applications
		AMS-III.AK	Biodiesel production and use for transport applications

[1] 4,285 projects out of 6,724 projects (771 projects for biomass, 1,763 projects for hydro, 133 projects for solar, 1,618 projects for wind). For small scale projects, 458 projects for biomass, 905 projects for hydro, 92 projects for solar, 509 projects for wind in total 1,964 projects (as of 1 September 2011)

A. Application Examples

Renewable energy projects are divided into two categories, non-biomass energy and biomass energy. Non-biomass energy mainly includes hydro power, wind power and solar energy (power and thermal).

In this section, emission reduction calculation application examples of mini-hydro power and biomass thermal energy generation are introduced.

A.1 Mini-hydro power

Company A has a CDM project plan with the following details:

- New mini-hydro power plant project selling the power to CEB
- Capacity: 1.1 MW
- Expected operation: (dry season) 0.6MW, (wet season)1.1MW
- 0.1MW of generated electricity is required for operating the mini-hydro plant
- Daily operating hours: 24 hours
- Monthly operating days: 25 days
- Season: (dry season) 4 months, (wet season) 8 months
- Grid emission factor: 0.70 kgCO2/kWh

Emission reduction is calculated by the following steps:

Step1

- How many hours does the plant operate in dry season?
- How many hours does the plant operate in wet season?

- Daily operating hours: 24 hours
- Monthly operating days: 25 days
- Season: (dry season) 4 months, (wet season) 8 months

Dry season:

24 hours/day × 25days/month × 4 months/y = **2,400 hours/y**

Wet season:

24 hours/day × 25days/month × 8 months/y = **4,800 hours/y**

Step2

- How much electricity to be sold to the grid in dry season?
- How much electricity to be sold to the grid in wet season?

- Operating hours in each season: (Dry) 2,400 hours, (Wet) 4,800hours
- Expected operation: (dry season) 0.6MW, (wet season) 1.1MW
- Electricity requirement by the plant: 0.1MW

Amount of electricity to be sold to the grid can be obtained by operation ratio (MW) times number of operating hours.

Dry season:

2,400 hours/y × (0.6 MW − 0.1MW) = **1,200 MWh/y**

Wet season:

4,800 hours/y × (1.1 MW − 0.1MW) = **4,800 MWh/y**

Step3

- How much electricity to be sold to the grid annually?

- Amount of electricity to be sold to the grid in dry season: 1,200 MWh/y
- Amount of electricity to be sold to the grid in wet season: 4,800 MWh/y

Annual Electricity	=	**Electricity (Dry season)**	+	**Electricity (Wet season)**
	=	1,200 MWh/y	+	4,800 MWh/y
	=	**6,000 MWh/y**		

Step4

- How much emission is reduced annually by the project?

- Amount of electricity to be sold to the grid annually: 6,000 MWh/y
- Grid emission factor: 0.70 kgCO2/kWh

Emission Reduction (tCO2/y)	=	**Amount of Electricity (MWh/y)**	×	**Grid emission factor (tCO2/MWh)**
	=	6,000 MWh/y	×	0.70 tCO2/MWh
	=	**4,200 tCO2/y**		

Emission Reduction = Baseline emission − Project emission
= 4,200 tCO2/y − 0 tCO2/y
= 4,200 tCO2/y

Emission reduction by the project activity is calculated to be 4,200 tCO2/y.

A.2 Biomass thermal energy generation

Company B has a CDM project plan with the following details:

- Biomass heat generation for on-site use
- The biomass to be used is saw dust and rice husk (no leakage occurs)
- Fossil fuel used in baseline scenario: 2,000 tons of furnace oil per annum
- Daily operating hours: 20 hours
- Monthly operating days: 25 days
- Seasonal operation: operation is constant
- Grid emission factor: 0.70 kgCO2/kWh
- Grid electricity required for operation of the new plant: 100kW
- Diesel required for transportation of biomass: 10 ton/month
- Emission factor of fossil fuel is shown as below:

Fuel Type	CO2 emission coefficient(tCO2/t)
Furnace Oil	3.173
Diesel Oil	3.209

Emission reduction is calculated by the following steps:

Step1

- How many hours does the plant operate annually?

- Daily operating hours: 20 hours
- Monthly operating days: 25 days
- Seasonal operation: operation is constant

Annual operation hours

$$20\frac{hours}{day}\times 25\frac{days}{month}\times 12\frac{month}{year}=6{,}000\frac{hour}{year}$$

Step2

- How much GHG emission is reduced annually by replacing furnace oil by biomass fuel? [baseline emission]

- Amount of furnace oil to be replaced: 2,000 ton/y
- Emission factor of furnace oil: 3.173 tonCO2/ton_fuel

Baseline emission (tCO2/y)	=	Amount of fuel to be replaced (MWh/y)	×	Emission factor of the fuel (tCO2/MWh)
	=	2,000 ton/y	×	3.173 tCO2/ton_fuel
	=	**6,346 tCO2/y**		

Step3

- How much electricity is required for operating the plant annually?
- How much fuel is required for biomass transportation annually?

- Grid electricity consumption for operation of the new plant: 0.1 MW
- Diesel required for transportation of biomass: 10ton/month

Electricity consumption

0.1MW × 6,000 h/y = 600 MWh/year

Fossil fuel consumption for biomass transport

10 ton/month × 12 months = 120 ton/year

Step4

- How much GHG is emitted annually through fossil fuel consumption by the project activity? [project emission]

- Electricity consumption: 600MWh/year
- Diesel required for transportation of biomass: 120ton/year

Emission associated to grid electricity consumption

600 MWh/y × 0.7 tCO2/MWh
= 420.0 tCO2/y

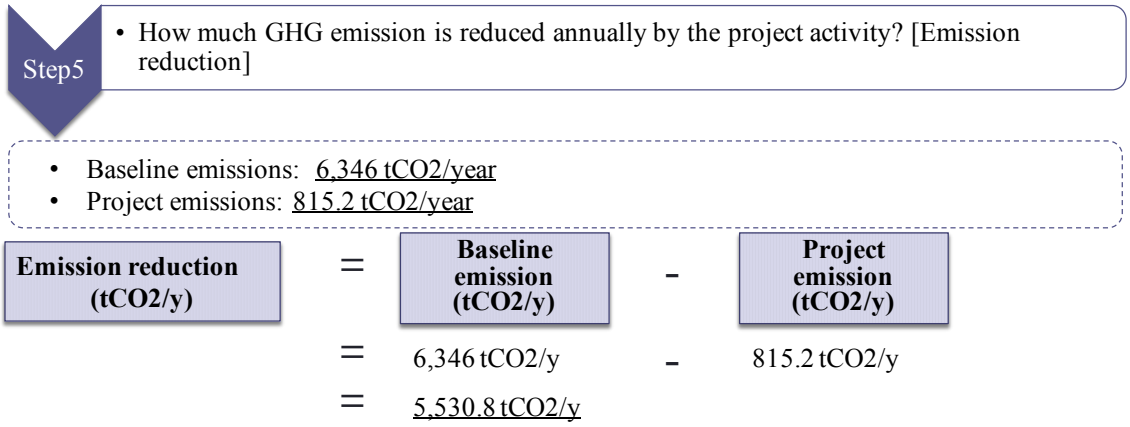
Emission associated to biomass transport

120 t/year × 3.209 tCO2/t
= 395.1 tCO2/y

Project emissions

420.0 tCO2/y + 395.1 tCO2/y = 815.1 tCO2/y

Fuel Type	Net Calorific Value (TJ/t)	Effective CO2 emission factor (tCO2/TJ)	Oxidation factor	CO2 emission coefficient (tCO2/t)
	(a)	(b)	(c)	(a)*(b)*(c)
Furnace Oil	0.041	77.4	1.0	3.173
Gas/Diesel Oil	0.0433	74.1	1.0	3.209
Naphtha	0.0456	73.3	1.0	3.342
Residual Oil	0.041	77.4	1.0	3.173
Source	Energy Data 2007	2006 IPCC Guidelines for National GHG Inventories, Volume 2: Energy, Table 1.4		



Emission reduction by the project activity is calculated to be 5,530.8 tCO2/y.

4.1.4 Issues to Be Considered when Planning Renewable Energy Projects

Renewable energy projects utilize natural resources such as water flow, wind, and sunlight to obtain energy. The biggest advantage of these types of energy is that they do not require fuel to operate, a factor that results in a lower operation cost. On the other hand, the main disadvantage is the non-stable nature of availability of resources which are heavily influenced by fluctuations of natural conditions (hourly and seasonal fluctuation. In the case of biomass, market condition heavily influences the availability of biomass fuel resources etc).

Important factors for project planning and potential risks regarding project development/implementation are discussed in the following section.

A. Important factors for project planning

Unlike energy facilities utilizing fossil fuel, renewable energy facilities have more constraints in terms of location. In selecting a site, many natural factors need to be considered. Important factors for project planning renewable energy projects are described below:

A.1 Fluctuation of natural resources:

All natural resources are influenced by climate conditions and hence have fluctuation in their availability. Especially for agro-residue based biomass utilization facilities, consideration of seasonal fluctuation and procurement of biomass fuels must be well planned to make sure that sustainable energy supply to the users is maintained (e.g., combination procurement of seasonal biomass resources and one`s own biomass cultivation). The factors summarized in Table 17 need to be considered for project planning taking in account of fluctuation of natural resources.

Table 17: Important Factors Regarding Fluctuation of Natural Resources

Type of energy	Important Factors
Hydro	• Seasonal fluctuation of river flow
Wind	• Wind intensity • Wind fluctuation (hourly, impact to the grid) • Annual wind availability (plant factor)
Solar	• Insolation intensity • Hours of insolation (plant load factor)
Biomass	• Seasonal fluctuation • Fluctuation due to market (For example, rubber trunk availability is affected by rubber latex market price. When the price is high, plantation owners will not replant and replanting is carried out only when the price is low,. Adequate storage of fuels and captive energy plantations could reduce the impacts of such fluctuations)

A.2 Distance to national grid connecting points/users:

Another important factor for project planning is the distance between national grid connecting point/users and the project site. If the distance is too far, cost of transmission lines needed to be developed to supply the electricity will increase significantly and loss of electricity may also increase. While non-biomass projects can only be located in places where these energy sources are available, biomass projects are relatively flexible in selecting locations. However, procurement of biomass fuel from an area located at a long distance from the project site may decrease the financial feasibility of the project. In addition, steam based biomass power plants cannot be frequently stopped and started. If such power plants are connected to existing electricity distribution network, every time a disruption is encountered by such network, the steam power plants need to be stopped. This type of operation would be very detrimental for the life and operation of the power plant. Steam based power plants should have dedicated transmission lines linking the power plant and grid substation.

A.3 Technology:

For project planning, technology is one of the most important factors that determine the success of the project. Project owners need to assess the advantages and disadvantages of technology options. For biomass project, there are various type of conversion technologies such as direct combustion, gasification, gas engine/turbine, steam generation, boiler etc. Suitable technology for a particular project may be different depending on the usage of energy as well as the characteristics of biomass resources to be used as fuel. In addition, some of the resources need pre-treatment to reduce water content or some other modifications to make the fuel easy to handle. In case of solar power, cost and efficiency of technology becomes more critical than other types of natural energy resources, as solar energy is only available for eight hours /day on average.

A.4 Plant design:

Optimal plant design is important to compensate for the instability of energy resources. For example, for hydro power, unit composition is to be determined to optimize the operation ratio considering seasonal fluctuation (for total 10 MW project, 5MW * 2 units or 2.5 MW * 4 units etc). For wind power, in addition to unit composition, arrangement of windmill is another factor to be considered (if windmills are too close, interference may occur. If too far, more land will be required). For solar energy, depending on the utilization purpose (electricity or heat), technology and financial conditions become very different. For biomass, efficiency wise, larger scale may have more advantage if enough biomass with reasonable price is assured. However, larger scale projects have more challenges to make sure that stable supply of biomass fuel is maintained.

A.5 Conflict on benefits:

It is very important to consider the potential conflicts of benefits among stakeholders. Especially in the case of hydropower projects, stakeholders benefitting from the river such as villagers, farmers using irrigation, water boards etc cannot be ignored during project planning. For biomass projects, current users of biomass resources need to be considered for planning the biomass procurement plan.

B. Risks

Risks regarding renewable energy projects are summarized below:

B.1 Natural Factors:

All the renewable energy is significantly affected by natural conditions.

Table 18: Risks Associated with Natural Factors

Type of energy	Important Factors
Hydro	• Natural disasters (drought, land slide) • Change of water flow due to climate change
Wind	• Storm (too strong wind may destroy the panel) • Lightning • Change of wind due to climate change
Solar	• less insolation (cloud cover)
Biomass	• Lack of supply due to climate conditions (drought, flooding)

B.2 Land tenure issues:

Many of the projects have faced land ownership/ tenure issue of the project site. This may cause significant

delay of the project implementation. In case of hydro power, factors such as relocation, fishery rights, water concession and impacts on downstream stakeholders also need to be considered. For the case of biomass cultivations such as integrated energy plantations or energy plantations, land eligible for these purposes are mostly state owned land. Therefore, even though project participants identify the unutilized land or low-utilized land for project sites, land right needs to be acquired from the Government, which may require time and efforts.

B.3 Tariff policy/policy/trend:

The financial merits of renewable energy projects are i) renewable electricity sales to the grid, ii) renewable electricity/heat sales to the users (in case of ESCO) and iii) saved amount by fossil fuel displacement. i) is determined by the electricity tariff to be purchased by Ceylon Electricity Board(CEB), while ii) and iii) are determined by the price of fossil fuel to be replaced. In all three cases, the financial merits are significant depending on the tariff policy and fuel price policy of the Government. As of date, Sri Lankan Standardized Power Producers (SPPs) are enjoying the relatively better tariffs compared to other countries. However, this trend may change any time due to governmental policy. Depending on the trend, renewable energy might be more advantageous than fossil fuel although there is also a possibility that renewable energy may lose its advantage against fossil fuel. Although it is impossible to predict these factors accurately, Iit is always important for project owners to have a certain portfolio on the trend. Sri Lankan Government has decided to increase Non Conventional form of energy as a policy as shows below.

Table 19: Policy Targets of Renewable Energy Introduction (electricity)

Year	Conventional Hydrolytic	Maximum from Oil	Coal	Minimum from NCRE
1995	94%	6%	-	-
2000	45%	54%	-	1%
2005	36%	61%	-	3%
2010	42%	31%	20%	7%
2015	28%	8%	54%	10%
2020				20%

*NCRE: non-conventional renewable energy

Source: Sustainable Energy Authority (2008) and Mahinda Chinthana (2011)

Table 20: Cumulative Renewable Energy Capacity Additions (MW)

Year	Biomass	Hydro	Wind	Other	Total	%Energy
2007	1	119	3		123	4
2008	11	155	3		169	4.5
2009	15	165	14		194	4.7
2010	15	200	34	1	250	6.4
2011	20	225	34	1	280	6.8
2012	20	280	35	1	336	9.1
2013	20	295	85	2	402	9.8
2014	30	310	85	2	427	9.9
2015	40	330	85	5	460	10

Source: Ministry of Power and Energy (2008)

B.4 Fluctuation of biomass market value

In the case of biomass, stable material procurement can be the most important and critical factor that determines the success of the project. In addition, biomass is the resource whose market value varies depending on demand and supply balance. There are lots of cases observed in other Asian countries where the biomass price was assumed to be very low when the project initiated, but later on due to the higher demand of biomass resources for fuel purpose, the price rapidly increased which resulted in the rate of operation of the facility to be dropped. Securing one`s own supply source (including development of dedicated plantation for biomass supply) or having a long term contract with suppliers are considered as good options to make sure that reliable sources of biomass is available (for development of one`s own dedicated plantation, labor cost will be an important factor that determines the financial viability of the activity as fuel. In principle, is the most low value products among various potential usages of biomass (e.g. as food, livestock feed, manure, fuel), usage of the biomass as fuel is the option from which the least value in monetary terms can be obtained. Hence, when considering owning a dedicated plantation (that will require significant labor cost), comparison should also be done with other scenarios e.g. usage of the same land for plantation of cash crops etc , which may have a higher yield in financial terms. This factor needs to be given careful consideration.

B.5 Others:

For small facilities like solar panel, theft is one of the issues that project owners can face. To prevent the facility from being stolen, some necessary measures might need to be taken which may add to the project cost.

<Renewable Energy Projects in Sri Lanka>

Adavikanda Mini-Hydro Power (1)

Adavikanda Mini-Hydro Power (2)

Manpuri Wind Power

Biomass thermal energy generation

<Biomass resources in Sri Lanka>

Gliricidia

Saw dust

Rubber tree

Cinnamon

Bagasse

Rice husk

4.1.5 Things to Be Kept in Mind for Renewable Energy Projects

The followings are the issues for further promoting renewable energy CDM projects in Sri Lanka.

A. Difficulties in demonstrating investment barrier

A.1 Lack of publicly available data to determine realistic benchmark

For benchmark analysis, publicly available figures need to be used. In Sri Lanka, neither sectoral average commercial lending rate nor sectoral premium risk factor is publicly available. Therefore, in general, minimum lending rate can only be applicable as benchmark for FIRR (Financial Internal Rate of Return) calculation. In addition, according to "*Guidelines on the Assessment of Investment Analysis (ver04)*" (EB61 Annex 13), benchmark for return on equity set for Sri Lanka by CDM EB was 12.5 ~14% depending on the sector. These figures can be regarded as low values relative to prevailing local commercial investment. Therefore, even the projects that are considered not financially feasible in Sri Lankan context are rarely able to satisfy the benchmark analysis.

A.2 Difficulties in determining biomass procurement cost

For biomass projects, raw material (biomass fuel) price is one of the most significant factors to determine the financial feasibility of the project. Although there are significant uncertainties in determining biomass procurement cost, DOE may not accept the variability and volatility especially for sensitivity analysis. Biomass projects generally have a high risk associated with them because a slight change of biomass fuel price may significantly affect the project viability. However, in the sensitivity analysis, a fixed price of biomass must be applied (as opposed to the real nature of biomass price which shows a great fluctuation), this factor may become a real challenge for project participants to clear the validation process. In such cases, justifying technological barrier may be one option to demonstrate additionality if the project introduces a new technology to Sri Lanka. Another option is to demonstrate additionality based on "*Guidelines for Demonstrating Additionality of Microscale Project Activities (Ver02)*", which allows renewable energy

projects less than 5MW capacity to establish additionality without investment analysis.

B. Uncertainty about future price mechanism of fossil fuel

As mentioned in "4.1.4 Issues to Be Considered to Plan Renewable Energy Projects, B. Risks", financial feasibility of renewable projects is significantly influenced by the trend of fossil fuel price. World fossil fuel market price has been increasing during the last five years. However, fossil fuel price in Sri Lanka is decided by the Government of Sri Lanka by subsidizing it and does not necessarily follow the trend of world fossil fuel market price. In addition, at the current power purchase system for renewable electricity, tariffs given to the SPPs are not linked to fossil fuel prices. However, it will create uncertainties for SPPs as O&M cost of renewable energy, especially biomass fuel procurement cost, is heavily linked to fossil fuel prices.

C. Lack of supply chain for biomass resources

Biomass resources have been a common fuel in Sri Lankan traditional industries. A few examples of varieties of biomass resources suitable for fuel usages and hence used in Sri Lankan traditional industries are rubber trunk, timber off-cuts, saw dust etc. However, for new industries, fossil fuel has been commonly used. Compared to the traditionally utilized biomass resources, effective efforts to utilize biomass resources including rice husk, coconuts residue, part of saw dust and gliricidia trees have not been made even though a number of large scale fossil fuel user companies show their interest on biomass utilization. The biggest obstacle for the facility owner is uncertainties in stable material procurement which can have an adverse impact on the core business of the company utilizing these materials. In Sri Lanka, supply areas of these unutilized biomass resources are dispersed all over the country. Lack of a supply chain for biomass resources in Sri Lanka makes it difficult to match the supply side with the demand side. Development of biomass plantation will be an option to address this issue. Development of biomass resources supply chain or development of biomass plantation may also be realistic options. However, labour cost is one of the key challenges in energy plantation. Experience of successful implementation and a solid business plan will be required to convince entrepreneurs to invest and participate in projects utilizing biomass for fuel.

D. Leakage issues regarding biomass procurement

As of today, when project owners develop biomass utilizing CDM projects, biomass supply and demand analysis needs to be done by the project owner itself. This is a requirement to assess potential leakages due to biomass competition (this is not required for one`s own biomass cultivation). When the project owner plans to utilize biomass resources for which a proper statistical data is lacking, such as gliricidia trees, it may become an additional burden for the project owner. Nationally authorized biomass resource generation and consumption assessment may be useful to solve this issue.

4.2 Fuel Switch/Energy Efficiency Project Development

4.2.1 Introduction

Energy efficiency project aimed to reduce energy, consumption by improving mechanical performance or plant operation patterns. In Sri Lanka and elsewhere, improving energy efficiency is important theme because saving energy expenditure will mobilize its resources from imported fuel to other vulnerable products. Sri Lanka is no exception. Almost half of primary energy is afforded with imported fuel and its dependency is increasing year by year. Saving energy consumption will directly reducing fuel expenditure and shift it to daily welfare of the country.

This chapter explains the principle of energy efficiency projects and how energy efficiency and fuel change projects are designed into CDM and how those projects are monitored to maximize project outcome.

- Fuel change projects save energy and carbon dioxide emissions by alter high carbon intensive fuel to low carbon intensive fuels. Some fuels require mechanical modifications in the plant. Further it combined with energy efficiency project to reduce energy efficiency.
- Energy efficiency project improves energy efficiency of plant and process by modifying the equipments or operational patterns and behaviors. Operational patterns is recognized as an effective measures to reduce energy consumption, however, the monitoring of the behavior patterns is difficult and that baseline is not clear. Hence the CDM is so far covers mechanical modification as an energy efficiency projects.
- Energy efficiency projects should pay attention to accurate monitoring in post project implementation. It is often the case that the measurement instruments include the energy consumption of the out of project boundaries or factors that should not be accounted for the CDM projects.

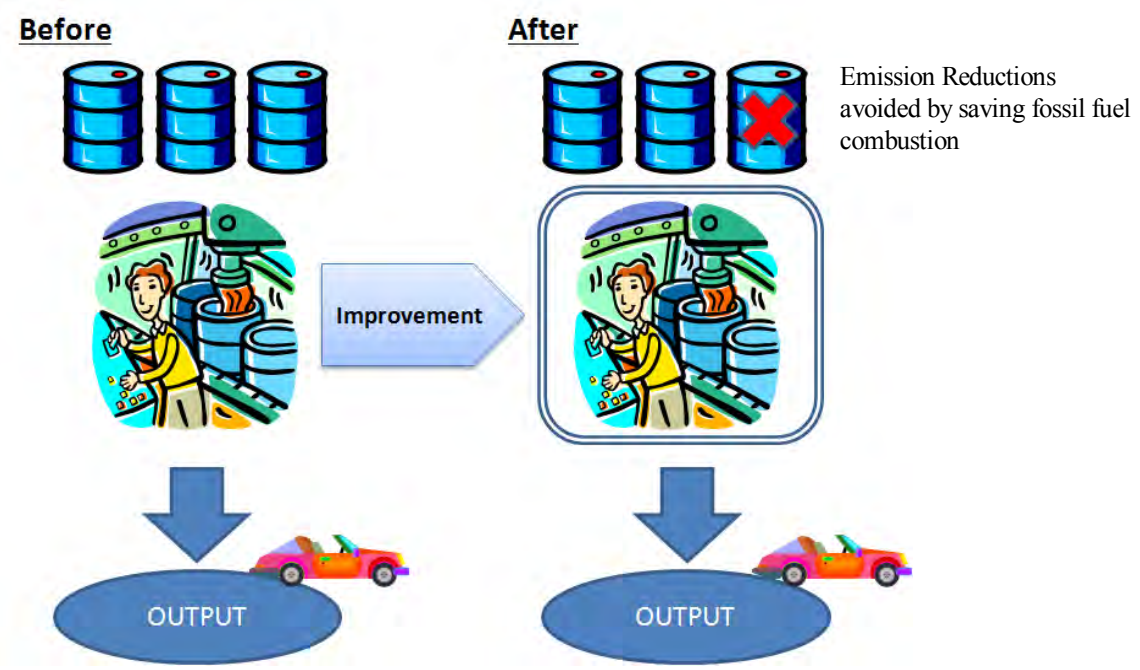


Figure 45: Simplified Image of Energy Efficiency Project

The energy saving should not result in output reduction or utility down-grade. The CDM project envisages same service and outputs are delivered before and after the modification in place.

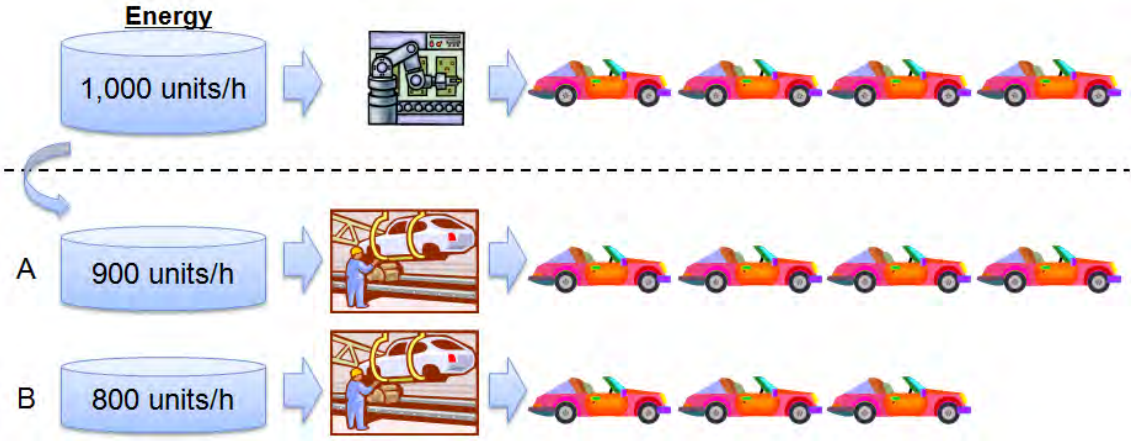


Figure 46: Case examples of energy efficiency project

Suppose a case of car manufacturing plant. The plant produces 4 cars per hour by 1000 units of energy per hour. The plant then made a modification its facility.

After the modification, the case A making same four cars by 900 units of energy per hour, while case B making three cars by 800 units of energy per hour. Case B consumes smaller amount of energy. Which project is efficiency improving?

Focus on the energy consumption per a car, it shows as follows;

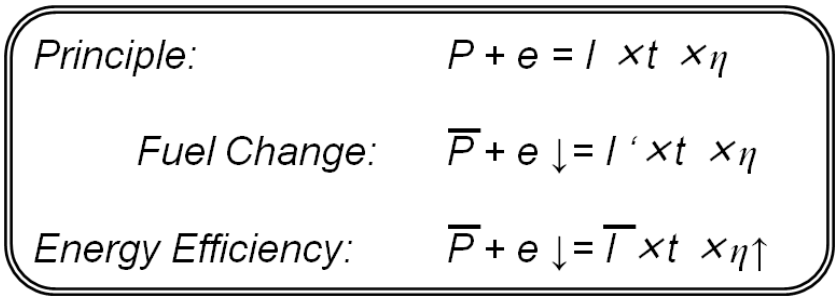
Case A 900 ÷ 4 = 225 units/car

Case B 800 ÷ 3 = 266 units/car

Hence the absolute energy consumption amount is small in case B, but the energy efficiency is better in Case B.

4.2.2 Principle

Fuel Change and Energy Efficiency Projects are described as follows.



A. Principle equation

The principle of the energy efficiency project is illustrated with following equations.

P + e = I x t x η (1)

Where

P: Product (it can be understood as an utility, e.g. lighting or air-flow)

e: emissions

I: Input

t: time

η: efficiency

Both fuel change and energy efficiency projects are both address to factors of this equation. It is important to note that project has to maintain its original output/utility when implementing energy saving or efficiency projects.

B. Fuel change project

Product + emissions↓ = input' x time x efficiency (2)

Where:

input': a lower carbon intensity fuel

In fuel change project changes input from high-carbon intensive fuel to low- carbon intensive fuel while maintaining time and efficiency. The project maintains product/utility and basically maintains time and efficiency constant. If the project enables to shorten working time or improve its product efficiency those project proportion would be treat differently.

C. Energy efficiency project

Product ↑ + emissions↓= Input x time x efficiency↑ (3)

Energy efficiency project improves efficiency and reduce emissions. Product and/or utility will improve simultaneously. It is often the case that improving efficiency results in shorter un-time to provide same amount of output/utility, hence the total amount of emission is reduces as per following equations.

Product + emissions↓ = Input x time↓ x efficiency (4)

D. Behavioral change

Improving energy efficiency through mechanical performance is measurable and through performance monitoring, one can claim emission reductions. Some projects reduce energy consumption by changing human behavior.

For instance, installing a monitoring instrument for air-conditioner can reduce electricity consumption by people are aware the air-conditioner works too cold or too warm. However, the energy saving controlled manually, it is difficult to attribute energy saving to installed system. These controlled systems, so-called demand control, are getting popular by coupling with advisory services. However, one should note that demand control has to be de-coupled with human intentions and recorded its activity precisely to yield carbon credits.

E. Emission reduction calculation

Emission reduction calculations principles are common to biomass fuel change and renewable energy projects.

ER = BE – PE + LE (5)

Where

ER: Emission Reductions

BE: Baseline Emissions

PE: Project Emissions

LE: Leakage

In energy efficiency projects ―leakage" missions is definitive. If the applied energy generating equipments are transferred from other activities, the emission occurs in original equipments' location has to be accounted as

leakage emissions. The project shall look into the methodology and its descriptions of the leakage emission counting.

4.2.3 CDM Methodologies

Energy efficiency projects are widely implemented and explored. UNEP/Reso's statistics shows that energy efficiency project occupies 12.1%2 of total CDM projects and 7.5% for small scale CDM. Energy efficiency projects are relatively smaller modification of the facility and less investment compared to green-field power generation projects.

Approved methodology for energy efficiency projects shows the potential of energy efficiency projects' in CDM by improving project economy by generating credit income. Among 206 approved methodologies, there are more than half of methodologies are related to energy efficiency and fuel change. Some methodologies are site/technology specific and difficult to apply. These methodologies are developed based on specific CDM projects and be difficult to fulfill ~~–a~~pplicable conditions" stipulated. See attached list of methodologies applicable for energy efficiency projects.

It is advisable for project developers to apply approved methodology rather than developing a new methodology, even though it is logically and procedurally possible. New methodology development gives an uncertainty for CDM project implementation by an ambiguity of methodology's approval duration.

Among these numerous methodology the project has to identify the most appropriate project by following steps. (Note: these steps are not formal steps. It presented for reference purpose)

STEP 1: Energy Usage

Supply side energy efficiency

Power supplier and distributer implement energy efficiency measures; inc. auxiliary power gen. the sector includes heat recovery, combined cycle, rehabilitation of power station smart grid

Demand side energy efficiency

Application of energy efficient equipment, lamps, ballasts, refrigerators, motors, fans, air conditioners, home-appliances in numerous sites.

STEP 2: Fuel change or mechanical energy efficiency modification

STEP3: Employed technology and industry

STEP4: Whether the project is Greenfield project or retrofit project

[2] 815 projects out of 6,725 projects. For 1,460 small scale projects, 110 projects are Energy Efficiency category (as of 1 September 2011)

By knowing these conditions, the project identifies applicable methodology among the list of approved methodology. The project shall satisfy the applicable conditions of the chosen methodology. It is an idea to check if there are preceding registered project with same project profile, then the project can identify the possible leakage and other possible issues to be taken account.

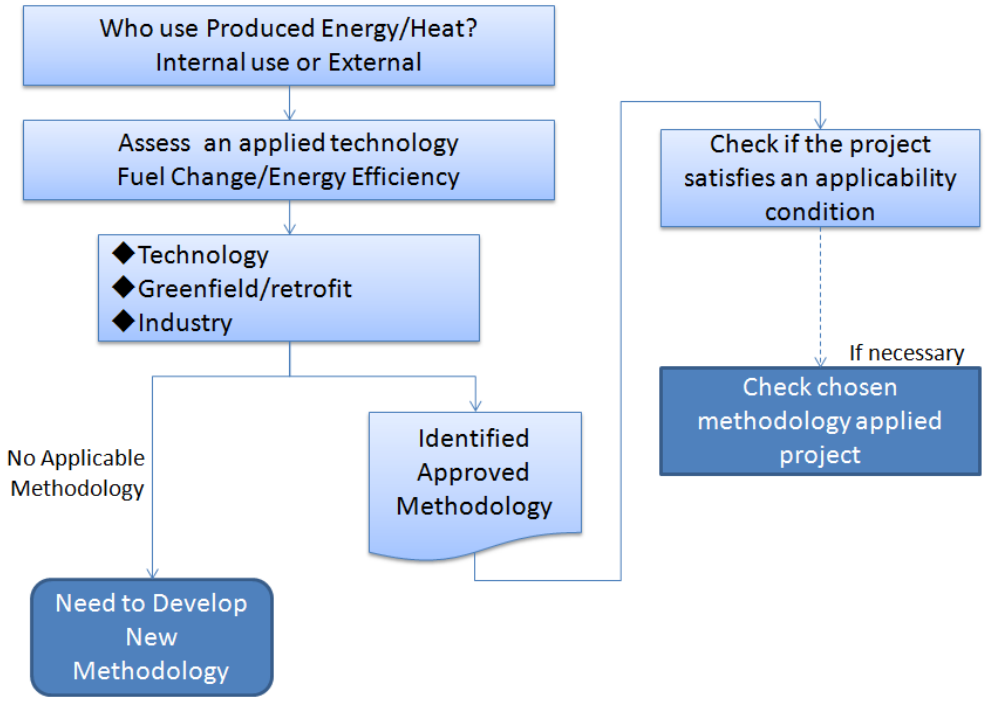


Figure 47: Flowchart for selecting a methodology

4.2.4 Application Examples

A. Fuel change project (biomass)

Fuel change project would divert fuel or inputs from high carbon intensive one to lower inputs. In case the lower carbon intensive inputs are biomass product, the emissions are regarded as zero because an emission from biomass sources are, originally, sequestered in biomass and its release to atmosphere is cancel its sequestration. (See Forestation project section)

For these projects, one must note that mechanical modification is inevitable to apply new fuels. Further advice shall be sought to engineering companies of its degree of modifications. The table on next page shows the emission intensity of major fuels used in industry.

Table 21: Emission intensity of major fuels used in industry

Fuel	Heat Value (TJ/MT)	COEF (tCO2/TJ)	EF (tCO2/MT)	Gravity	
Coal	0.0293	101.0	2.816	1.300t/m3	3.661tCO2/t
Furnace Oil	0.0410	77.4	3.173	0.972t/kl	3.264tCo2/kl
Residual Oil	0.0410	77.4	3.173	0.972t/kl	3.264tCO2/kl
Diesel Oil	0.0433	74.1	3.209	0.846t/kl	3.793tCO2/kl
Natural Gas	0.0411	64.2	2.639		2.108kgCO2/Nm3
LPG	0.0502	63.1	3.168		3.168tCO2/kg
Grid Electricity					0.686tCO2/MWh

Emission factors may vary and that it should be confirmed through authoritative information sources when developing a Project Design Document. Project changing from liquid fuel to gaseous fuel, or solid fuel to liquid fuel often need a mechanical modification of the facility. These changes further improve an overall efficiency. The methodology will describe how those effects are to be measured.

Having proposed these fuel changes project, prices of low emission fuels are relatively expensive compared to widely used fuel, furnace oil. Propagation of fuel change project in Sri Lanka has to wait until the price level of lower-emission fuel becomes acceptable for facility owners.

B. Water-Pump Application

Energy efficiency project takes place in more precise locations rather than plant-wide modification. In a particular part of the energy and utility supply facilities are upgraded to more energy efficient facilities/ by replacement. A new facility can also apply for CDM by demonstrating employed technology's additionality.

A water pump is a vital component for industry facility. By replacing old water- pump to more efficient design and less electricity consumption pump will reduce energy consumption. Estimation shows that energy efficient pump saves 20% of electricity in one location. If a whole plant is replacing the inefficient and vital part of pumps, then it successfully saves huge amount of energy.

The facility does not necessarily locate one location but scattered in networks. For example, the pumps in water system or transformers in electricity transmission line can be replace to energy efficient and less GHG intensive type which yields carbon credits In line with approved methodologies. The multiple-site project can

be developed as a ―Programmatic CDM". As a single site and multiple site projects, the water pump application is covered by the AM0020 and for small scale project AMS-II.C.

Emission reduction calculations are performed as follows

BEy = EBL, y x EF CO2/electricity, y

E BL,y = EER x Qy/ (1-ly)

Where

BEy	Baseline emissions in year y	(tCO2e)
E BL, y	Baseline energy consumption in year y	(kWh)
EF CO2/electricity, y	Emission factor in year y	(tCO2/MWh)
EER	Unit energy consumption in baseline	(MWh/unit)
Qy	Total Water Supply in year Y	(unit)
ly	Annual technical loss in the grid transmission	

PEy =EPPJ,y x EF CO2,y

Where

PEy	Project Emissions in year y	(tCO2e)
EP PJ,y	Energy consumption after project in year y	(kWh)
EF CO2,y	Emission factor in year y	(tCO2/MWh)

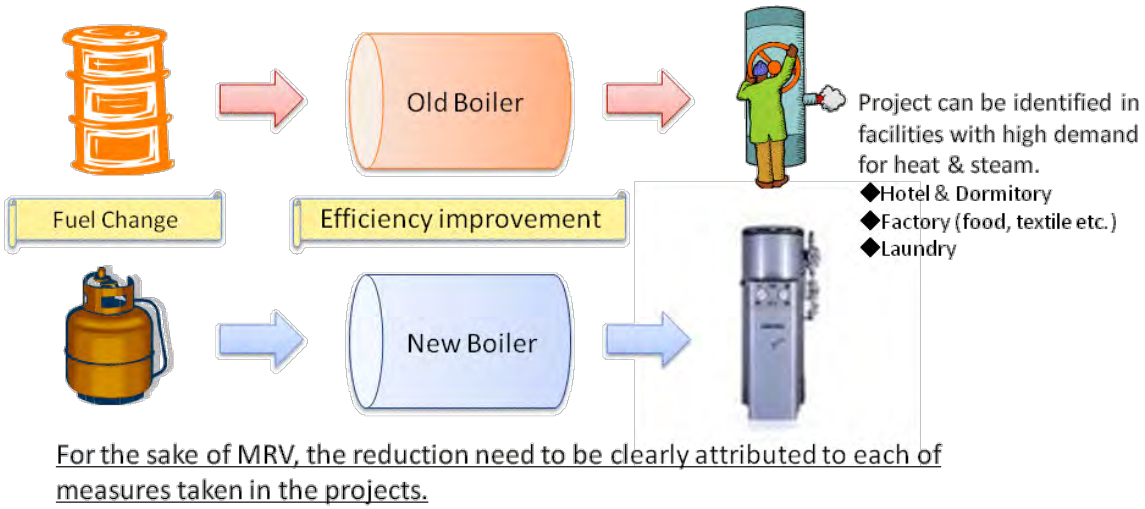
ER = BE-PE+LE

C. Multiple Technology Application

Previous two cases are modification of particular part of the plant or technology. The project can employ more than one technology and methodology and designed as a single project. In case fuel change project, it is often a case that changing fuel forces to replace old boiler to new boiler and improve boiler efficiency. In that case, the project needs to apply two methodologies to describe its improvements. The alternation of fuel to biomass will be covered with fuel change methodology and boiler's efficiency improvement shall be covered with a modification of boiler.

The case below applies multiple energy efficiency methods and they are covered with different methodology consistent to employed technology.

a) The laundry uses steam generated with furnace oil changing the fuel to natural gas. The change requires modifying burner and increasing efficiency.



For the sake of MRV, the reduction need to be clearly attributed to each of measures taken in the projects.

b) The ceiling light converted from mercury lump to LED (light emitting diode) lump.

c) The exposed steam pipes are covered with a cover made by asbestos.

While above three measures address an energy saving, it is a different question if it can be acceptable as a CDM. The questions are can the project monitor the reduction amount precisely and are there approved technology to employ for CDM?

Valves and critical parts exposed to room temperatures, are covered with glass-wool blanket.

	Project (a) Boiler Fuel Change	Project (b) LED Application	Project (d) Blanket Application
AMS	III.B	II.E	---
Baseline	Keep using furnace oil	Keep using mercury lamps	Expose valves
Project	Replace furnace oil to natural gas	Replace mercury lamp to LED lamp to reduce electricity consumption	Cover valve to avoid heat expose to atmosphere
Monitoring	Gas consumption with gas flow meter and gas supplier's invoice	Electricity consumption with metering devices and electricity bill	Continuous monitoring temperature of fluid and exposed environment
CDMable?	○	○	×

The above box is a summary of this project's design. What may profound in this case is that while the pipe blanket is an easy measure to install, the energy saving result is hardly measureable. There numerous factors to affect an energy consumption of the system and its measurement are simply nightmare. Costs for installing necessary measurement of parameters to determine energy consumption reduction outweighs the energy saving and carbon credit revenue. Hence the CDM project may only be applied for rest of three measures.

C.1 Emission reductions

a Boiler fuel change

Emission reduction calculations are performed as follows, the plant operates with following assumptions as per indicated in table below.

Furnace Oil Consumption	1,752	Kl/year
HV of Furnace Oil	39.85	GJ/kl
HV of Natural Gas	46.1	MJ/Nm3

Consumption of furnace oil before the project is 1,752kl/year.

CO2 emission factor of furnace oil is 3.086tCO2/kl

Therefore, CO2 emission from furnace oil is derived as

1,752kl/year x 3.086tCO2/year

= 5,406.67 tCO2

As the gravity of furnace oil is 0.972t/kl.

Thus the amount of furnace oil consumed is

1,752kl/year x 0.972t/kl

= 1,703t/year

Heat value of furnace oil is 41.0GJ/t from the table (0.0410TJ/t = 41.0GJ/t)

The heat derived from furnace oil combustion is

1,703 t/year x 41.0GJ/t

= 69,823GJ/year

The natural gas's heat value is given as 0.0461GJ/m^3 = 46.1MJ/m^3

69,823GJ/year ÷ 46.1MJ/m^3

= 1,515 x 10^3 m^3

CO2 emission factor of natural gas given as 2.108kgCO2/m^3

1,515 x 10^3 m^3 x 2.108 kgCO2/m^3

= 3,194tCO2/year

b LED Application

Assumptions are as follows;

Electricity Consumption of Hg Lamp	400	W/unit
Electricity Consumption of LED Lamp	118	W/unit
Number of Hg lights	137	Units
Number of LED	83	Units
Daily Working Hours	12	Hours/day
Annual Working Days	264	Days/year

Electricity consumption of halogen lamp is

400W/unit x 137 units x 12 hours/day x 264days/year

= 54.8kW x 3,168 hours/year

= 173,606.4kWh/year

By converting to LED lamp

118W/unit x 83 units x 12 hours/day x 264days/year

= 9.794kW x 3,168 hours/year

= 31,027.39kWh/year

The emission coefficient of electricity is derived as 0.686tCO2/MWh

(173,606.4kWh/year – 31,027.39kWh/year) x 0.686tCO2/MWh

= 142,579kWh/year x 0.686tCO2/MWh

= 142.58MWh/year x 0.686tCO2/MWh

= 97.81tCO2/year

4.2.5 Things to be kept in mind for Energy Efficiency Projects

A. Monitoring

First, the precise monitoring of the project' reduction effect is inevitable for CDM projects to yield credits. For instance, the project, modifying a part of electricity or system in the plant shall monitor the modified part without disturbance of other part's activities energy consumption effects. To comply with approved methodology, CDM project may require installing a specific measurement instrument at appropriate locations.

Contamination of the energy data should be avoided by designing a location of measurement instruments and its operating methodology. CDM projects need to carry out a precise monitoring of the project performance. However, the project need to carefully managing a cost of monitoring and the credit revenue expected by implementing a stringent monitoring. As suggested in pipe blanket project, monitoring could hardly determine the emission reduction amount, and then the project should not pursue CDM to avoid further troubles.3

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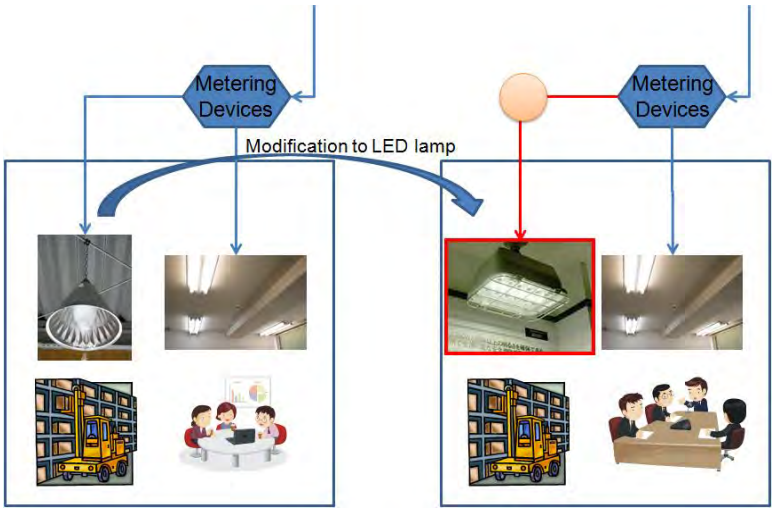
[3] Designing an effective monitoring, the project should refer to UN guidelines and/or Chapter 4 of ~~–G~~HG Protocol for Project Accounting.
The five principles presented in the GHG Protocol is a common principles for CDM and other emission reduction projects.

- Relevance: Use Data, methods, criteria, and assumptions that are appropriate for the intended use of reported information
- Completeness: consider all relevant information that may affect the accounting and quantification of GHG reductions, and complete all requirements
- Consistency: use data, methods, criteria, and assumptions that allow meaningful and valid comparisons.
- Transparency: provide clear an sufficient information for reviewers to assess the credibility and reliability of GHG reduction claims
- Accuracy: reduce uncertainties as much as is practical



Energy saving need to monitor precisely to segregate from other electricity and/or energy usage in same "system" to avoid disturbances.

Project may need to set a metering device for the project purpose.

For instance, the project modifies lighting to LED only its part o the building. Suppose the electricity consumption is only monitored at the original metering devices. The electricity consumption in remained part of the building, spaces continuously using fluorescent lamps, will impact the electricity consumption of the building. In above illustration, the office space is now used for meeting space and lighting in the office space is shortening only because purpose of special-use is changed. If the project only monitor the metering devices, the energy saving by replace to LED shows larger than actual impacts. To avoid mistakes, the project should equip a monitoring device (red-circle) separate to common metering device to monitor an electricity consumption of the warehouse space, where lamps are modified.

The case is easily identifies special distinction of project boundary. Building's special design and electrical wiring or other utility supply systems are not consistent and carefully examined before project implementation.

B. Energy costs and other vital information

Second, the energy efficiency projects are largely affected by the energy prices and other vital factors affecting project formulations.

Energy efficiency and energy saving projects' emission reductions are relatively small to power generation projects. As a result the project's revenue are sensitive to energy prices. It is often a case that energy prices are capped or subsidized for the sake of economy development and the energy saving project and its investment are vulnerable to energy price changes. Energy prices' hike or sudden drop impacts the project's additionality by improving ~~"re~~turn on investment" and may vanishing CDM project additionality.

- Conservativeness: use conservative assumptions, values, and procedures when uncertainty is high.

4.3 Afforestation/Reforestation

4.3.1 Principles of GHG removal of A/R CDM

A. –GHG emission reduction" and –GHG removal"

Energy based CDM projects such as renewable energy CDM projects avoid emission of GHG into the atmosphere where as A/R CDM projects remove the GHG from the atmosphere and store it inside the tree (known as carbon sink or carbon sequestration).

Energy based CDM project calculates –emission reduction" potential of the project, whereas A/R CDM projects calculates –GHG removal" potential of the project.

This difference between –GHG emission reduction" and –GHG removal", makes A/R CDM unlike any other CDM projects, which will be explained in detail in this section.

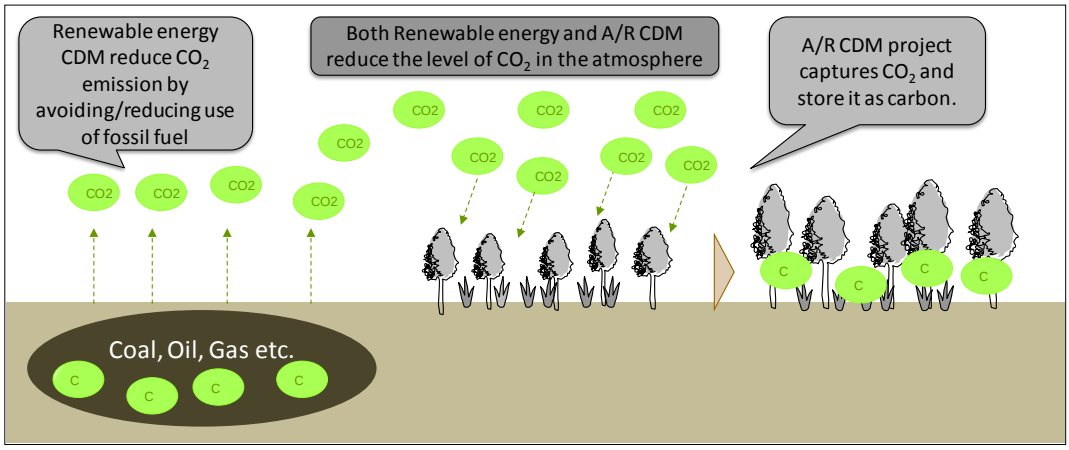


Figure 48: Avoidance of GHG emission and Removal of GHG

B. Non-permanence issue

The carbon which is stored inside the tree by an A/R CDM projects may be released back to the atmosphere due to forest fire or degradation of the trees. This is a non-permanence issue of the A/R project, where there are always dangers of re-release of the carbon back to the atmosphere.

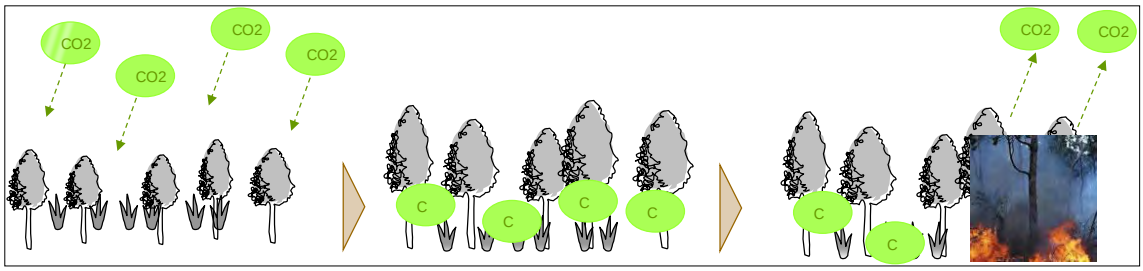


Figure 49: Non-permanence issue

GHG emission reduction projects such as renewable energy projects does not have such non-permanence issue. For example, if 1MWh of electricity was produced using solar energy instead of fossil fuel, which would have released say 0.7tons of CO_2, then the CDM project has prevented the release of 0.7tons CO_2 for that particular occasion. The fact that the ~~re~~release of 0.7 tons CO_2 was prevented" will not change in the future as this is what has already happened in the past.

Non-permanence nature of the A/R project is problematic when issuing carbon credit. If the A/R CDM project site re-releases GHG to the atmosphere (e.g. due to forest fire), the carbon credit issued for the GHG removal by the project needs to be invalidated (since the carbon is no longer stored by the forest). It is not practical to monitor the forest for eternity and invalidate the carbon credit on the event of re-lease of the GHG to the atmosphere.

UNFCCC has created special type of CERs for the A/R CDM projects, which are different from the CER from other CDM projects, namely long-term CER (t-CER) and temporary CER (t-CER). Both l-CER and t-CER expires at certain point to take into consideration the non-permanent nature of the A/R CDM project.

l-CER will expire upon end of the crediting period (i.e. at the end of the A/R CDM project). A crediting period for the A/R CDM project is either 20 years, which could be renewed 2 times (i.e. maximum 60 years), or 30 years with no renewal.

For example, if 10 ton of l-CER is issued for an A/R project, at the end of its crediting period that 10 ton of l-CER will expire and the l-CER holder will need to acquire equivalent amount of carbon credit (10 tons worth of AAU、ERU、CER, or RMU) to offset the loss. This is known as credit replacement rule, which applies to both l-CER and t-CER.

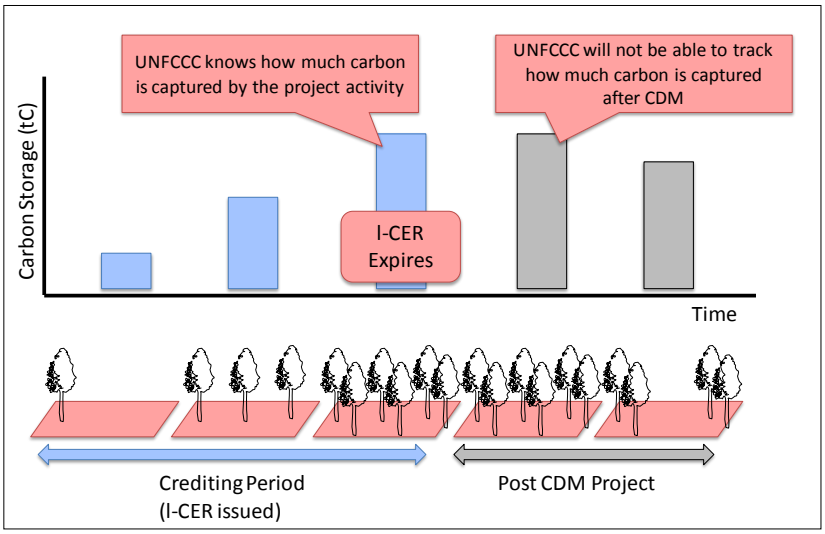


Figure 50: Expiry of l-CER credit

t-CER expires at the end of the subsequent commitment period from the time of its issuance. Upon expiry of the t-CER, the t-CER holder must acquire equivalent amount of carbon credit (AAU、ERU、CER, RMU, or t-CER) to offset its loss. The expired t-CER could be re-issued during the crediting period of the same project.

For example, if t-CER is issued from an A/R CDM project during the first commitment period (2008-2012), the credit will expire during the 2nd commitment period (which needs to be ratified under a new international framework). The expired t-CER could be reissued during the 3rd commitment period, since the existence of the carbon sink could be re-verified and monitored during the 3rd commitment period (i.e. as long as the A/R CDM project is active).

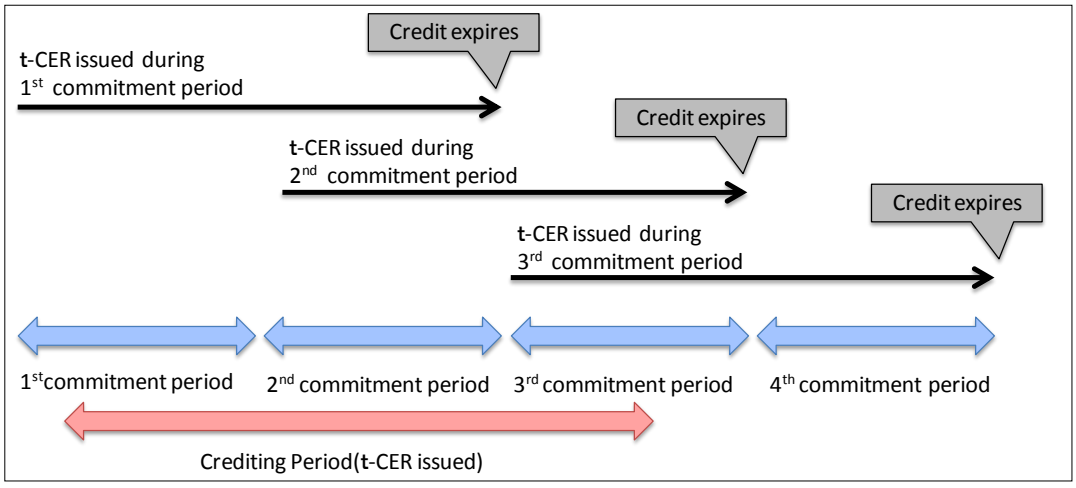


Figure 51: Expiry of t-CER credit

The time-limited nature of the l-CER and t-CER is problematic for the CER buyer since they will need to acquire equivalent amount of carbon credit every time their t-CER l-CER expires (the risk could be transferred

to the seller, however there is always the risk of non-delivery). Carbon credits from A/R project without expiry is currently being developed outside of the Kyoto Mechanism frame. This is discussed in later section *"VCS (credit pooling approach)"*.

4.3.2 A/R CDM eligibility conditions[4]

A. Procedures to demonstrate the eligibility of lands for A/R CDM project activities

For the A/R activities to qualify as CDM project, it must suffice the eligibility conditions set by the UNFCCC, which are as follows[5]:

(A) Demonstrate that the land at the moment the project starts does not contain forest by providing information that:

(i) Vegetation on the land is below the forest thresholds adopted for the definition of forest by the host country DNA (see next section *"Forest definition"*).

(ii) All young natural stands and all plantations on the land are not expected to reach the minimum crown cover and minimum height of forest definition adopted by the host country DNA; and

(iii) The land is not temporarily unstocked, as a result of human intervention such as harvesting or natural causes.

(B) Demonstrate that the activity is a reforestation or afforestation project activity (see later section *"Definition of Afforestation and Reforestation"* for further detail):

In order to demonstrate steps (A) and (B), project participants shall provide information that reliably discriminates between forest and non-forest land according to the particular thresholds adopted by the host country DNA, inter alia:

(a) Aerial photographs or satellite imagery complemented by ground reference data (see further section *"Remote sensing technology"*); or

(b) Land use or land cover information from maps or digital spatial datasets; or

(c) Ground based surveys (land use or land cover information from permits, plans, or information from local registers such as cadastre, owners registers, or other landregisters).

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[4] This section covers further details of A/R CDM definitions described in Chapter 2.

[5] Reference: EB35, Annex 18 [http://cdm.unfccc.int/EB/035/eb35_repan18.pdf]

B. Forest definition

A/R projects converts non-forested land into forested land. Therefore it is important to differentiate forests from non-forests. UNFCCC defines –forest" according to its land area, tree canopy coverage and tree height as follows:

UNFCCC forest definition:

- Minimum land area: 0.05~1ha
- Minimum tree canopy coverage: 10~30%
- Minimum tree height: 2~5 meters

Each CDM host country DNA has its own forest definition, which is set within the range of the UNFCCC forest definition. Arid country –forests" may have low canopy coverage and short tree height where as rainforest rich country –forests" may have high canopy coverage and tall tree height. If a country set its forest definition with low canopy coverage and short minimum tree height, many of the shrub land may be already regarded as forests. On the other hand if the forest definition is set at high canopy coverage and tall minimum tree height, some of the tree species may have too little canopy coverage or is too short to create forests.

Sri Lankan forest definition is as follows:

- Minimum land area: 0.05ha
- Minimum tree canopy coverage: 20%
- Minimum tree height: 3 meters

Relatively small patch of land will qualify as A/R CDM project site, as minimum land area is set to the minimum possible range from the UNFCCC forest definition.

C. Definition of Afforestation and Reforestation

For the A/R activity to qualify as CDM project A/R activity needs to be inline with what the UNFCCC recognise as Afforestation or Reforestation. UNFCCC definitions of –Afforestation and Reforestation"are as follows[6]:

Afforestation

is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

[6] Reference: UNFCCC, Glossary of CDM terms version5 [http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf]

Reforestation

is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

Following figure compares Afforestation projects with Reforestation projects:

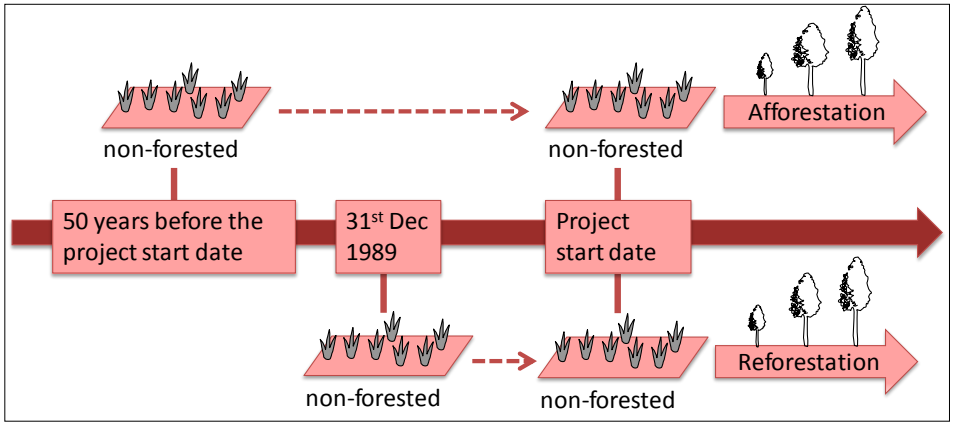

Figure 52: Comparison of Afforestation and Reforestation[7]

D. Remote sensing technology

There are various ways to distinguish non-forested land with forested land as described in previous section "*A/R CDM eligibility conditions*". Most time efficient way of all is to use aerial photography and satellite images known as remote sensing technologies. These technologies could analyse large area of land in matters of minutes or hours, which may take weeks or even months by ground survey. Remote sensing technology is also applicable for monitoring of project activities such as detection of forest fires. Present remote sensing technologies are however, not perfect, and need to be complemented by ground surveys. For example, it is difficult to distinguish between degraded forest with non-degraded forest and in many cases it cannot measure height of the trees. With the advancement in remote sensing technologies such as hyper-spectrometer and LIDAR[8]. In the future, all the A/R CDM measurements and monitoring activities may be done by remote sensing technology, however for now, combination of remote sensing technology with ground survey is necessary.

[7] Source: JICA (2008) Guidebook for Small Scale AR CDM activities

[8] Hyper spectormter use multiple wavelengths to analyse the condition of the forest, where as Laser Imaging Detection and Ranging (RIDAR) use lazar to measure different distances. including distance between ground and tree tops.

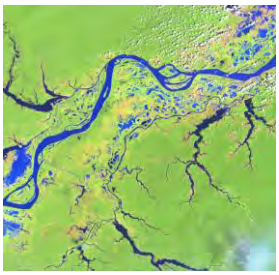

Figure 53: Remote sensing technology9 and ground survey (measuring the radius of the tree)

E. Project boundary

A/R CDM project must define its ―project boundary". Carbon credit is accounted only for project activity (i.e. conversion of non-forested land to forested land), which takes place within the project boundary. Single A/R CDM may have several separate sites.

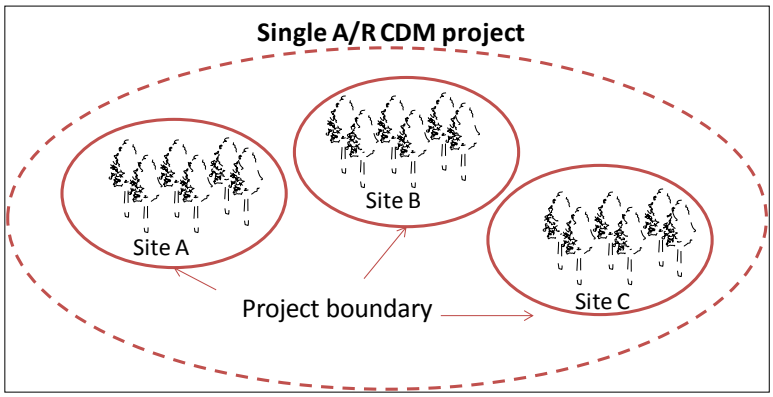

Figure 54: Project boundary

4.3.3 GHG removal calculation method

A. General A/R CDM formulae

The carbon credit (t-CER or l-CER) will be issued depending on the ―GHG removed" from the atmosphere by the project activity, which is equivalent of ―emission reduction" of energy based CDM projects.

The total additional amount of ―GHG removed" due to the A/R CDM project activity is the ―net anthropogenic GHG removal by sink". The same amount of l-CER or t-CER as ―net anthropogenic GHG removal by sink" will be issued.

[9] Source: Landsat.org [http://landsat.org/landsat_gallery/P229R62D113000.html]

Carbon credit is issued for the additional (or extra) GHG removal occurred in comparison to the baseline scenario (i.e. if A/R CDM did not take place).

The general formulae for calculating the "net anthropogenic GHG removal by sink" is as follows (see the figure below):

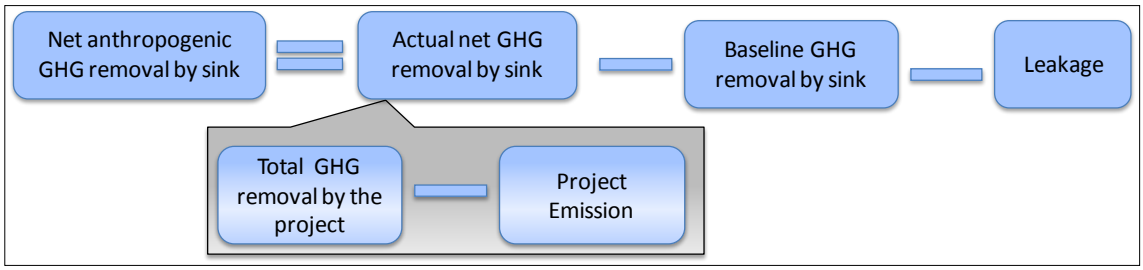

Figure 55: General formulae for A/R CDM

Each components of the above formula will be explained in the following sections.

B. Actual GHG removal by sink

Total carbon pool of the forest of the project activity is the "Total GHG removed by the project". The total carbon pool of the forest will consist of above ground biomass (planted trees and other vegetation), below ground biomass, litters, deadwood, and soil carbon. However, some of the A/R CDM methodologies may not account for the litters, deadwood, and soil carbon assuming that the carbon stock of litters, deadwood and soil will not decrease due to the project activity (it should increase due to the tree plantation activities).

A/R project may result in release of GHG due to activities such as use of chainsaw or clearing of the undergrowth. The GHG emission due to the project activity needs to be subtracted from the total GHG removal by the project, which gives the "actual net GHG removal by sink".

Following list shows some of the examples of project emission:

Table 22: Types of project emission

Types of emission	Types of activities
GHG emission due to use of fossil fuel	● Use of chainsaw (for thinning) ● Use of tractors (for initial land clearing) ● Use of trucks (for transportation of logs) ● Use of vehicles (for patrol)
GHG emission due to burning of biomass	● Land clearing ● Shifting cultivation
GHG emission due to Nitrogen fertilization (formation of N_2O)	● Application of fertilizers (N_2O emissions from application of fertilizers to seedlings and fertilization runoffs are disregarded

	from the project emission)

C. Baseline GHG removal by sink

Usually non-forested land will have vegetations, such as shrubs and grass. Therefore, there will be certain level of GHG removal by the non-forested land. The most likely scenario without the A/R CDM activity is called the baseline scenario, and the estimated GHG removal by the baseline scenario is the ~~"B~~Baseline GHG removal by sink".

Appropriate A/R CDM methodologies could be selected by studying the most likely baseline scenario of the project. For example, if the baseline scenario is agricultural land use, then methodology AR-AM0004 *"Reforestation or afforestation of land currently under agricultural use"* or, small scale A/R CDM methodology AR-AMS0001 *"Simplified baseline and monitoring methodologies for small-scale A/R CDM project activities implemented on grasslands or croplands with limited displacement of pre-project activities"* are good candidates for the project.

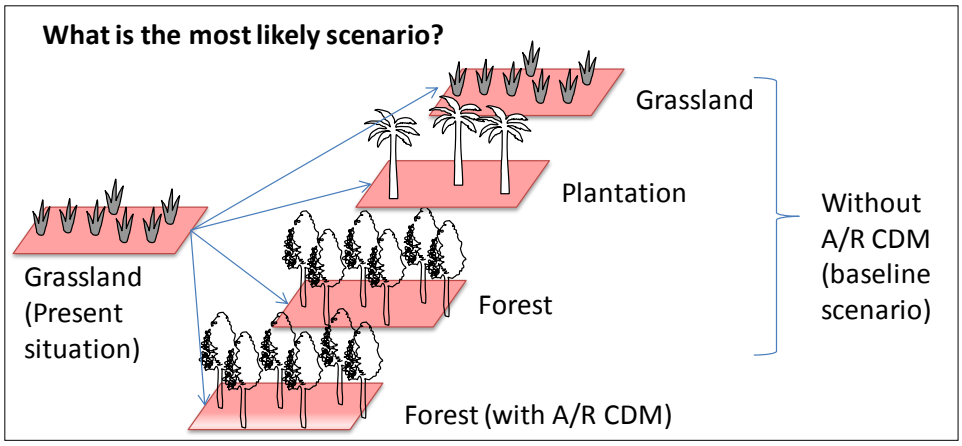

Figure 56: Baseline scenarios

D. Leakage

Leakage is GHG emission which happens outside of the project boundary, which is caused by the implementation of the A/R CDM project.

For example, A/R CDM project may cause some local people to resettle outside of the A/R CDM project boundary. These people may clear a different patch of forest in order to resettle, which will cause GHG emission outside of the A/R CDM project boundary. These leakage must be accounted as part of the A/R CDM project emission.

Other possible leakages are as follows:

- Increase in transportation of logs, machineries and workers due to the project activity.
- Employment opportunity from the project activity increase the local population resulting in increased demand for fuel wood, which in turn caused deforestation around the project area.
- If the pasture land was converted to forests as part of A/R CDM project, the cattle farmer may clear the neighboring forests to open up an alternative pasture land.

4.3.4 New forest carbon sink initiatives

A. VCS (credit pooling approach)

As explained earlier, time limited characteristic of t-CER and l-CER due to the non-permanence nature of the A/R projects is one of the setback of the A/R CDM.

Verified Carbon Standard (VER), which was established by Climate Group, International Emissions Trading Association (IETA) and World Economic Forum, proposed a credit pooling approach, which certain percentage of the issued carbon credits from the A/R activities are pooled into a single account, called buffer account. The buffer account acts like an insurance scheme and any loss of GHG removal, due to forest fire, logging and/or termination of the project activity, could be offset by using the credit from the buffer account. As long as the buffer account has sufficient credits to offset the loss, the issued carbon credit could be considered as permanent.

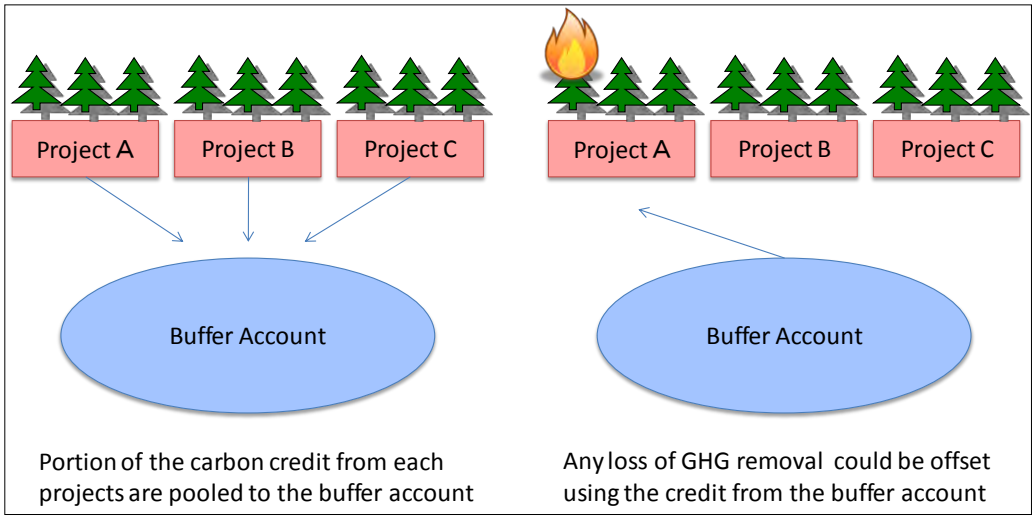

Figure 57: Credit pooling approach

B. REDD+

Protection of the existing forests could mitigate GHG emission resulting from logging and land clearing activities, which according to the World Bank accounts for nearly 20% of the global emissions.

Reducing Emission from Deforestation and Forest Degradation (REDD) is a carbon credit mechanism, which issues carbon credit for preventing the loss of the existing forests.

The baseline scenario (known as reference scenario) will be logging and land clearing activities, where as the project scenario will be the conservation of the existing forests.

Leakage of the REDD is an issue. Prevention of logging in the REDD site may exert pressure for logging in adjacent forests. In order to prevent such leakage, certain level of timber production must occur within the REDD project site. Conservation of the existing forests and planting of trees at the logged area (and subsequent sustainable forest management) is known as REDD-plus (REDD+).

REDD+ is not implemented as Kyoto Mechanism, however it does exist as a voluntary scheme such as Verified Carbon Standard (VCS).

The implementation of the REDD+ as part of new global warming treaty is under discussion as described in the Bali Action Plan.

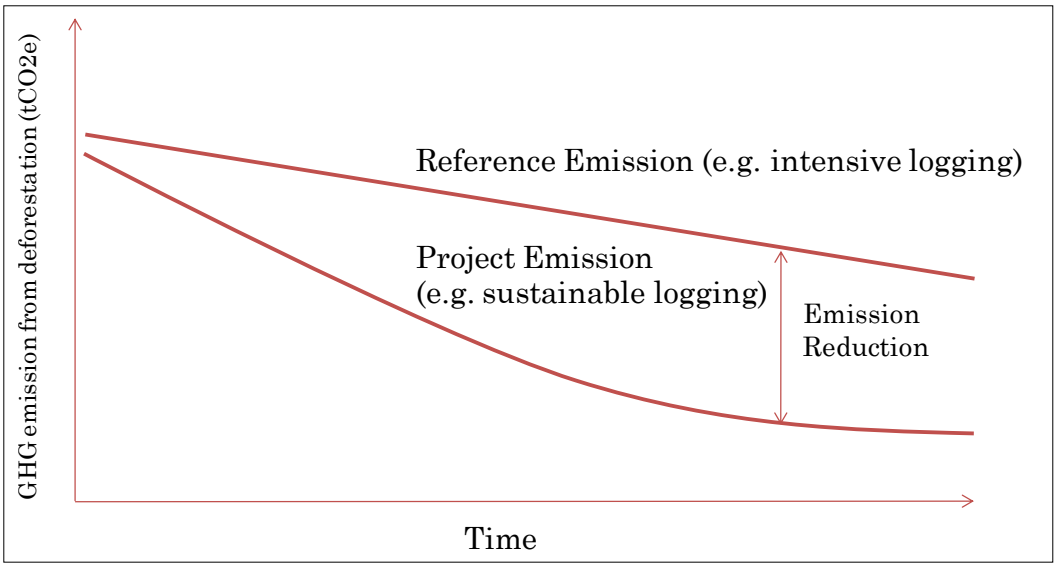

Figure 58: REDD emission reduction example

4.3.5 Forest related carbon credit project opportunity in Sri Lanka

Sri Lanka as an island nation has limited land size, therefore it is difficult to conduct large scale A/R or REDD projects, which could been seen in countries like Brazil and Indonesia. Also, project sites are likely to be fragmented. Bundling of projects (i.e. bundling of small scale A/R CDM) and use of programmatic CDM are ways to increase the size of the A/R or REDD projects.

Another important point is that due to the limited GHG removal (or emission reduction) expected per project, there should be other incentives, other than CER revenue, to sustain the A/R or REDD projects. Following are

some of the suggestions (potential projects are not limited to them):

A. Sustainable forest management project

Forests could sustain carbon pool as long as the timber is harvested sustainably, meaning that less trees are cut than it is cultivated. Rotational timber harvesting would enable, enough time for the trees to grow back before the next harvest. Furthermore, extended rotation forest, which the harvest age is increased beyond the optimum economic harvest age, could provide larger timbers, habitat for wildlife and non-timber products. Forest Stewardship Council (FSC) certificate, which labels timber derived from sustainably managed forest, would add value to the timber product. Carbon finance will be part of the revenue, which will improve the overall economic feasibility of the such project.

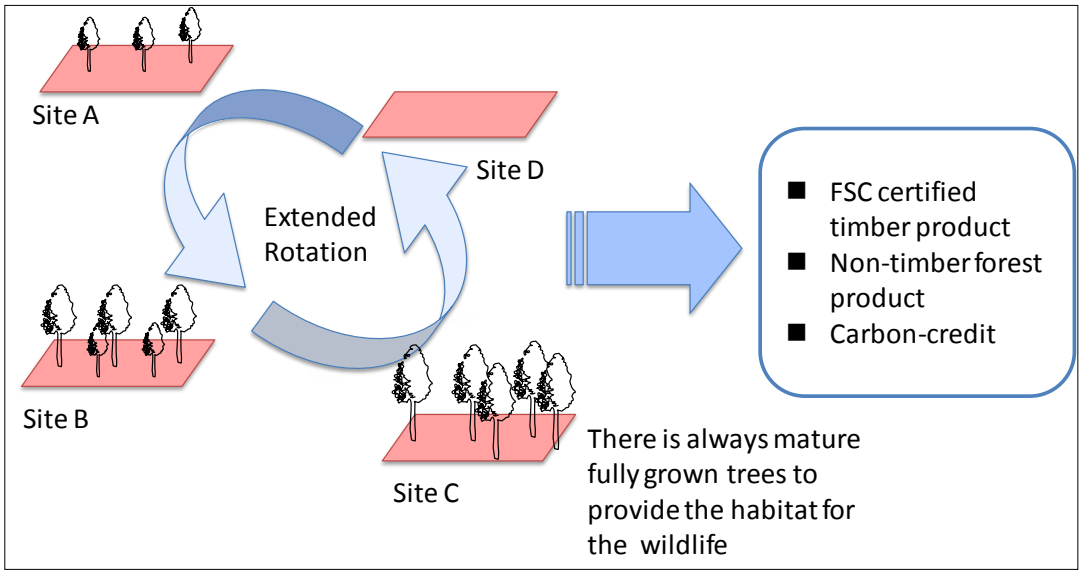

Figure 59: Sustainable forestry project

B. Watershed conservation project

Deforestation of the mountain areas may cause water shortages due to decreased water retaining capacity of the land. Some of the exiting forests may play a crucial role as watershed, however they may be under threats from logging and/or land use change (e.g. to farming). Other places may require reforestation in order to bring back the watershed function of the land. Carbon credit revenues from REDD+ and A/R project may assist financing such watershed conservation projects.

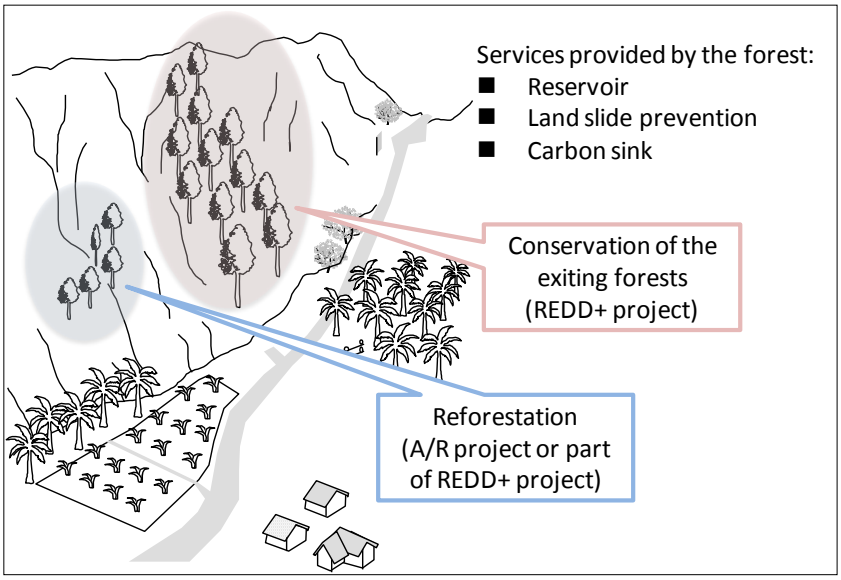

Figure 60: Watershed conservation project