Indira Gandhi National Open University
School of Agriculture

MAM-067
Management of Renewable Energy in Agriculture

Block

5

CLEAN DEVELOPMENT MECHANISM (CDM)

Unit 12
Introduction to Clean Development Mechanism 219

Unit 13
Project Design and Development Cycle 243

Unit 14
CDM Project Management 275

BLOCK 5 CLEAN DEVELOPMENT MECHANISM (CDM)

This Block familiarises learners with the concept, structure and functioning of the Clean Development Mechanism, and then gradually takes them through the project design, development cycle and management aspects of CDM projects. By the end of the Block, learners will be able to appreciate how CDM operates as a tool for climate change mitigation, sustainable development and carbon finance.

Unit 12 focuses on the significance of the **Clean Development Mechanism (CDM),** its origin and rationale within the UNFCCC and Kyoto Protocol. It explains the basic concept, goals and dual objectives of CDM, and introduces key institutional actors such as the UNFCCC Secretariat, COP/CMP, Executive Board, DOEs, DNAs, consultants and CER buyers. Cooperative mechanisms like emission trading and joint implementation are also briefly discussed.

Unit 13 on **Project Design and Development Cycle** takes the learner from policy-level understanding to the operational and procedural aspects of CDM projects. It introduces the Project Design Document (CDM-PDD) and explains its role as the core planning and documentation tool for CDM activities. It outlines types of projects, steps in project design, national approval through the DNA, and key stages of the CDM cycle from validation to CER issuance. This Unit discusses concepts like baseline setting, crediting period, monitoring plans, emission factors, global warming potential and EIA.

This **Unit 14 CDM Project Management** covers the managerial, financial and risk-related aspects, including project viability, CER quantity and pricing, transaction costs and project economics. It highlights how CER revenues affect viability, funding options and the importance of risk management.

The **Units 12, 13 and 14** together provide a comprehensive understanding of the **Clean Development Mechanism** from its conceptual underpinnings and institutional framework to the design, implementation and management of CDM projects on the ground. The block not only strengthens the learner's knowledge of international climate policy but also equips them with the analytical and managerial skills needed to participate in, or evaluate, CDM and similar carbon market-based initiatives in their future professional roles.

The material provided in this **Block** is supplemented with various *examples* and activities to make the learning process simple and interesting. We have also provided Check Your Progress questions for the self-test at a few places in these units, which invariably lead to possible answers to the questions set in those exercises. What perhaps you ought to do is to go through Units and jot down important points as you read, in the space provided in the margin. This will help you assimilate the content. A list of reference books has been provided at the end of each Unit for further detailed reading.

UNIT 12 INTRODUCTION TO CLEAN DEVELOPMENT MECHANISM

Structure

12.0 Objectives

12.1 Introduction

12.2 Concept of Clean Development Mechanism (CDM)

12.3 Structure of CDM

- 12.3.1 UNFCCC Secretariat
- 12.3.2 Conference of Parties (COP)/CMP
- 12.3.3 Designated Operational Entity
- 12.3.4 Designated National Authority
- 12.3.5 Executive Board
- 12.3.6 Panels and Working Groups
- 12.3.7 Consultants
- 12.3.8 CER Buyers

12.4 Goals of CDM

12.5 The Kyoto Protocol

- 12.5.1 Major Provisions and Commitments under the Kyoto Protocol
- 12.5.2 Limitations and Outstanding Issues in the Kyoto Protocol

12.6 Cooperative Mechanism

- 12.6.1 Emission Trading
- 12.6.2 Clean Development Mechanism (CDM)
- 12.6.3 Joint Implementation

12.7 CDM and Sustainable Development

12.8 CDM Rules and Conditions

12.9 Let Us Sum Up

12.10 Key Words

12.11 Suggested Further Readings/References

12.12 Answers to Check Your Progress

12.0 OBJECTIVES

After going through this Unit, you will be:

- discuss the concept and significance of the Clean Development Mechanism (CDM);
- identify the structure and roles of key institutions involved in CDM;

- explore the goals and dual objectives of CDM in promoting emission reductions and sustainable development;
- evaluate how CDM supports climate change mitigation and facilitates green investments in developing countries; and
- examine the fundamental rules, conditions, and limitations that govern CDM projects and eligibility.

12.1 INTRODUCTION

To address the challenge of climate change, countries around the world came together and signed international agreements like the Kyoto Protocol. These agreements help regulate and reduce the greenhouse gases (GHGs) that cause global warming. But here's the interesting part – developed countries, which are historically responsible for a large share of emissions, are allowed to invest in clean, eco-friendly projects in developing countries to meet part of their own emission reduction targets. This system is known as the Clean Development Mechanism (CDM).

In simple terms, CDM is like a global partnership. A developed country supports a project - like a wind power plant or a solar lighting system – in a developing country. That project reduces emissions, and in return, the developed country earns Certified Emission Reductions (CERs), which it can use to meet its own emission goals. At the same time, the host country gets technology, investment, and development benefits.

In this Unit, we will explore what CDM is, how it works, and why it matters for sustainable development. You'll learn about the different institutions involved, the rules and procedures CDM follows, and the benefits it offers not only to the environment but also to businesses and economies. By the end of this Unit, you will have a clearer understanding of how environmental responsibility and business opportunities can go hand in hand– something that every future manager should know.

12.2 CONCEPT OF CLEAN DEVELOPMENT MECHANISM (CDM)

International concern over the environmental impacts of the world's uncontrolled use of coal, oil, and gas has grown in the second half of the twentieth century. The damage caused to plants, animals, and buildings by acid rain and the effects on human health of poor air quality and smog have led to a raft of national, regional, and international agreements aimed at controlling these problems by cutting emissions of the gases that cause them.

In the mid-1980s, awareness began to increase of yet another problem caused by fossil fuels– climate change, also known as global warming or the greenhouse effect. The warming gases (known as greenhouse gases) are given off when fossil fuels are burnt. These gases increaze in the atmosphere, leading to rises in global temperature and sea levels. The most important greenhouse gas is carbon dioxide (CO_2). Concentrations of carbon dioxide in the atmosphere today are already 30 per cent higher than the levels that existed before the Industrial Revolution.

The Clean Development Mechanism (CDM) is a key tool in the Kyoto Protocol, allowing countries with emission reduction targets (Annex I countries) to undertake and benefit from reductions in greenhouse gas emissions in other (non-Annex. I) countries. Under the Kyoto Protocol, the developed countries took on binding quantitative commitments to limit their greenhouse gas emissions for the period 2008-2012. Each country with a binding emission commitment has been allocated an emission quota called its assigned amount. The quota is divided into assigned amount units (AAU), which can be traded with other developed countries. This type of arrangement is called a cap-and-trade system. In addition to taking part in emissions trading, the developed countries can meet their commitments through domestic abatement, projects in other developed countries (Joint Implementation projects), and finally, through the Clean Development Mechanism (CDM).

The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one ton of CO_2, which can be counted towards meeting Kyoto targets.

According to the Kyoto Protocol, the purpose of the CDM is to assist the developed countries in meeting their commitments and to assist developing countries in achieving sustainable development (see Article 12 of the Protocol). One could argue that CDM projects facilitate the transfer of new environmentally sound technology to developing countries. However, significant transfers of new technology are unlikely in developing countries if there are no costs (tax or carbon price) associated with emissions, especially if those transfers lead to higher production costs. Moreover, the CDM may encourage the introduction of new technology, even though the most cost-effective measure would be to reduce production. This is because emission credits can be earned by introducing new technology, whereas it is difficult to define reductions in production as CDM activities.

The CDM allows developed countries to earn certified emission reduction units (CERs) through emission-reduction or emission-removal projects in developing countries. *Examples* include afforestation (*i.e.,* planting *new* forests), switching to less polluting fuels or energy sources, and energy efficiency measures. Since emissions reductions achieved through the CDM may be used in their entirety to offset emissions in developed countries, the mechanism is not designed to bring about an overall decrease in global emissions.

The CDM is intended to meet two objectives:

1) to assist parties not included in Annex. I 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 dangerous 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 treaty and are the industrialized countries. Non-Annex. I parties are developing countries.

Fig. 12.1: Shows a Block Diagram Elaborating the Working of CDM.

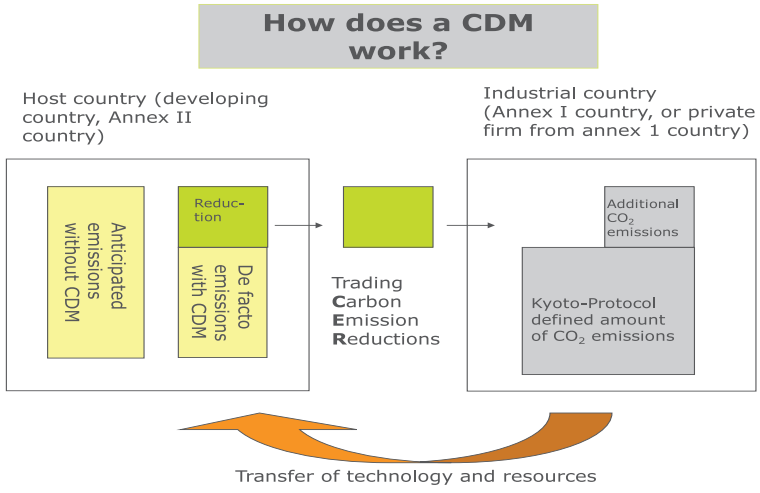

Fig. 12.1: Working of CDM

Annex. I refers to the UNFCCC and is a list of countries that are committed to supporting developing countries to address climate change. These are more or less identical with the developed countries and economies in transition (former Soviet Union bloc members).

Annex. I of the UN Framework Convention on Climate Change			
Australia	Finland	Lithuania*	Slovenia*
Austria	France	Luxembourg	Spain
Belarus*	Germany	Monaco	Sweden
Belgium	Greece	Netherlands	Switzerland
Bulgaria*	Hungary*	New Zealand	Turkey
Canada	Iceland	Norway	Ukraine*
Croatia*	Ireland	Poland*	United Kingdom of Great Britain and Northern Ireland
Czech Republic*	Italy	Portugal	
Denmark	Japan	Romania*	
European Community	Latvia*	Russian Federation*	United States of America
Estonia*	Liechtenstein	Slovakia*	

*Countries that are undergoing the process of transition to a market economy, and with Annex I as amended at COP3 (Decision 4/CP.3)

However, the CDM is important in reducing the costs of complying with the Kyoto Protocol, since it ensures that more countries cut their emissions, and there are many low-cost options for reducing emissions in developing countries. Moreover, the expectation that the CDM would result in lower costs may have made the developed countries willing to take on stricter commitments than they would otherwise have done.

The Major Advantages of CDM are as Follows:

1. An environmental advantage, on both a local and global level, from the reduction in GHG emissions resulting from the project.
2. A development advantage, both economic and social, for the host country, which benefits from the location of the project and the transfer of technologies.
3. An economic advantage due to the improved financial viability of low GHG emission technologies, which favours their application, and for entities with GHG emission reduction commitments, the possibility of satisfying these commitments at less cost.

Check Your Progress 12.1

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What is the Clean Development Mechanism (CDM)?

.....

.....

2) What is the main purpose of the CDM according to the Kyoto Protocol?

.....

.....

3) What are Certified Emission Reductions (CERs)?

.....

.....

4) How does the CDM contribute to reducing the overall cost of emission reduction?

.....

.....

12.3 STRUCTURE OF CDM

The CDM Executive Board, answerable to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, is tasked with approving all CDM projects and granting CERs. Like one AAU, one CER gives the right to emit one ton of CO_2 equivalent (CO_2e). The number of emission credits issued corresponds to the calculated emissions reduction from the CDM project, which is the difference between the level of emissions without the CDM project (the business-as-usual or BaU level) and emissions after the project has been carried out. Structure of CDM is shown in Fig.12.2.

CDM Institution

- UNFCCC secretariat/ "CDM Team"
- COP/CMP
- Designated Operational Entity

- Designated National Authority
- Executive Board
- Panels and Working Groups
- Brokers/Consultants
- CER Buyers

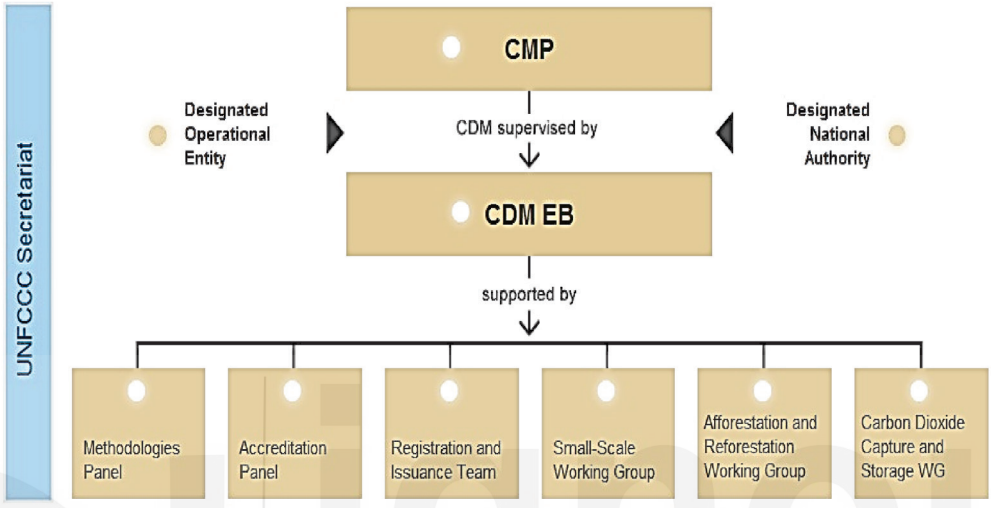

Fig. 12.2: Structure of CDM

12.3.1 UNFCCC Secretariat

The UNFCCC secretariat's sustainability efforts are part of a wider United Nations campaign to manage its sustainability performance by measuring, reducing and offsetting its impacts, particularly its carbon footprint. The UN as a whole and the UNFCCC itself have mandates to strive to increase sustainability efforts and cut carbon footprint. The UNFCCC Secretariat supports cooperative action by states to combat climate change and its impact on humanity and ecosystems. This is a contribution to a sustainable world and to realizing the vision of peace, security and human dignity on which the UN is founded.

12.3.2 Conference of Parties (COP)/CMP

The Conference of the Parties refers to the Parties to the UNFCCC. The COP serves as the Meeting of the Parties to the Kyoto Protocol (CMP). All States that are Parties to the Kyoto Protocol are represented at the CMP, while States that are not Parties participate as observers. The CMP reviews the implementation of the Kyoto Protocol and takes decisions to promote its effective implementation. The CMP meets annually during the same period as the COP. Parties to the Convention that are not Parties to the Protocol are able to participate in the CMP as observers, but without the right to take decisions. The functions of the CMP relating to the Protocol are similar to those carried out by the COP for the Convention. The CMP:

1. has authority over and makes rules for the CDM,
2. decides on the recommendations made by the Executive Board, and
3. Designates operational entities that are provisionally accredited by the Executive Board.

12.3.3 Designated Operational Entity

Private certifiers who validate projects and verify emission reductions are called a designated operational entity (DOE). A DOE under the CDM is either a domestic legal entity or an international organisation accredited and designated (on a provisional basis until confirmed by the CMP) by the CDM Executive Board. It has two key functions:

1. A DOE validates and subsequently requests registration of a proposed CDM project activity,
2. A DOE verifies emission reductions of a registered CDM project activity, certifies as appropriate and requests the Board to issue certified emission reductions accordingly.

12.3.4 Designated National Authority

Authorities who approve projects and facilitate participation are called the designated national authority (DNA). A designated national authority (DNA) is the organization granted responsibility by a Party to authorize and approve participation in CDM projects. Establishment of a DNA is one of the requirements for participation by a Party in the CDM.

The main task of the DNA is to assess potential CDM projects to determine whether they will assist the host country in achieving its sustainable development goals, and to provide a letter of approval to project participants in CDM projects. This letter of approval must confirm that the project activity contributes to sustainable development in the country, that the country has ratified the Kyoto Protocol, and that participation in CDM is voluntary. It is then submitted to the CDM Executive Board to support the registration of the project. In accordance with the CDM modalities and procedures, Parties participating in the CDM shall designate a national authority for the CDM. The registration of a proposed CDM project activity can only take place once approval letters are obtained from the designated national authority of each Party involved, including confirmation by the host Party that the project activity assists it in achieving.

12.3.5 Executive Board

The CDM Executive Board (CDM EB) supervises the Kyoto Protocol's clean development mechanism under the authority and guidance of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP). The CDM EB is fully accountable to the CMP. The CDM EB will be the ultimate point of contact for CDM Project Participants for the registration of projects and the issuance of CERs

12.3.6 Panels and Working Groups

1. **Methodologies Panel:** Established to develop recommendations to the Board on guidelines for methodologies for baseline and monitoring plans, and prepare recommendations on submitted proposals for new baseline and monitoring methodologies.
2. **Afforestation & Reforestation Working Group (A/R WG):** Established to prepare recommendations (in cooperation with the Methodologies Panel) on submitted proposals for new baseline and monitoring methodologies for CDM afforestation/reforestation project activities.

3. **Small-scale Working Group:** The SSC WG was established to develop recommendations to the CDM EB on guidelines for small-scale methodologies for baselines and monitoring plans, and prepare recommendations on submitted proposals for new baseline and monitoring methodologies for small-scale CDM project activities.

4. **Accreditation Panel:** The Accreditation Panel was established to develop recommendations and facilitate the decision-making of the CDM EB in accordance with the standards and procedures for accrediting operational entities.

5. **Registration and Issuance Team (RIT):** The CDM Registration and Issuance Team is a group of external experts that assists the CDM EB by assessing requests for registration of project activities or programmes of activities, as well as requests for issuance for which review has been requested.

6. **Carbon Dioxide Capture and Storage Working Group (CCS WG):** The CCS WG was established to prepare recommendations on submitted proposals for new baseline and monitoring methodologies. The WG is expected to work in cooperation with the Meth Panel.

12.3.7 Consultants

The CDM consultant shall confirm full understanding and commitment to the responsibilities to perform the following tasks:

1 To prepare the PDD and revise it according to instructions by the Designated Operational Entity (DOE) until the DOE agrees to submit the project for UNFCCC registration;

2 To contract the DOE and channel loan proceeds to the DOE as payment for validation services;

3 To continuously monitor the progress of actual project implementation and report to UNOPS on the status of the project with a specific focus on the chance of the project materialising as an operating asset;

4 To accept a staged milestone-based payment and a certain liability for disbursed funds in the event that PDD and validation activities continue despite lacking progress on actual project implementation.

12.3.8 CER Buyers

Certified Emission Reductions (CERs) are a type of emissions unit (or carbon credits) issued by the Clean Development Mechanism (CDM) Executive Board for emission reductions achieved by CDM projects and verified by a DOE under the rules of the Kyoto Protocol. CERs can be used by Annex 1 countries in order to comply with their emission limitation targets or by operators of installations covered by the European Union Emission Trading Scheme (EU ETS) in order to comply with their obligations to surrender EU Allowances, CERs or Emission Reduction Units (ERUs) for the CO_2 emissions of their installations. CERs can be held by governmental and private entities on electronic accounts with the UN. CERs can be purchazed from the primary market (purchazed from the original party that makes the reduction) or the secondary market (resold from a marketplace).

Check Your Progress 12.2

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What is the main role of the CDM Executive Board?

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.....

2) What are the main institutions involved in the structure of CDM?

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.....

3) What are the responsibilities of CDM consultants?

.....

.....

4) Who are CER buyers, and how can CERs be used?

.....

.....

12.4 GOALS OF CDM

The clean development mechanism was designed to meet a dual objective:

1 To help Annex I countries fulfil their commitments to reduce emissions in a cost-effective way, and to offset greenhouse gases.

2 To assist developing countries/host country in achieving sustainable development.

It has been observed that a huge amount of greenhouse gases (GHG) is emitted by developed countries due to industrial activity, and it needs to be reduced. The GHG emission reductions are many times more expensive to achieve in Annex I countries than in non-Annex I countries (the opportunities for emission reduction are bigger there). Therefore, a strong link is to be formed between these countries to meet the target for reducing GHG emissions.

CDM projects earn tradable, saleable certified emission reduction (CER) credits that can be used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. Benefits of CDM projects include investment in climate change mitigation projects in developing countries, transfer or diffusion of technology in the host countries, as well as improvement in the livelihood of communities through the creation of employment or increazed economic activity.

12.5 THE KYOTO PROTOCOL

The new protocol, known officially as the ***Kyoto Protocol to the UN Framework Convention on Climate Change,*** was adopted in Kyoto, Japan, on 11 December 1997 at the third Conference of the Parties to the UNFCCC. The Kyoto Protocol is significant because it legally binds greenhouse gas emission commitments for

the developed countries (this includes most of the developed countries listed in Annex I of the UNFCCC). The commitments agreed, according to the Protocol, lead to an overall global reduction of greenhouse gases in the coming years.

However, the Kyoto Protocol is far from a simple document. Not only the commitments themselves but also the mechanisms by which the developed country may achieve them are extremely complex. Although countries recognize the need to cut global emissions of carbon dioxide and the other GHGs to prevent dangerous global warming, many developed countries, aided by intensive public pressure from the fossil fuel industry, refused during the negotiations to agree to the kinds of cuts in their domestic greenhouse gas emissions that the science demands. The result was commitments in the Protocol which fall far short of what is really needed to protect the earth from major climatic changes.

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty that sets binding obligations on industrialized countries to reduce emissions of greenhouse gases. The treaty recognizes that developed countries have contributed the most to the anthropogenic build-up of carbon dioxide in the atmosphere (around 77% of emissions between 1750 and 2004), and that carbon dioxide emissions per person in developing countries (2.9 tons in 2010) are, on average, lower than emissions per person in developed countries (10.4 tons in 2010). According to the UNFCC website, the Protocol "recognizes that developed countries are principally responsible for the current high levels of GHG (6 greenhouse gases covered: CO_2, CH_4, N_2O, HFC, PFC, SF_6) emissions in the atmosphere as a result of more than 150 years of industrial activity, and places a heavier burden on developed nations under the principle of 'common but differentiated responsibilities."

As part of the Kyoto Protocol, many developed countries have agreed to legally reduce their emissions of greenhouse gases in two commitment periods. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh, Morocco, in 2001, and are referred to as the "Marrakesh Accords." Its first commitment period started in 2008 and ended in 2012. The second commitment period applies to emissions between 2013-2020. The protocol was amended in 2012 to accommodate the second commitment period, but this amendment has (as of January 2013) not entered into legal force. Fig. 12.3 shows the sector-wise annual world greenhouse gas emissions in 2021.

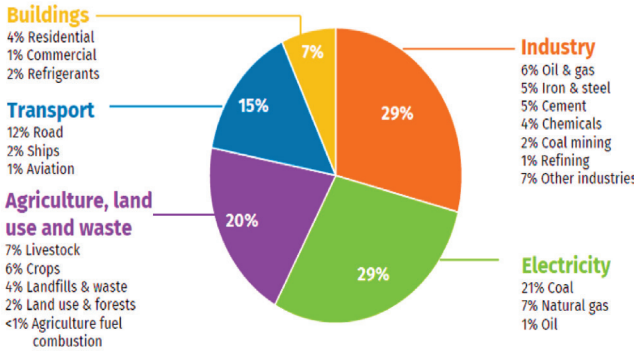

Fig. 12.3: Annual World Greenhouse Gas Emissions in 2021 (by sector)

(**Source:** *Rhodium Group*)

There are 192 parties to the convention: 191 states (including all the UN members except Andorra, Canada, South Sudan and the United States) and the European Union. The United States signed but did not endorse the Protocol, and Canada withdrew from it in 2011. The Protocol was adopted by Parties to the UNFCCC in 1997 and entered into force in 2005.

Some of the Principal Concepts of the Kyoto Protocol are:

1 Binding commitments for the Annex. I Parties. The main feature of the Protocol is that it established legally binding commitments to reduce emissions of greenhouse gases for Annex. I Parties. The commitments were based on the Berlin Mandate, which was a part of UNFCCC negotiations leading up to the Protocol.

2 Implementation. In order to meet the objectives of the Protocol, Annex I Parties are required to prepare policies and measures for the reduction of greenhouse gases in their respective countries. In addition, they are required to increaze the absorption of these gases and utilize all mechanisms available, such as joint implementation, the clean development mechanism and emissions trading, in order to be rewarded with credits that would allow more greenhouse gas emissions at home.

3 Minimizing Impacts on Developing Countries by establishing an adaptation fund for climate change.

4 Accounting, Reporting and Review in order to ensure the integrity of the Protocol.

5 Compliance Establishing a Compliance Committee to enforce compliance with the commitments under the Protocol.

Belarus, Kazakhstan and Ukraine have stated that they may withdraw from the Protocol or not put into legal force the Amendment with second round targets. Japan, New Zealand, and Russia have participated in Kyoto's first round but have not taken on new targets in the second commitment period. Other developed countries without second-round targets are Canada (which withdrew from the Kyoto Protocol in 2012) and the United States (which has not ratified the Protocol).

> *Parties to the Kyoto Protocol adopted an amendment to the Kyoto Protocol by decision 1/CMP.8 in accordance with Articles 20 and 21 of the Kyoto Protocol, at the eighth session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol held in Doha, Qatar, in December 2012.*

International emission trading allows developed countries to trade their commitments under the Kyoto Protocol. They can trade emissions quotas among themselves and can also receive credit for financing emissions reductions in developing countries. Developed countries may use emissions trading until late 2014 or 2015 to meet their first-round targets.

Developing countries do not have binding targets under the Kyoto Protocol, but are still committed to reducing their emissions. Actions taken by developed and developing countries to reduce emissions include support for renewable energy, improving energy efficiency, and reducing deforestation. Under the Protocol, emissions of developing countries are allowed to grow in accordance with their development needs.

The ultimate objective of the UNFCCC is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would stop dangerous anthropogenic interference with the climate system." For each of the different anthropogenic GHGs, different levels of emissions reductions would be required to meet the objective of stabilizing atmospheric concentrations. Carbon dioxide (CO_2) is the most important anthropogenic GHG. Stabilising the concentration of CO_2 in the atmosphere would ultimately require the effective elimination of anthropogenic CO_2 emissions.

12.5.1 Major Provisions and Commitments under the Kyoto Protocol

The Major Provisions and Commitments under the Kyoto Protocol are:

a) **Emission Commitments for the Developed Countries:** The emissions targets for the various developed countries are different - in other words, there is no single target that is the same for all developed countries. The USA, for example, has to reduce its emissions by seven per cent. The European Union and most of the Central and Eastern European countries have to reduce their emissions by eight per cent, Poland and Hungary by six per cent and Croatia by five per cent. Canada and Japan's target is a six per cent reduction. On the other hand, some countries are allowed to increaze their emissions, having argued that reductions would have an adverse impact on their national economies. These are Australia (an eight per cent increaze), Norway (one per cent) and Iceland (ten per cent). Russia, Ukraine and New Zealand argued successfully for targets that would allow their emissions to merely stabilise. The individual commitments are listed in Annex B of the Kyoto Protocol.

b) **Assigned Amounts, to be Achieved by a Fixed period/Country's Emission Budget:** Each developed country's commitment is phrased in the Protocol in terms of an *'assigned amount'*. Developed countries have to achieve their assigned amounts within the five-year period 2008-2012, this being the first *commitment period* agreed under the Protocol. So, *for example,* although the USA has to make a seven per cent reduction in its 1990 level of greenhouse gas emissions, its assigned amount is described as 93 per cent of its 1990 emissions, multiplied by the five years of the commitment period. The individual developed country commitments are listed in Annex B of the Kyoto Protocol.

c) **Commitments in 'CO_2 Equivalents':** Six greenhouse gases– carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) – are controlled under the Protocol. However, the commitments described above are not targets for each gas, but for all six gases added together in a 'basket' weighted by the relative effect of each gas. This means that a country can allow emissions of one greenhouse gas to increaze, so long as corresponding decreases are made in the emissions of other greenhouse gases, and the country's commitment is achieved.

   Assigned amounts are calculated using an estimate of the CO_2 equivalence of each gas, based on the global warming potentials (GWPs) of the six gases. GWPs are a measure of the amount of cumulative warming each gas delivers over different periods of time relative to CO_2. Methane,

nitrous oxide, HFCs, PFCs and SF_6 are all more powerful global warming gases than carbon dioxide and have higher GWPs–21 for methane, 310 for nitrous oxide, 1,300 for HFC-134a, 9,200 for perfluoroethane and 23,900 for SF_6 measured over 100 years. For the purposes of calculating assigned amounts, countries use the different GWPs to convert emissions of methane, nitrous oxide, HFCs, PFCs and SF_6 to their carbon dioxide equivalent.

One loophole written into the Protocol is that developed countries are allowed to choose either 1990 or 1995 as their base year for calculating emissions of HFCs, PFCs and SF_6. Emissions of HFCs were low in 1990 but had increased substantially in the majority of countries by 1995. Choosing 1995 allows these countries to increase their baseline emissions and thus their assigned amounts, and increases the total assigned amount for the developed countries by around 0.6-0.7 per cent.

d) **Calculation of Assigned Amounts:** The Protocol requires most developed countries to achieve their commitment using 1990 as a reference, or base year. Under the UNFCCC, countries with economies in transition (the former Soviet Union and Central and Eastern European countries) were allowed to choose a different base year because their emissions were declining by 1990, resulting in a lower emissions baseline. Emissions in the base year are calculated as the total amount of greenhouse gases resulting from the following sectors or *sources:* energy, industrial processes, solvent and other product use, agriculture and waste. These are known as 'gross' emissions.

For a Party to meet its emission commitments, its total emissions during the commitment period need to be less than its assigned amount. As a consequence of the mechanisms described above, the assigned amount can be added to or subtracted from. Below is a sample calculation of an assigned amount for the first commitment period, which includes all the provisions:

Assigned Amount = Total 'gross' greenhouse gases in the base or reference year (+/-) Emissions absorbed or released as a result of afforestation and reforestation activities since 1990 – Emissions releazed as a result of deforestation activities since 1990 (+/-) Emissions bought from or sold to other developed countries through emissions trading in 2008-2012 period (+/-)Emission reduction units transferred from host countries or to donor countries from Joint implementation projects in 2008-2012 period + Certified emission reductions resulting from CDM projects in host countries carried out from 2000-2012.

e) **Assigned Amounts which can be Achieved using 'Flexibility Mechanisms':** The Protocol allows developed countries to achieve their commitments in four ways:

Joint fulfilment, or 'bubble' agreements between developed countries (Article 4 of the Protocol), Joint Implementation (JI) between developed countries (Article 6), emissions trading between developed countries (Article 17) and through the Clean Development Mechanism (CDM) established under Article 12 (the flexibility mechanisms are described in detail later in this document). The first three all involve the developed

countries, that is, countries with legally binding commitments, and so although emissions are transferred between these countries, the overall global assigned amount (the "at least five per cent" reduction) is not changed. However, under the CDM, the developed countries can fund projects in developing countries, which bring about reductions in the greenhouse gases that would have been emitted in those countries if the project had not taken place. The developed countries can add these emissions 'credits' to their assigned amounts.

f) **Assigned Amounts which can be Achieved using 'Sinks':** Developed countries are allowed to achieve their assigned amounts using sinks in a limited form. The term '***Sinks***' refers to ***those natural processes that absorb carbon dioxide from the atmosphere***. These include oceans and forests. Growing forests absorb carbon dioxide from the atmosphere and store it, but deforestation releases stored carbon back into the atmosphere. In other words, sinks can become sources.

Under the Protocol, the emissions absorbed or emitted by certain land use, land use change and forestry (LULUCF) activities, which include afforestation, reforestation and deforestation activities caused by human activities, can be added to the developed country's assigned amount for the first commitment period. The result is an emissions total for the commitment period, which is 'net' of these emissions. Since the base year for the majority of countries is calculated in terms of 'gross' emissions from sources rather than 'net', the result is an increase in emissions to the atmosphere.

g) **'Banking' of Emissions:** If a developed country does not emit the whole of its assigned amount by the end of the commitment period, it is allowed to carry forward the unused portion to the next commitment period. This is known as **'banking'** of emissions.

h) **Ratification and Entry into Force:** The Kyoto Protocol becomes binding under international law (or 'enters into force') ninety days after 55 countries which are Parties to the UNFCCC have ratified it. It is then binding on these countries, and on any others which subsequently ratify it. These 55 countries must include Annex I Parties, which together account for 55 per cent of the carbon dioxide emitted by the Annex I countries in 1990. This means that no single country can block entry into force. Ratification can be a lengthy and time-consuming process. Every country has a different method of translating international agreements into domestic law. Getting legislative approval in many democracies can take years. Apart from the lack of specific details on key issues such as the flexibility mechanisms and sinks, the Kyoto Protocol has some serious omissions.

i) **Compliance Mechanism:** The Kyoto Protocol includes a commitment in Article 18 to develop a compliance mechanism. At present, the Protocol lacks a non-compliance mechanism with real substance or legally binding consequences if a Party fails to meet its emission commitments. A strong and effective non-compliance regime is crucial to the Protocol's ability to ensure real and measurable environmental benefits and emissions reductions and to maintain international credibility and confidence.

12.5.2 Limitations and Outstanding Issues in the Kyoto Protocol

Certain Issues are not Described in the Kyoto Protocol:

a) **Controls on International Aviation and Marine Transport Fuels (bunker fuels):** Emissions from international air and marine transport are not included in the emissions commitments under the Protocol, despite widespread recognition that these sources are growing rapidly. Since 1991, when negotiations first began on the UNFCCC, countries have been unable to agree on how to allocate these emissions between countries. As a result, emissions from these sectors are not included in the assigned amounts agreed at Kyoto. This is a significant loophole – Greenpeace estimates that if emissions from these sectors grow as predicted, at about three per cent per year.

b) **Specific Review of Emission Commitments:** The Protocol does not contain a specific review procedure for the emission commitments, despite intensive efforts by Greenpeace and other environmental groups at Kyoto. Such a review process is crucial to the success of the Protocol since, without it, there can be no assessment of its effectiveness, a procedure to strengthen the commitments in the future or adjustments made in the light of emerging science. The Protocol does provide for general reviews, linked to reviews of the UNFCCC, and these must be developed to allow specific reviews of the emissions commitments. This is another outstanding issue that must be addressed as soon as possible.

12.6 COOPERATIVE MECHANISM

Countries with commitments under the Kyoto Protocol to limit or reduce greenhouse gas emissions must meet their targets primarily through national measures. As an additional means of meeting these targets, the Kyoto Protocol introduced three market-based mechanisms, thereby creating what is now known as the "carbon market".

The Kyoto Mechanisms are:

- Emissions Trading
- The Clean Development Mechanism (CDM)
- Joint Implementation (JI)

The Kyoto Mechanisms:

1 Stimulate sustainable development through technology transfer and investment

2 Help countries with Kyoto commitments to meet their targets by reducing emissions or removing carbon from the atmosphere in other countries in a cost-effective way.

3 Encourage the private sector and developing countries to contribute to emission reduction efforts.

JI and CDM are the two project-based mechanisms that feed the carbon market. JI enables industrialized countries to carry out joint implementation projects with other developed countries, while the CDM involves investment in sustainable

development projects that reduce emissions in developing countries. The carbon market is a key tool for reducing emissions worldwide. It was worth 30 billion USD in 2006 and is growing. Annex I Parties must provide information in their national communications under the Protocol to demonstrate that their use of the mechanisms is "supplemental to domestic action" to achieve their targets. This information is assessed by the facilitative branch of the Compliance Committee.

Apart from the inadequate greenhouse gas emissions commitments, the Kyoto Protocol contains a number of provisions whose details were not resolved at the final negotiating session in Kyoto. These include the so-called flexibility mechanisms (emissions trading, joint implementation and the Clean Development Mechanism) and the use of sinks by developed country Parties to achieve their emission commitments. Within these provisions is the potential for a number of sizeable 'loopholes', elements which could sanction emission levels far above what was intended in Kyoto, and which have the potential to undermine and even overwhelm the Protocol's global reduction target of at least five per cent.

12.6.1 Emission Trading

Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare – emissions permitted them but not "used" – to sell this excess capacity to countries that are over their targets. The economics literature provides the following definitions of cap and trade emissions trading schemes.

A cap-and-trade system constrains the aggregate emissions of regulated sources by creating a limited number of tradable emission allowances, which emission sources must secure and surrender in numbers equal to their emissions.

In an emissions trading or cap-and-trade scheme, a limit on access to a resource (the cap) is defined and then allocated among users in the form of permits. Compliance is established by comparing actual emissions with permits surrendered, including any permits traded within the cap.

Under a tradable permit system, an allowable overall level of pollution is established and allocated among firms in the form of permits. Firms that keep their emission levels below their allotted level may sell their surplus permits to other firms or use them to offset excess emissions in other parts of their facilities.

Emissions trading, or cap and trade, is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. A central authority (usually a governmental body) sets a limit or cap on the amount of a pollutant that may be emitted. The limit or cap is allocated or sold to firms in the form of emissions permits, which represent the right to emit or discharge a specific volume of the specified pollutant. Firms are required to hold a number of permits (or allowances or carbon credits) equivalent to their emissions. The total number of permits cannot exceed the cap, limiting total emissions to that level. Firms that need to increase their volume of emissions must buy permits from those who require fewer permits.

The transfer of permits is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions. Thus, in theory, those who can reduce emissions most cheaply will do so, achieving the pollution reduction at the lowest cost to society.

There are active trading programmes for several air pollutants. For greenhouse gases, the largest is the European Union Emission Trading Scheme, whose purpose is to avoid dangerous climate change. In the United States, there is a national market to reduce acid rain and several regional markets for nitrogen oxides. Fig. 12.4 elaborates the carbon market. Markets for other pollutants tend to be smaller and more localized.

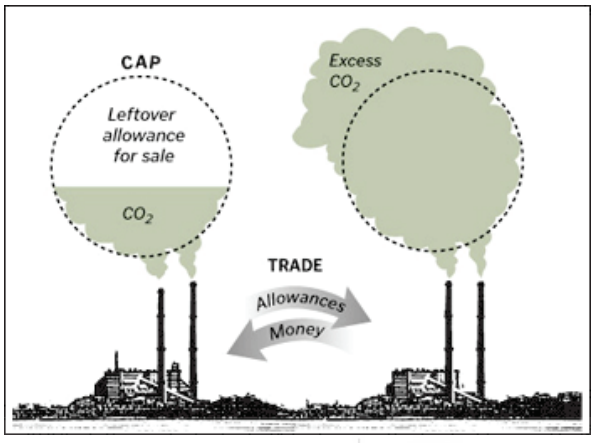

Fig. 12.4: Carbon Market

Emission Markets: For emissions trading where greenhouse gases are regulated, one emissions permit or allowance is considered equivalent to one metric ton of carbon dioxide (CO_2) emissions. Other names for emissions permits are carbon credits, Kyoto units, assigned amount units, and Certified Emission Reduction units (CER). These permits or units can be sold privately or in the international market at the prevailing market price. These trade and settle internationally, and hence allow allowances to be transferred between countries. Each international transfer is validated by the United Nations Framework Convention on Climate Change (UNFCCC). Each transfer of ownership within the European Union is additionally validated by the European Commission.

Trading exchanges have been established to provide a spot market in permits, as well as a futures and options market to help discover a market price and maintain liquidity. Carbon prices are normally quoted in euros per tonne of carbon dioxide or its equivalent (CO_2e). Other greenhouse gases can also be traded, but are quoted as standard multiples of carbon dioxide with respect to their global warming potential. These features reduce the quota's financial impact on business while ensuring that the quotas are met at a national and international level.

Currently, there are six exchanges trading in UNFCCC-related carbon credits: the Chicago Climate Exchange (until 2010), European Climate Exchange, NASDAQ OMX Commodities Europe, PowerNext, Commodity Exchange Bratislava and the European Energy Exchange. NASDAQ OMX Commodities Europe listed a contract to trade offsets generated by a CDM carbon project called Certified Emission Reductions.

Trading in emission permits is one of the fastest-growing segments in financial services in the City of London, with a market estimated to be worth about €30 billion in 2007. Louis Redshaw, head of environmental markets at Barclays Capital, predicts that "Carbon will be the world's biggest commodity market, and it could become the world's biggest market overall."

12.6.2 Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO_2, which can be counted towards meeting Kyoto targets. The mechanism is seen by many as a trailblazer. It is the first global, environmental investment and credit scheme of its kind, providing standardised emissions offset instruments, CERs.

CDM is intended to meet two objectives: (1) to assist parties not included in Annex I 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 dangerous climate change; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments.

A CDM project activity might involve, for example, a rural electrification project using solar panels or the installation of more energy-efficient boilers. The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets.

Operating Details of the CDM

A CDM project must provide emission reductions that are additional to what would otherwise have occurred. The projects must qualify through a rigorous and public registration and issuance process. Approval is given by the Designated National Authorities. Public funding for CDM project activities must not result in the diversion of official development assistance. The mechanism is overseen by the CDM Executive Board, answerable ultimately to the countries that have ratified the Kyoto Protocol.

Operational since the beginning of 2006, the mechanism has already registered more than 1,650 projects and is anticipated to produce CERs amounting to more than 2.9 billion tonnes of CO_2 equivalent in the first commitment period of the Kyoto Protocol, 2008-2012.

The CDM allows industrialized countries to buy CERS and to invest in emission reductions where it is cheapest globally. Between 2001, which was the first year a CDM project could be registered and 7 September 2012, the CDM issued 1 billion Certified Emission Reduction units. As of 1 June 2013, 57% of all CERS had been issued for projects based on destroying either HFC-23 (38%) or N_2O (19%). Carbon capture and storage (CCS) was included in the CDM carbon offsetting scheme in December 2011.

The purpose of the CDM is to promote clean development in developing countries, *i.e.,* the non-Annex I countries (countries that aren't listed in Annex I of the Framework Convention). The CDM is one of the Protocol's "project-based mechanism", in that the CDM is designed to promote projects that reduce emissions. The CDM is based on the idea of emission reduction production. These reductions are produced and then subtracted from a hypothetical baseline of emissions. The emissions baselines are the emissions that are predicted to

occur in the absence of a particular CDM project. CDM projects are "credited" against this baseline, in the sense that developing countries gain credit for producing these emission cuts.

12.6.3 Joint Implementation

The mechanism known as "joint implementation," defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO_2, which can be counted towards meeting its Kyoto target. Joint implementation offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer.

JI is one of three flexibility mechanisms set out in the Kyoto Protocol to help countries with binding greenhouse gas emissions targets (so-called Annex I countries) meet their obligations. JI is described in Article 6 of the Kyoto Protocol. Under Article 6, any Annex I country can invest in an emission reduction project (referred to as a "Joint Implementation Project") in any other Annex I country as an alternative to reducing emissions domestically. In this way, countries can lower the costs of complying with their Kyoto targets by investing in projects that reduce greenhouse gas emissions in an Annex I country where reducing emissions may be cheaper, and then using the resulting Emission Reduction Units (ERUs) towards their commitment goal. The mechanism known as "joint implementation," defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO_2, which can be counted towards meeting its Kyoto target. Joint implementation offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer.

JI is a programme under the Kyoto Protocol that allows industrialized countries to meet part of their required cuts in greenhouse-gas emissions by paying for projects that reduce emissions in other industrialized countries. Unlike the case of the Clean Development Mechanism, the JI has caused less concern of spurious emission reductions, as the JI project, in contrast to the CDM project, takes place in a country that has a commitment to reduce emissions under the Kyoto Protocol.

A JI project must provide a reduction in emissions by sources or an enhancement of removals by sinks. Projects must have approval of the host Party, and participants have to be authorized to participate by a Party involved in the project. Projects starting from the year 2000 may be eligible as JI projects if they meet the relevant requirements, but ERUs may only be issued for a crediting period starting after the beginning of 2008.

If a host Party meets all of the eligibility requirements to transfer and/or acquire ERUs, it may verify emission reductions or enhancements of removals from a JI project. Upon such verification, the host Party may issue the appropriate quantity of ERUs. This procedure is commonly referred to as the "Track 1" procedure."

If a host Party does not meet all, but only a limited set of eligibility requirements, verification of emission reductions or enhancements of removals as being additional has to be done through the verification procedure under the Joint Implementation Supervisory Committee (JISC). Under this so-called "Track 2" procedure, an independent entity accredited by the JISC has to determine whether the relevant requirements have been met before the host Party can issue and transfer ERUs. A host Party that meets all the eligibility requirements may at any time choose to use the verification procedure under the JISC (Track 2 procedure).

12.7 CDM AND SUSTAINABLE DEVELOPMENT

In addition to reducing GHG emissions and promoting technology transfer, CDM projects can help bring economic development and broader environmental benefits to poor regions of the world. *For example,* a renewable energy project in rural Africa can create employment opportunities, improve lighting and refrigeration for medicines, provide water purification, and prevent deforestation from the harvesting of fuel wood and the operation of polluting diesel generators. While there may be such co-benefits for many projects, by most accounts, explicit systems have not been established to ensure that the CDM's sustainable development goals are achieved. The UN defines sustainable development as a strategy that "meets the needs of the present without compromizing the ability of future generations to meet their own needs." However, the Kyoto Protocol does not define sustainable development explicitly, nor does it provide guidance on how it should be achieved or measured within the CDM. As such, the promotion of sustainable development under the CDM is largely delegated to host developing country governments, acting through their DNAs. To support host country governments in their decision-making process, the CDM requires that project proposals include an explanation of how they contribute to sustainable development.

Yet there are few, if any, cases of projects being rejected by host country DNAs, which could be seen as an indication that national sustainable development criteria are insufficiently ambitious or are not being rigorously applied by DNAs.

Most developing countries do not appear to favour projects with high sustainable development benefits over other projects that have few or no sustainable development benefits. Developing countries have few incentives to apply stringent criteria for sustainable development since they are effectively competing for CDM projects with other developing countries. More stringent standards could raise the cost of projects and deter potential investors. The CDM review process does include procedures to ensure projects do not cause adverse economic, social, or environmental harm. Yet, few procedures exist to ensure that projects produce social and environmental sustainable development benefits. Until more specific sustainable development criteria at the global or national level are introduced, it is difficult to objectively assess to which the CDM contributes to this goal.

Early in the CDM programme, a significant fraction of the emission reductions have come from a few large projects that reduced GHG emissions at low cost, for example, industrial HFC and N_2O abatement projects, but which delivered limited sustainable development benefits other than reduced GHGs. Although

these projects produced high-quality offsets at a low cost, they did little to introduce innovative technologies, reduce other forms of pollution, or otherwise benefit local communities. Similarly, the vast majority of CDM project investment has gone to a few relatively larger economies in the developing world, by passing the poorest countries that are arguably in greater need of assistance. The international offset market will naturally gravitate towards emission reduction opportunities with the lowest cost (including transaction costs such as those related to obtaining approval from host country DNAs), and no quotas currently exist for how many reductions can come from particular countries or geographic regions. The offset market has therefore targeted countries (see Fig. 12.5) with the greatest emission-reduction potential and favourable investment climates (*e.g.* China, India, Brazil, and Mexico).

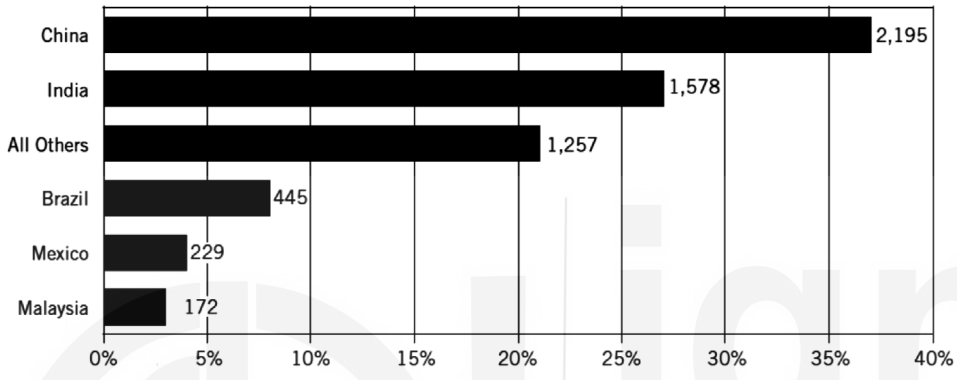

Fig. 12.5: Number of Projects by Host Country

Arguably, the limited success of the CDM in achieving its sustainable development goals can be partially attributed to the insistence of national governments on preserving sovereignty over their own domestic development decisions. The autonomy of each country's Designated National Authority (DNA) to approve or reject projects is *an example* of this. Consequently, the lack of emphasis on sustainable development should not be attributed solely to the CDM programme, nor should it be a rationale for rejecting the CDM as a source of international offsets. Furthermore, as most of the low-hanging fruit have already been picked, more investment has recently gone into energy efficiency and renewable energy projects (*i.e.,* projects with greater potential for promoting low-emission economic development) instead of the large industrial GHG capture and destruction projects. Numerous changes to the CDM are also underway that could lead to more projects that contribute to sustainable development, including the adoption of rules to allow a "programme of activities" or "programmatic CDM" (*e.g.,* multiple small-scale energy efficiency improvements).

12.8 CDM RULES AND CONDITIONS

There are several important rules of the CDM. Three examples are: 1) Nuclear facilities cannot be used to generate CERs, 2) Only afforestation and reforestation projects are allowed under the CDM. *For example,* projects that reduce deforestation are not allowed, and 3) ODA must not be diverted to fund CDM projects.

1. Annex 1 parties are to refrain from using certified emissions reductions generated from nuclear facilities to meet their quantified greenhouse gas emission reduction targets.

2. The eligibility of land use, land-use change and forestry project activities under the CDM is limited to afforestation and reforestation.

3. Public funding for CDM projects from annex I parties is not to result in the diversion of official development assistance and is to be separated from, and not counted towards, the financial obligations of Annex 1 Parties.

> Official development assistance can be, and is being, used to prepare CDM projects.
>
> *For example,* the Danish government has used its ODA in select countries to help develop CDM projects. Then, other non-ODA funds have been used by the Danish government and the private sector to actually buy the carbon credits generated by the CDM project.

Check Your Progress 12.3

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What are the three market-based mechanisms introduced under the Kyoto Protocol?

.....

.....

2) What is Emissions Trading as per the Kyoto Protocol?

.....

.....

3) What is the meaning of "Banking of Emissions"?

.....

.....

4) How does CDM contribute to sustainable development in developing countries?

.....

.....

12.9 LET US SUM UP

The Clean Development Mechanism (CDM) is a unique and practical solution under the Kyoto Protocol that connects climate responsibility with global cooperation. CDM enables developed countries to meet part of their emission reduction targets by funding environmentally beneficial projects in developing countries. These projects– such as afforestation, renewable energy initiatives, or energy-efficient technologies– not only reduce greenhouse gas emissions but also bring social and economic benefits to the host nations.

The structure of the CDM includes key organizations such as the UNFCCC Secretariat, Designated Operational Entities (DOEs), and Designated National Authorities (DNAs). The CDM Executive Board supervises the process and ensures the integrity of emission reduction efforts. By aligning with the goals of

the Kyoto Protocol, the CDM supports sustainable development and promotes clean technologies and innovation in emerging economies.

12.10 KEY WORDS

Annex. I Countries : Industrialised countries with binding emission reduction targets under the Kyoto Protocol.

Certified Emission Reductions (CERs) : Carbon credits earned from CDM projects, each representing one tonne of CO_2 avoided or reduced.

Clean Development Mechanism (CDM) : A mechanism under the Kyoto Protocol allowing developed countries to invest in emission-reducing projects in developing countries and earn Certified Emission Reductions (CERs).

Designated National Authority : A national body responsible for approving CDM projects and ensuring they align with local sustainable development goals.

Designated Operational Entity : An independent third-party body that validates and verifies CDM projects.

Emission Trading : A market-based system allowing countries or companies to trade carbon credits to meet emission reduction targets.

Kyoto Protocol : An international treaty that commits developed countries to legally binding targets for reducing greenhouse gas emissions.

Sustainable Development : Development that meets present needs without compromising the ability of future generations to meet theirs.

UNFCCC : The United Nations Framework Convention on Climate Change, the umbrella treaty guiding international climate negotiations and action.

12.11 SUGGESTED FURTHER READINGS/ REFERENCES

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12.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 12.1

1) The Clean Development Mechanism (CDM) is a system under the Kyoto Protocol that allows developed countries (Annex I countries) to invest in emission-reduction projects in developing countries and earn Certified Emission Reductions (CERs) to meet their own emission reduction targets.

2) The main purpose of the CDM is to help developed countries meet their emission reduction commitments and to assist developing countries in achieving sustainable development.

3) Certified Emission Reductions (CERs) are tradable credits earned from CDM projects, each equivalent to one ton of CO_2 reduced, which can be used by developed countries to fulfil their emission reduction obligations.

4) The CDM lowers costs by allowing developed countries to invest in emission reductions where it is cheaper and more efficient, typically in developing countries, rather than relying solely on expensive domestic measures.

Check Your Progress 12.2

1) The CDM Executive Board is responsible for approving CDM projects, granting Certified Emission Reductions (CERs), and supervising the overall implementation of the Clean Development Mechanism under the authority of the Conference of the Parties (CMP).

2) The main institutions include the UNFCCC Secretariat, COP/CMP, Designated Operational Entity (DOE), Designated National Authority (DNA), Executive Board, Panels and Working Groups, Consultants, and CER Buyers.

3) DM consultants prepare and revise the Project Design Document (PDD), coordinate with DOEs for validation, monitor project progress, and ensure compliance with UNFCCC registration requirements.

4) CER buyers can be governments or private entities that purchase CERs to meet their emission reduction targets under the Kyoto Protocol or compliance obligations under schemes like the EU Emission Trading System (EU ETS). CERs can be traded in primary or secondary markets.

Check Your Progress 12.3

1) Emissions Trading, Clean Development Mechanism (CDM) and Joint Implementation (JI)

2) A system where countries with surplus emission allowances can sell their excess capacity to countries that are over their targets, promoting cost-effective emission reductions.

3) It allows countries to carry forward unused emission allowances from one commitment period to the next.

4) CDM promotes technology transfer, investment, and local employment, while improving livelihoods through clean energy and environmental protection.

UNIT 13 PROJECT DESIGN AND DEVELOPMENT CYCLE

Structure

13.0 Objectives

13.1 Introduction

13.2 Project Design Document (CDM-PDD)

13.3 Project Design and Formulation

13.4 Types of Project

13.5 National Approval

13.6 Designated National Authorities

13.7 Duties of the DNA

13.8 Validation/Registration

13.8.1 Validation

13.8.2 Registration

13.9 Project Financing

13.10 Monitoring

13.11 Verification

13.12 Certification

13.13 Issuance of Certified Emission Rate (CER)

13.14 CDM Programme of Activity

13.15 General Description of Project Activity

13.16 Baseline Methodology

13.17 Crediting Period

13.18 Monitoring Methodology and Plan

13.19 Calculation of GHG Emission by Sources

13.20 Emission Factors

13.21 Global Warming Potential

13.22 Environmental Impacts

13.23 Let Us Sum Up

13.24 Key Words

13.25 Suggested Further Readings/References

13.26 Answers to Check Your Progress

ignou THE PEOPLE'S UNIVERSITY

13.0 OBJECTIVES

After going through this Unit, you will be able to:

- identify various types of projects, design and their formulations;
- discuss the purpose of the Clean Development Mechanism (CDM);
- state the duties of the Designated National Authorities (DNA);
- describe the roles and responsibilities of key CDM entities such as UNFCCC Secretariat, COP/CMP, DOE, DNA, and Executive Board;
- examine the general description of the project activity;
- find out the GHG emission by sources and various factors of emission; and
- understand global warming potential and its environmental impacts.

13.1 INTRODUCTION

Have you ever wondered how major environmental projects are systematically planned and implemented to reduce global emissions? Or how countries ensure that climate-friendly initiatives, especially under international frameworks like the Clean Development Mechanism (CDM), are both environmentally sound and economically viable?

In today's global climate policy landscape, the CDM plays a key role by allowing developed countries to invest in greenhouse gas emission reduction projects in developing countries and receive Certified Emission Reductions (CERs) in return. But before any CERs are issued, the project must go through a structured and detailed project design and development cycle.

This Unit introduces you to the technical and administrative process of developing a CDM project. From preparing a Project Design Document (PDD) to obtaining national approval, and from monitoring greenhouse gas emissions to verifying reductions, each step is essential for ensuring that the project aligns with global climate goals and generates measurable benefits.

By exploring this Unit, you will not only understand the technical elements of project design but also learn about various project types, the roles of national and international authorities, and the regulatory procedures involved in transforming an idea into a registered CDM activity. This understanding is crucial for future business managers and administrators who may engage in sustainability and carbon finance projects at the organizational or policy level.

13.2 PROJECT DESIGN DOCUMENT (CDM-PDD)

The project design document (PDD) form was developed by the Executive Board on the basis of Appendix B of the CDM modalities and procedures. Project participants shall submit information on their proposed CDM project using the CDM-PDD form.

The segment on project design and plan controls the onlooker through the substance needed in PDD, which must be made for every CDM project. It likewise depicts the methodology for small-scale CDM projects. The section has a subsection for every single item that is required in the PDD. Each subsection explains each step of the CDM project cycle.

PDD not only describes the seven-step activities of the CDM project cycle but also the institutions involved in the process and the reports that need to be produced. Project participants are the parties to the Kyoto Protocol/a private/ or public entity accredited by a party to participate in CDM projects under the Party's liability.

13.3 PROJECT DESIGN AND FORMULATION

The CDM Project Cycle is Completed in Seven Different Steps:

Step 1: Design and Formulation (it includes the formation of PDD)

Step 2: National Approval

Step 3: Validation

Step 4: Financing

Step 5: Monitoring

Step 6: Verification/Certification

Step 7: CER Issued

Some of the activities for the CDM project cycle are the same as those of other investment projects. Despite these activities, there are some unique steps for the CDM project which include steps to generate emission credits, such as baseline setting, validation, registration, monitoring and verification/certification of emissions reduction.

Contents Required for the Project Design Document (PDD):

a) General description of project activity

b) Baseline methodology

c) Duration of project activity/crediting period

d) Monitoring methodology and plan

e) Calculation of GHG emissions by sources

f) Environmental impacts

g) Stakeholder comments

Annex. 1. Contact information on project participants

Annex. 2. Information regarding public funding

Annex. 3. New baseline methodology

Annex. 4. New monitoring methodology

Annex. 5. Table of baseline data

For the small-scale CDM Annex 3-5 are not compulsory, but Annex 3-4 are included in two separate stand-alone forms.

13.4 TYPES OF PROJECT

There are three types of projects referred to as CDM projects. These types have since been amended by 1/CMP.2, paragraph 28. The CDM projects are divided into three categories:

1. Renewable Energy Projects

- Electricity generation by the user/household
- Mechanical energy for the user/enterprize
- Thermal energy for the user
- Electricity generation for a system

Renewable energy project activities with a maximum output capacity equivalent to 15 megawatts (or an appropriate equivalent). "Maximum output" is defined as: Installed/rated capacity, as indicated by the manufacturer of the equipment or plant, disregarding the actual load factor of the plant

2. Energy efficiency improvement projects

- Supply-side energy efficiency improvements– transmission and distribution activities
- Supply-side energy efficiency improvements - generation
- Demand-side energy efficiency programmers for specific technologies
- Energy efficiency and fuel switching measures for industrial facilities
- Energy efficiency and fuel switching measures for buildings

Energy efficiency improvement projects are the activities that reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 60 gigawatt hours per year.

Energy efficiency is defined as: the improvement in the service provided per unit power, that is, project activities which increase unit output of traction, work, electricity, heat, light (or fuel) per MW input are energy efficiency project activities.

"Energy consumption" is defined as: the consumption reduced and measured in watt-hours with reference to an approved baseline. Lower consumption as a result of lower activity shall not be taken into consideration.

3. Other Project Activities

- Agriculture K. Switching to fossil fuels
- Emission reductions in the transport sector
- Methane recovery

Agricultural projects, fuel switching, industrial processes and waste management are some examples under this category. Possible examples in the agricultural sector include improved manure management, reduction of enteric fermentation, improved fertiliser usage or improved water management in rice cultivation.

Other project activities may qualify, although methodologies for these activities would need to be developed: Other project activities that could

qualify include CO_2 recycling, carbon electrodes, adipic acid production and the use of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) making reference to the emission reductions generated by such projects expressed in CO_2 equivalent. In order for these to be calculated in a consistent and transparent manner, appropriate baseline methodologies need to be developed.

These categories are reviewed at least once a year and updated as necessary. The Executive Board shall review and amend, as necessary, Appendix B at least once a year. Any amendments to Appendix B shall apply only to project activities registered subsequent to the date of amendment and shall not affect registered CDM project activities during the crediting periods for which they are registered. These three project types are mutually exclusive – that is, project activities that contain more than one component must meet the eligibility criteria relevant to each component. It is not sufficient that a project activity come within the Type (i) limits for its renewable energy component if it exceeds the Type (iii) limits for its agricultural component.

The Board agreed that the three types of project activities outlined in decision 17/CP.7, paragraph 6 (c), are mutually exclusive. In a project activity with more than one component that will benefit from simplified CDM modalities and procedures, each component shall meet the threshold criterion of each applicable type, *e.g.,* for a project with both a renewable energy and an energy efficiency component, the renewable energy component shall meet the criterion for "renewable energy" and the energy efficiency component that for "energy efficiency".

The Board reaffirmed that, as stipulated in the simplified modalities and procedures for small-scale CDM project activities, the three types of eligible small-scale project activities are mutually exclusive and that project participants submitting new categories of projects should first consider whether these belong to type-I (renewable energy projects), to type-II (energy efficiency improvements) and, if not eligible under the two previous types, to type-III (other small-scale CDM project activities). Where a project activity comprises multiple components of the same type, the combined size of the components must not exceed the limits set out above:

The Board agreed that the sum of the size of components of a project activity belonging to the same type (capacity for type-I, energy savings for type-II and emission reductions for type-III) should not exceed the limits for small-scale CDM project activities as stated in paragraph 28 of the decision - /CMP 2 (*e.g.,* the limit for methane recovery component is 60 $ktCO_2$ e/yr and the limit for the electricity production component is 15 MW output capacity).

In Table 13.1, all the CDM projects are grouped into types that are sorted according to descending frequency in the Pipeline. The accumulated 2012 CERs are the total GHG reduction in the projects from the start of the crediting period until the end of 2012.

EE - industry has been split into EE - own generation, where electricity is produced from waste gas or wasted energy, and EE - industry, which now only covers end-use savings.

Table 13.1: CDM Projects are Grouped into Types

Type	Number		CERs/yr (000)		2012 CERs (000)		CERs Issued (000)	
Wind	2625	30%	239851	19%	280692	13%	145166	10%
Hydro	2277	26%	337303	27%	344776	16%	184597	13%
Biomass energy	815	9%	55880	5%	116867	5%	41445	3%
Methane avoidance	727	8%	30899	3%	73214	3%	21374	1%
Landfill gas	413	5%	58960	5%	173270	8%	55368	4%
EE own generation	409	5%	53094	4%	133400	6%	67957	5%
Solar	416	4.8%	14015	1.1%	4194	0.2%	1286	0.09%
EE Industry	139	1.6%	5577	0%	9246	0%	2985	0.2%
Fossil fuel switch	139	1.6%	73140	6%	129299	6%	49587	3%
EE Supply side (power plants)	117	1.3%	57035	5%	15532	1%	3171	0.2%
N_2O	108	1.2%	57634	5%	249223	11%	271246	19%
Coal bed/ mine methane	107	1.2%	69045	6%	84900	4%	34536	2.4%
EE Households	103	1.2%	3891	0.3%	2856	0.1%	424	0%
Afforestation & Reforestation	66	0.8%	4563	0.4%	18147	0.8%	10924	1%
Fugitive	59	0.7%	51118	4%	54099	2%	22973	1.6%
EE Service	36	0.4%	605	0.05%	334	0.02%	9	0%
Transport	34	0.4%	4727	0.4%	4819	0.2%	1146	0.1%
Geothermal	35	0.4%	12401	1%	12957	1%	7444	0.5%
Cement	28	0.3%	4396	0%	21585	1%	3024	0.2%
Energy distrib.	28	0.3%	10274	1%	5974	0%	1501	0%
HFCs	23	0.3%	81334	7%	473629	21%	519593	36%
PFCs and SF6	18	0.2%	5540	0%	11365	0.5%	4481	0.3%
Mixed renewables	10	0.11%	544	0.0%	116	0.01%	16	0%
CO_2 usage	3	0.03%	80	0.0%	155	0.01%	10	0.001%
Tidal	1	0.01%	315	0.0%	474	0.02%	433	0%
Agriculture	2	0.02%	58	0.0%	1	0%		

Total	8738	100%	1232281	100%	2221572	100%	1450693	100%
HFCs, PFCs, SF_6 & N_2O reduction	149	1.7%	144508	12%	734217	33%	795316	55%
Renewables	6179	71%	660311	54%	760075	34%	380388	26%
CH_4 reduction & Cement & Coal mine/ bed	1339	15%	214556	17%	407673	18%	137286	9.5%
Supply-side EE	554	6%	120403	10%	154905	7%	72628	5.0%
Fuel switch	139	1.6%	73140	5.9%	129299	5.8%	49587	3.4%
Demand-side EE	278	3.2%	10073	0.8%	12437	0.6%	3418	0.2%
Afforestation & Reforestation	66	0.8%	4563	0.4%	18147	0.8%	10924	1%
Transport	34	0.4%	4727	0.4%	4819	0.2%	1146	0.08%

13.5 NATIONAL APPROVAL

The government of a developing country is accountable for screening the CDM projects and deciding whether a project meets the requirements of sustainable development. Therefore, the host country must develop national criteria and requirements that ensure a coherent, justifiable and transparent assessment. Further, it is important that these criteria are in agreement with the nation's development priorities.

A country wishing to participate in the CDM must appoint a national CDM authority to access, approve and may serve as the point of contact. The general guidelines on baselines and additionality have been given; it is the responsibility of the developing country to determine the national criteria for project approval.

13.6 DESIGNATED NATIONAL AUTHORITIES

A designated national authority (DNA) is the organisation granted responsibility by a Party to authorize and approve participation in CDM projects. Establishment of a DNA is one of the requirements for participation by a Party in the CDM. The main task of the DNA is to assess potential CDM projects to determine whether they will assist the host country in achieving its sustainable development goals, and to provide a letter of approval to project participants in CDM projects. This letter of approval must confirm that the project activity contributes to sustainable development in the country, that the country has ratified the Kyoto Protocol, and that participation in CDM is voluntary. It is then submitted to the CDM Executive Board to support the registration of the project. DNA has additional roles to play, such as the submission of proposed standardized baselines for their country, among others. These responsibilities have increazed as the CDM has evolved. A host nation must designate a national authority, which will have the obligation to choose whether the undertaking movement makes a commitment to attaining the nation's sustainable development goal

and whether the host country agrees to participate in the project. One important factor in establishing a DNA is institutional sustainability, and consequently, this depends on the legal status of the institution, revenue generated, the ability to self-finance to institution and its level of activity.

There are a number of possible approaches for developing DNA, and it must take into account the needs and resources of each country. Some lessons can be learned from the National AIJ (activities implemented jointly) entities that were created under the pilot phase. Various approaches to developing the DNA are described briefly as under:

1) Single Government Department Model

All the activities of DNA are undertaken by one department or ministry, most likely the environmental department. As the CDM projects might involve different sectors and their validation requires specific technical expertize, and therefore the department may seek help from other technical experts of government agencies/ministries upon demand. The experts may form a group together and collaborate with the DNA secretariat to evaluate and validate the project. Thus, it is the sole responsibility of the secretariat for the approval of CDM projects.

2) A Two-Unit Model

In some cases, it is suitable to split the activities of DNA into two parts. The first part could be located in the department responsible for climate change, while the second part could be an independent unit. This separation responds to the concern of avoiding possible conflicts of interest in the process of project formulation and approval.

3) Inter-Departmental Government Model

This requires establishing a structure that allows all the relevant departments of government to be integrated together as permanent members of DNA. The Ministry of Environment can act as a coordinator, but all member departments undertake the approval of projects. A committee can be set up to initiate this approval. The coordinator acts as the registration office and thus receives project proposals on behalf of the DNA. The coordinator then communicates with other DNA members.

4) Foreign Direct Investment – Piggyback Model

The majority of the nations have an FDI institutional framework, which promotes foreign financing. Commonly, this embodies a promotional office and an approval or implementation office. These institutions get ventures from foreign investors and assess and sanction projects utilizing pre-structures criteria which, to a great extent, reflect the national development priorities.

The FDI framework could thus conform to the CDM and can be used as DNA. This makes it possible for the investment office to receive and approve projects. The investment office receives projects from different areas and has an established system for handling these.

5) Outsourcing Model

Many DNA services can be outsourced by the host country to various private agencies. This agency evaluates and validates the DNA services. The agency would report to a government agency that plays the role of DNA, and then the government would forward the project approval letter to the DOE.

13.7 DUTIES OF THE DNA

The following are the Duties of the DNA:

1) Receive, process and consider applications for CDM project approvals submitted in terms of these regulations.

2) Apply the approval procedures in terms of this regulation for all CDM projects received for approval, provided that such projects do not transgress any laws of Belize.

3) Consider all applications for approval by project proponents on Project Design.

4) Documents and, where appropriate, provide comments on Project Design Documents.

5) Issue Letters of Approval to Project Proponents in respect of Clean Development Mechanism Projects.

6) Establish and maintain a register of Designated Operational Entities entitled to validate, verify and certify CDM projects in Belize as contemplated in paragraph 27 of the annexe to the decision.

7) Liaise with and render such assistance as may be necessary to any Designated Operational Entity referred to in paragraph.

8) Establish and maintain a register of all Belize CDM projects validated, verified or certified in terms of the Kyoto Protocol and the Decision; and

9) Perform such other functions or duties as may be required to give effect to the provisions of the Kyoto Protocol.

Check Your Progress 13.1

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What is the Project Design Document (PDD) in the CDM framework?

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2) What are the seven steps of the CDM project cycle?

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3) Mention any three models of establishing a DNA in a developing country.

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4) Name any three duties of the DNA.

.....

.....

13.8 VALIDATION/REGISTRATION

Validation and registration are key stages in the CDM project cycle that ensure transparency, credibility, and compliance with the Kyoto Protocol. The process begins with validation, as explained below.

13.8.1 Validation

A designated operational entity (DOE) that is selected by the project participants will then review the PDD and ask for feedback from NGOs. After receiving the feedback, the DOE has to decide whether the project should be validated or not. These DOEs can be auditing and accounting firms, consulting companies, and law firms that have the ability to conduct acceptable and independent assessments of emission reductions. If the project is validated, the DOE will forward it to the Executive Board for formal registration. The DOE shall review the PDD to confirm if:

1. Parties in the project have ratified the Kyoto Protocol.
2. The PDD has been openly accessible, and remarks have been welcomed from the nearby stakeholders for a period of 30 days. A synopsis of the remarks is provided with the report on how due record was taken of any remarks.
3. Project participants have submitted to the DOE the dissection of the ecological effect of the task and, if the effects are viewed as critical, have attempted a natural effect evaluation succeeding the system of the host party.
4. The baseline and monitoring methodologies are among those already approved by the EB, or a new methodology.

The DOEs can be approved for 15 sectional scopes. The definition of scope is based on the list of sectors in Annex 1 of the Kyoto Protocol. These 15 scopes are:

1. Energy Industries
2. Energy Distribution
3. Energy Demand
4. Manufacturing Industries
5. Chemical Industries
6. Constructional
7. Transport
8. Mining/Mineral Production
9. Metal Production
10. Fugitive Emissions from Fuels
11. Fugitive Emissions from the Production and Consumption of Halocarbons and Sulphur Hexafluoride

12. Solvents Use
13. Waste Handling and Disposal
14. Afforestation and Reforestation
15. Agriculture

13.8.2 Registration

In accordance with the modalities and procedures for the CDM: "Registration is the formal acceptance by the Executive Board of a validated project as a CDM project activity. Registration is the prerequisite for the verification, certification and issuance of CERs related to that project activity".

In order to apply for registration of a CDM project activity, the DOE conducting the validation must submit a request for registration to the Executive Board, which requires the DOE to:

1. Submit to the Executive Board, if it determines the proposed project activity to be valid, a request for registration in the form of a validation report, including the project design document, the written approval of the host Party, and
2. An explanation of how it has taken due account of comments received.

   The Executive Board has since clarified that the registration request must be submitted using the CDM project activity registration and validation report form (F-CDM-REG). The requirements of F-CDM-REG conform to the requirements, so submission of this completed form with the necessary attachments will satisfy, and no separate reports are required.

F-CDM-REG requires the following information to be completed and/or attached:

1. *Section 1:* basic project information (the name of the project, the name of the DOE submitting the request for registration, the names of the project participants and the sector into which the project falls);
2 *Section 2:* summary of validation findings (the PDD, the validation report and the CVs of validation team members must be attached);
3 *Section 3:* further documents (the letters of approval and the modalities of communication must be attached); and
4 *Section 4:* a declaration that the DOE has no conflict of interest in relation to the project.
5. The fees for the registration of the CDM project should be paid to EB. It is decided that the registration fees for small-scale CDM projects have to be reduced to US$5000 and an increaze of up to US$30000 for other projects, according to the annual emission reduction of the CDM project.

This fee should be paid up-front for examining the CDM project for the issuance of the CERs; the fees will be deducted from the shares.

After a registration request is submitted by the DOE and the registration fee is paid, the secretariat endeavours to begin the registration process as soon as possible. The first step is the completeness check, scheduled for 7 days, followed by the information and reporting check, scheduled for 23 days. The relevant checklists may be viewed at this stage.

If a registration request does not meet the checking requirements, it is considered incomplete, and the responsible DOE and project participants are notified accordingly. In this case, the registration request may be resubmitted with revised documentation and will then be treated as a new submission.

Only after the successful completion of both checks is the registration request published on the CDM website and presented to the CDM Executive Board. Parties involved in the project or members of the CDM Executive Board may request a review of any project within the first 28 days of publication. If a Party involved or at least three members of the CDM Executive Board do so, the registration request will go under review. Otherwise, the secretariat will take action to register the project.

13.9 PROJECT FINANCING

Financing for the project is a crucial and common part of project implementation for every project. With the validation and registration of the project, developers need to take action to implement the project that will generate emission reduction credits and benefits to create financial income.

There are many sources of funding for the CDM projects. The project developer should properly manage any potential risks from various sources that might evolve due to funding. This risk may be project risk, political risk and market risk. The project risk is the risk that includes whether the project will meet the requirements of the CDM and whether the project will generate the estimated emission reduction in PDD. Political risks include the entry into force of the Kyoto protocol and rectification of the Protocol by the participating governments. Market risks include the price of CERs and transaction costs.

13.10 MONITORING

The carbon content of a CDM project cannot acquire value in the international carbon market unless submitted to a verification process designed specifically to measure and audit the carbon component. Monitoring is defined in the *CDM* as follows:

For a CDM project activity (non-A/R) or PoA (non-A/R), collecting and archiving all relevant data necessary for determining the baseline, measuring anthropogenic emissions by sources of GHGs within the project boundary, and leakage, as applicable.

Therefore, monitoring refers to the measurement and analysis of greenhouse gas emissions from a project within its boundary to determine the volume of emission reductions that are attributable to the project. Monitoring, leading to the production of a monitoring report, is an essential prerequisite to verification, certification and ultimately issuance. Monitoring is implemented through the monitoring plan, which is included as part of the project design document (PDD) submitted for registration.

Project participants shall include, as part of the project design document, a monitoring plan that provides for:

1. The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions by sources of greenhouse gases occurring within the project boundary during the crediting period;

2. The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases within the project boundary during the crediting period;
3. The identification of all potential sources of, and the collection and archiving of data on, increazed anthropogenic emissions by sources of greenhouse gases outside the project boundary that are significant and reasonably attributable to the project activity during the crediting period;
4. The collection and archiving of information relevant to the provisions in paragraph 37 (c) above;
5. Quality assurance and control procedures for the monitoring process;
6. Procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed CDM project activity, and for leakage effects;
7. Documentation of all steps involved in the calculations referred to in paragraph 53 (c) and (f) above.

13.11 VERIFICATION

Verification is the periodic independent review and ex post determination by the designated operational entity of the monitored reductions in anthropogenic emissions by sources of greenhouse gases that have occurred as a result of a registered CDM project activity during the verification 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 as verified.

Essentially, verification is the process of confirming the authenticity of reductions in greenhouse gas emissions by a CDM project over a defined period of time (a verification period). In order to do this, a CDM project's emission reductions are monitored, and the monitoring data for a verification period are reviewed and assessed.

In Brief, the Key Elements of Verification are:

1. A periodic independent review and ex post determination;
2. Reductions in greenhouse gas emissions by sources that have been monitored;
3. That is performed by an independent designated operational entity (DOE).

According to paragraph 27 of the modalities and procedures, an operational entity cannot perform the verification and certification, normally, of a CDM project if it has validated the same project.

- ***Verification Process***

The project participants in a CDM project engage a designated operational entity (DOE) to verify the data that has been collected by the project participants in accordance with the monitoring plan. That data will be set out in a monitoring report, which must be provided to the DOE engaged to conduct the verification.

The steps involved in verification are set out in 3/CMP.1, Annex, paragraph 62, and are as follows:

The designated operational entity contracted by the project participants to perform the verification shall make the monitoring report publicly available, and shall:

1. Determine whether the project documentation provided is in accordance with the requirements of the registered project design document and relevant provisions of decision 17/CP.7, the present annex and relevant decisions of the COP/MOP;
2. Conduct on-site inspections, as appropriate, that may comprize, inter alia, a review of performance records, interviews with project participants and local stakeholders, collection of measurements, observation of established practices and testing of the accuracy of monitoring equipment;
3. If appropriate, use additional data from other sources;
4. Review monitoring results and verify that the monitoring methodologies for the estimation of reductions in anthropogenic emissions by sources have been applied correctly and their documentation is complete and transparent;
5. Recommend to the project participants appropriate changes to the monitoring methodology for any future crediting period, if necessary;
6. Determine the reductions in anthropogenic emissions by sources of greenhouse gases that would not have occurred in the absence of the CDM project activity, based on the data and information derived under subparagraph (a) above and obtained under subparagraph (b) and/or (c) above, as appropriate, using calculation procedures consistent with those contained in the registered project design document and in the monitoring plan;
7. Identify and inform the project participants of any concerns relating to the conformity of the actual project activity and its operation with the registered project design document. Project participants shall address the concerns and supply relevant additional information; and
8. Provide a verification report to the project participants, the Parties involved and the Executive Board. The report shall be made publicly available.

CDM verification requirements, based on paragraph 62 of the CDM modalities and procedures, are described in detail in the CDM Validation and Verification Manual (VVM) (EB 55, Annex 1). DOEs refer to the VVM as a guide to ensure that they achieve quality and consistency in their validation and verification work.

Once a DOE has completed the steps above, project participants will most likely engage the DOE to certify the emission reductions achieved during the relevant verification period.

13.12 CERTIFICATION

Certification is Defined in 5/CMP.1, Annex, Paragraph 31 as Follows:

Certification is the written assurance by a DOE that an afforestation or reforestation project activity under the CDM achieved the net anthropogenic greenhouse gas removals by sinks since the start of the project, as verified (5/CMP.1, Annex, paragraph 31).

Certification is essentially the formal written confirmation by an independent auditor (being the designated operational entity (DOE)) that the greenhouse gas removals, which are set out in the verification report, were actually achieved. The key elements of certification are:

- It is a written assurance,
- Confirming that a project activity achieved removals of greenhouse gases during a specific period (usually the verification period preceding certification),
- That is performed by a DOE.

Provided that the requirements of 5/CMP.1 are met, the form and contents of the certification report are at the discretion of the DOE. The certification report is considered to constitute a request for issuance of temporary certified emission reductions (tCERs) or long-term certified emission reductions (lCERs), as appropriate:

The Certification Report Shall Constitute:

1. Where project participants have chosen the tCER approach to account for nonpermanence, a request to the Executive Board for issuance of tCERs equal to the verified amount of net anthropogenic greenhouse gas removals by sinks achieved by the afforestation or reforestation project activity under the CDM since the start of the project activity;
2. Where project participants have chosen the lCER approach to account for non-permanence and:
    a) Net anthropogenic greenhouse gas removals by sinks have increazed since the previous certification report, a request to the Executive Board for issuance of lCERs equal to the verified amount of net anthropogenic greenhouse gas removals by sinks achieved by the afforestation or reforestation project activity under the CDM since the previous certification;
    b) Net anthropogenic greenhouse gas removals by sinks have decreazed since the previous certification report, a notification to the Executive Board of the reversal of net anthropogenic greenhouse gas removals by sinks that has occurred at the afforestation or reforestation project activity under the CDM since the previous certification.

This Decision Applies to Small-Scale A/R (SSC A/R) Projects also:

The modalities and procedures for afforestation and reforestation project activities under the CDM shall apply to small-scale afforestation and reforestation project activities under the CDM except for paragraphs 12-30 (6/CMP.1, Annex, paragraph 3). However, in contrast to large-scale A/R projects, the DOE engaged to conduct validation may also conduct verification and certification:

The same operational entity may undertake validation as well as verification and certification (6/CMP.1, Annex, paragraph 1(e).

A single designated operational entity (DOE) may perform validation as well as verification and certification for a small-scale afforestation or reforestation project activity under the CDM or for bundled small-scale afforestation and reforestation project activities under the CDM (6/CMP.1, Annex, paragraph 12).

- ***Certification Process***

The Process of Certification for Afforestation and Reforestation (A/R) Projects is as follows:

The DOE shall, based on its verification report, certify in writing that, since its start, the afforestation or reforestation project activity under the CDM has achieved the net anthropogenic greenhouse gas removals by sinks. It shall inform the project participants, Parties involved and the Executive Board of its certification decision in writing immediately upon completion of the certification process, and make the certification report publicly available.

Therefore, the DOE must:

1. formally certify the emission removals achieved by the project;
2. provide written notice of its decision to the project participants, the Parties involved and the Executive Board; and
3. make its decision publicly available.

The project participants may select the time for the first verification and certification, but verification and certification must be carried out every 5 years after that (until the end of the project's crediting period). The initial verification and certification of an afforestation and reforestation project activity under the CDM may be undertaken at a time selected by the project participants. Thereafter, verification and certification shall be carried out every five years until the end of the crediting period (5/CMP.1, Annex, paragraph 32).

13.13 ISSUANCE OF CERTIFIED EMISSION RATE (CER)

The certification report shall constitute a request for issuance to the Executive Board of CERs equal to the verified amount of reductions of anthropogenic emissions by sources of greenhouse gases. The issuance shall be considered final 15 days after the date of receipt of the request for issuance, unless a Party involved in the project activity or at least three members of the Executive Board request a review of the proposed issuance of CERs. Such a review shall be limited to issues of fraud, malfeasance or incompetence of the designated operational entities. The rights and commitment of every member must be

made clear to members. They should include the option to sell CERs to third parties. The agreement ought to additionally determine the protection scope on the project, and it ought to stipulate the guidelines for determination of debate between the parties.

Furthermore, two per cent of the CERs issued must be paid to assist in meeting the costs of adaptation. The least developed nations are exempted from this charge. The UNFCCC secretariat, being the developer of the CDM registry, will keep track of all issued CERs.

The review for issues of fraud, malfeasance or incompetence of the designated operational entities should be conducted as follows:

1. Upon receipt of a request for such a review, the Executive Board shall decide on its course of action. If it decides that the request has merit, it shall perform a review and decide whether the proposed issuance of CERs should be approved;
2. The Executive Board shall complete its review within 30 days following its decision to perform the review;
3. The Executive Board shall inform the project participants of the outcome of the review and make public its decision regarding the approval of the proposed issuance of CERs and the reasons for it.

Upon being instructed by the Executive Board to issue CERs for a CDM project activity, the CDM registry administrator, working under the authority of the Executive Board, shall, promptly, issue the specified quantity of CERs into the pending account of the Executive Board in the CDM registry. The CDM project cycle flowchart is shown in Fig. 13.1

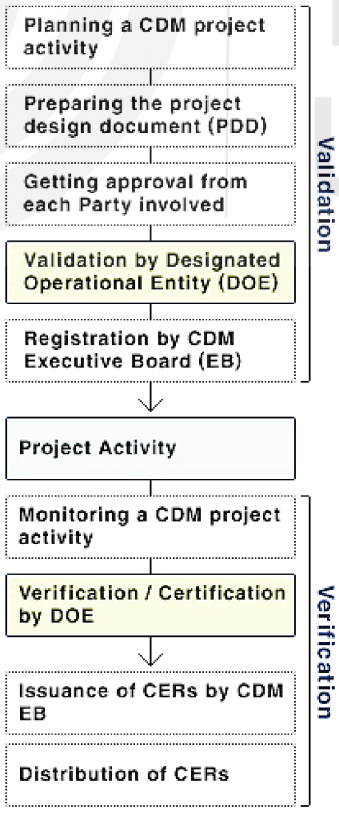

Fig. 13.1: CDM Project Cycle

Check Your Progress 13.2

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What are the key checks performed by the DOE during validation?

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2) Name any five sectional scopes under which Designated Operational Entities (DOEs) can be approved.

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3) What is the main objective of project financing in CDM projects?

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4) Why can't the same DOE normally conduct both validation and verification?

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13.14 CDM PROGRAMME OF ACTIVITY

A Programme of Activities (PoA) provides the organisational and methodological framework for component project activities (CPAs) with the same stated goal to operate within a single registered CDM program activity. The concept of a PoA is defined as:

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

A CDM programme activity can be described as a project activity under a programme of activities with a single, or a set of interrelated measures in order to reduce GHG emissions or result in net removals by sinks, applied within a single designated baseline methodology. The CDM programme activities under a programme of activity (PoA) can be registered as a single CDM project activity (CPA).

PoAs Operate at Two Levels: the programme level and the CPA level. The programme level provides the organizational structure governing the eligibility, operation, monitoring and crediting of individual CPAs included within the PoA. The CPA level consists of individual CPAs, which are the specific measures through which emissions reductions are generated. Multiple CPAs can be included under a PoA at the time of registration, and additional CPAs can be added at any point in the life of the PoA.

The Conference of the Parties serving as the meeting of the Parties, decides that a local/regional/national policy or standard cannot be considered as a clean development mechanism project activity, but that project activities under a programme of activities and defined boundary, can be registered as a single clean development mechanism project activity provided that approved baseline and monitoring methodologies are used that, defines that, avoid double-counting and account for leakage, ensuring that the emission reductions are real, measurable and verifiable, and additional to any that would occur in the absence of the project activity.

The Project Cycle Procedure provides that a PoA can involve CPAs being run in multiple countries, in which case a separate letter of approval would be required from each DNA involved. The *physical boundary* of PoA may extend to more than one country, provided that each participating non-annex I host party provides information that the PoA, and thereby all the CPAs, assists it in achieving sustainable development.

The Main Benefits of PoA are:

1. Transaction costs, investment risks and uncertainties for individual CPA participants are reduced.
2. PoAs are managed on a regional level, which speeds up the approval process.
3. Access to the CDM is extended to smaller projects that would not be viable as stand-alone projects.
4. Direct engagement of individual project developers in the CDM process is not required.
5. Emission reductions can be continuously scaled up after PoA registration, since an unlimited number of CPAs can be added at a later stage.
6. Many technologies with high co-benefits, *e.g*. on the household level, are supported by PoA.
7. Specific regional policy goals can be effectively supported by accessing carbon finance through PoA.
8. Monitoring and verification can be undertaken on a collective basis by utilizing a sampling approach.
9. No registration fee is due for each CPA included after registration. Registration fees are based on the expected average emission reductions of the "actual case" CPAs submitted at the PoA registration.

13.15 GENERAL DESCRIPTION OF PROJECT ACTIVITY

The general information that a Project design document (PDD) in section A of the document must contain is:

1. Project Title.
2. Short description of the project activity.
   a) The purpose of the project activity.

b) The view of the project participants on the project activity's contribution to sustainable development.

3. List of parties and private/public entities involved in the project.
4. Information allowing a unique identification of the project activity, including the location of the project.
5. Specification of project activity category, with the help of the UNFCCC CDM website.
6. Details for the transfer of environmentally safe and sound technology for the project, except for the Small-scale project activity.
7. Explanation of how the GHG emission is reduced.
8. Information on public funding and affirmation that it does not result in a diversion of official development assistance.
9. For small-scale PDD, confirmation is to be given that the project activity is not the de-bundled component of a larger project activity.

13.16 BASELINE METHODOLOGY

Baseline Methodologies are Defined in the CDM Glossary of Terms as Follows:

"A methodology applied to establish a baseline methodology. The CDM rules and requirements prescribe the baseline approaches that can apply to CDM project activities and CDM Programme of activities." In essence, a baseline methodology is the means to estimate the emissions that would have been created in the most plausible alternative scenario to the implementation of the project activity (called the baseline scenario).

The general information that a Project design document (PDD) in section B of the document must contain is:

1. Title and reference to the UNFCCC CDM website that specifies the category of the project or methodology applicable to the project activity.
2. Justification for the choice of methodology.
3. Explanation about how and why the project is additional and therefore not the baseline scenario.
4. Description of the project boundary.
5. Details of the baseline and its development.

Every single new baseline methodology must be approved. The EB has selected a bottom-up approach for the definition of the baselines and for monitoring the methodologies. When the executive board receives a project proposal using a new baseline methodology, it is forwarded to the Methodology panel. The panel, within 2 days, sends this proposal to 2 experts from the roster of experts maintained by the EB, and these 2 experts will make a desk review of the methodology and report back to the methodology panel. This panel will then advise EB whether this new methodology is acceptable or not.

In selecting an acceptable baseline methodology for a project activity, the project participants must select one of the following approaches:

1. Existing actual or historical emissions as applicable, or
2. Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment, or
3. The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20% of their category.

The EB, in its 10th meeting, mentioned the problem statement about the baseline calculation, and this is stated as 'Further clarifications on Methodological Issues'. This describes whether the baseline must be calculated and fixed before the project starts (ex-ante) or at the time of certification (ex-post). The statement is "The ex-post calculation of baseline emission rates may only be used if the proper justification is provided. Notwithstanding, the baseline emission rates shall also be calculated ex-ante and reported.

Appendix B of "Simplified Modalities and Procedures for the Small-Scale CDM" defines the standardised baseline. Indicative simplified baseline and monitoring methodologies for the selected small-scale CDM project activity categories are shown below.

13.17 CREDITING PERIOD

The general information that a Project design document (PDD) in section C of the document must contain is:

1. Duration of the project activity, including the date of start of the project and operational lifetime.
2. Choice of the crediting period: The crediting period for a CDM project activity is selected by the project participants, and as indicated by the Modalities and procedure for the CDM, they may be either:
   - A 7-year crediting period, renewable twice; or
   - A single 10-year crediting period.

The definition of crediting period is set out in the *CDM Glossary of Terms:*

The crediting period for a CDM project activity is the period for which reductions from the baseline are verified and certified by a designated operational entity for the purpose of issuance of CERs.

Therefore, the crediting period is the duration of time selected by the project participants during which the CDM project activity will be implemented, and greenhouse gas emission reductions and consequently certified emission reductions (CERs) will be generated.

In accordance with paragraph 49 of the modalities and procedures for a clean development mechanism, the crediting period may last a maximum of seven or ten years from this start date in the case of renewable and non-renewable crediting periods, respectively. The Executive Board will only issue CERs for a crediting period that commences after the date of registration of the relevant CDM project activity. CERs shall only be issued for a crediting period starting after the date of registration of a clean development mechanism project activity.

In the CDM glossary, the starting date of the project has been defined as "The date at which the implementation or construction of the project activity begins".

A longer crediting period is often preferred by the project participants over the 10-year option without renewal. But the original baseline is not valid after a period of seven years, and this long-term crediting period may include many risks. In order to avoid this crediting period must be revalidated by the designated operational entity. As the baseline methodology should not be changed, only an update of the data used in setting the baseline is needed for revalidation

13.18 MONITORING METHODOLOGY AND PLAN

Monitoring Methodologies are defined in the *CDM Glossary of Terms as follows: "A monitoring methodology refers to the method used by project participants for the collection and archiving of all relevant data necessary for the implementation of the monitoring plan."*

Therefore, a monitoring methodology is the means to calculate the actual emission reductions from the project, taking into account any emissions from sources within the project boundary. A monitoring methodology sets out how project proponents should develop and implement a monitoring plan for a particular project type, in order to gather the data required to calculate emission reductions from the project.

Both the baseline methodology and the monitoring methodology must be specified in the project design document (PDD). The general information that a Project design document (PDD) in section D of the document must contain is:

1. Name and reference to the UNFCCC website of the approved methodology applied to the project activity.
2. Justification of the choice of the methodology and why it is applicable to the project activity.
3. Table to be filled with information on the data to be monitored.
4. Name and contact information of the person/entity determining the monitoring methodology.

The project members must incorporate a monitoring plan in the PDD. A definite depiction of this plan must be incorporated in this area of the PDD, including an ID of the information and its quality as to exactness, similarity, culmination and legitimacy. Project participants shall include, as part of the project design document, a monitoring plan that provides for:

1. The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions by sources of greenhouse gases occurring within the project boundary during the crediting period;
2. The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases within the project boundary during the crediting period;
3. The identification of all potential sources of, and the collection and archiving of data on, increazed anthropogenic emissions by sources of greenhouse gases outside the project boundary that are significant and reasonably attributable to the project activity during the crediting period;

4. Quality assurance and control procedures for the monitoring process;
5. Procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed CDM project activity, and for leakage effects.

Monitoring data required for the verification and issuance are to be kept for two years after the end of the crediting period, or the last issuance of the CERs for this project activity, whichever occurs later.

Check Your Progress 13.3

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) Under what conditions can a policy or standard be considered under CDM?

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.....

2) Mention any three benefits of the PoA approach.

.....

.....

3) Why is information on public funding required in the PDD?

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4) What are the three approaches for selecting a baseline methodology?

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.....

5) What are the risks associated with long crediting periods?

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.....

13.19 CALCULATION OF GHG EMISSION BY SOURCES

The goal of the greenhouse gas (GHG) emissions calculation is the calculation and verification of GHG emissions along the supply chain. This includes all relevant emissions from biomass production, conversion processes, and transport and distribution. Information about the generated GHG emissions and about the GHG abatement in comparison to the use of fossil energy is one element of the data that is necessary for the traceability of sustainable biomass and bio-liquids.

Section E of PDD includes the information about the calculation of GHG emission reduction by the sources.

- *Calculation based on actual values*

On-Site Data Gathering

The following data for the calculation of GHG emissions must be gathered on-site. Documents/evidence on these data must be provided to the auditor. This can include production reports, production information systems, delivery notes, weighbridge protocols, contracts, invoices, etc. The basis for the calculation should always be the previous year. Annual average figures can be used:

1. Amount of main product and co-products,
2. Amount and type of raw materials used,
3. Amount of chemicals used (*e.g.* methanol, NaOH, HCl, hexane, citric acid, fuller's earth, alkali),
4. Amount of pesticides,
5. Amount of P_2O_5, K_2O, CaO and N-fertilizer,
6. Diesel consumption, electricity consumption,
7. Thermal energy consumption,
8. Process energy source,
9. Amount of wastes (*e.g.* palm oil mill effluent (POME), wastewater).

Data Gathering from Databases and Literature

The following sources can be used:

1. Official statistical data from government bodies,
2. Scientifically peer-reviewed literature,
3. Emission factors of, *for example,* fertilisers (emissions from production plus field emissions), diesel use in agricultural machinery or for transport, chemicals, electricity, POME in its different uses, and thermal energy should be taken from the "ISCC list of emission factors.

Data measured and gathered on-site must be documented (*e.g.* within the field record system, delivery orders, invoices). The date of all data used shall be documented. The data used shall be based on the most recent available data and shall be updated over time.

Use of Aggregated Values for Agricultural Management

For agricultural management, it is allowed to use either measured or aggregate values. When using aggregate values:

1. The regional differences for these values should be taken into consideration when using this data. For the EU, a value relevant for the NUTS2 level or a more fine-grained level shall be used.
2. Such numbers should primarily be based on official statistical data from government bodies when available and of good quality. If not available, statistical data published by independent bodies may be used. As a third option, the numbers may be based on scientifically peer-reviewed work, with the precondition that the data used lies within the commonly accepted data range when available.

3. The data used shall be based on the most recent available data from the above-mentioned sources. Typically, the data should be updated over time, unless there is no significant variability in the data over time.

4. For fertilizer use, the typical type and quantity of fertilizer used for the crop in the region concerned may be used. Emissions from the production of fertilizer should either be based on measured values or on technical specifications of the production facility. When the range of emissions values for a group14 of fertilizer production facilities to which the facility concerned belongs is available, the most conservative emission number (highest) of that group shall be used.

It refers to *for example* a situation where an economic operator knows that the fertilizer was produced by a certain company in a certain country. That company has a number of fertilizer production facilities in that country for which the range of processing emissions is known; an economic operator can claim the most conservative number of emissions from that group of fertilizer production facilities.

Requirements for the Calculation of GHG Emissions from Transport and Distribution :

1. Transport distance (d) [in km] loaded/ respectively empty – Distance the biomass is transported to the next element in the supply chain (return transports that are not taking place empty do not need to be taken into account),
2. Mode of transport (*e.g.,* diesel truck, 40 t) and
3. Amount of biomass transported.
4. Emission factor fuel (EFfuel),

Other than this, the calculation for the GHG emission can also be made based on:

1. Direct on-site emissions include emissions from fuel combustion in the project.
2. Direct off-site emissions include emissions by heat and electricity, which are going to be produced by the project (power plant, etc.).
3. Indirect on-site emissions are the emissions from energy consumption, *for example,* in the construction of dams, power intake, tunnels, and pipelines can be excluded as they are small compared to the emissions from the whole power plant.
4. Indirect off-site emissions are the emissions from the production of the raw materials and are outside the boundary, as they do not directly influence the project activity.

This Section of the PDD must be for each gas and source, including descriptions of the formula used to calculate the emission within the project boundaries, both for the project activity and baseline.

13.20 EMISSION FACTORS

The 2006 IPCC (Intergovernmental Panel on Climate Change) Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) provide methodologies for estimating national inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases. The 2006 IPCC Guidelines were prepared in response to an invitation by the Parties to the UNFCCC. They may assist Parties in fulfilling their commitments under the UNFCCC on reporting on inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases, as agreed by the Parties. The 2006 IPCC Guidelines are in five volumes.

An assessment has been carried out by the Minister of State (Environment and Forests Change) and the Indian Network for Climate Change Assessment, and a report has been published for this entitled "India's Greenhouse gas emission 2007". The information below is the information on India's emissions of Greenhouse gases (Carbon Dioxide [CO_2], Methane [CH_4] and Nitrous Oxide [N_2O]) emitted from anthropogenic activities at the national level from:

- Energy,
- Industry,
- Agriculture,
- Waste,
- Land Use Land Use Change & Forestry (LULUCF).

Key Results that were Published in the Report are:

i) The net Greenhouse Gas (GHG) emissions from India, that is emissions with LULUCF, in 2007 were 1727.71 million tons of CO2 equivalent, of which
   - CO_2 emissions were 1221.76 million tons;
   - CH_4 emissions were 20.56 million tons; and
   - N_2O emissions were 0.24 million tons.

ii) GHG emissions from Energy, Industry, Agriculture, and Waste sectors constituted 58%, 22%, 17% and 3% of the net CO_2e emissions, respectively

iii) The energy sector emitted 1100.06 million tons of CO_2e, of which 719.31 million tons of CO_2e were emitted from electricity generation and 142.04 million tons of CO_2e from the transport sector.

iv) The industry sector emitted 412.55 million tons of CO_2e.

v) The LULUCF sector was a net sink. It sequestered 177.03 million tons.
   - India's per capita CO_2e emissions, including LULUCF, were 1.5 tons/ capita in 2007.

13.21 GLOBAL WARMING POTENTIAL

Global-warming potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval, commonly 20, 100 or 500 years. GWP is expressed as a factor of carbon dioxide (whose GWP is standardised to 1). *For example,* the 20-year GWP of methane is 86, which means that if the same mass of methane and carbon dioxide were introduced into the atmosphere, the methane would trap 86 times more heat than the carbon dioxide over the next 20 years.

The substances subject to restrictions under the Kyoto protocol either are rapidly increasing their concentrations in Earth's atmosphere or have a large GWP. The GWP depends on the following factors:

1. the absorption of infrared radiation by a given species;
2. the spectral location of its absorbing wavelengths; and
3. the atmospheric lifetime of the species

Thus, a high GWP correlates with a large infrared absorption and a long atmospheric lifetime. The dependence of GWP on the wavelength of absorption is more complicated. Even if a gas absorbs radiation efficiently at a certain wavelength, this may not affect its GWP much if the atmosphere already absorbs most radiation at that wavelength.

The GWPs are estimated by complex modelling of the chemical interaction in the atmosphere and will change over time as the knowledge about atmospheric chemistry improves, but recent values must be used after they have been published in the IPCC assessment report, and the meeting of the Conference of the Parties (COP) under the UNFCCC has decided to use them.

While the 100-years time horizon GWPs are shown in the table below are the most commonly used, GWPs based on cumulative warming over 20 and 500-year periods were also developed by the IPCC and are used in some analyzes. For the HFCs and PFCs, it is common to use the GWP of the dominant gas to calculate the CO_2e for the emission of these gases.

13.22 ENVIRONMENTAL IMPACTS

Most scientists agree that the Earth is in fact experiencing increazing temperatures, and many believe that humans are enhancing this overall warming trend. The likely effects of global warming will not be limited to one country or even one continent and will permeate almost every aspect of the environment and of life for all living things. Potential effects listed here are just a handful of those discussed in the Intergovernmental Panel on Climate Change's (IPCC) 2007 report.

1) **Rising Sea Levels** are the most common concern, taking place with a thermal expansion of the oceans as a result of water molecules expanding in warmer temperatures, increazed precipitation, and the melting of mountain glaciers. Because all bodies of water have varying shapes and ocean water tends to "swell" differently depending on its starting temperature, the change in sea level is not uniform over the surface of the Earth. In the 20th century alone, sea levels rose 0.17 meters. Predictions for the next century range anywhere from 0.18 to 0.59 meters. While smaller projections would likely have only relatively modest impacts, the higher projections could have dramatic effects on low-lying coastal communities.

2) **Increazing Ocean Temperatures** could cause serious ecological damage. Approximately one quarter of the world's coral reefs have died over the last few decades, many of them affected by coral bleaching, a process directly tied to warming waters, which weakens the coral animals. An increaze in global temperature will likely enhance the ability for **severe weather,** which could mean stronger and more frequent storms. Warmer temperatures cause more evaporation of water, which, as part of the water cycle, eventually leads to increazed precipitation and further increazes the potential for flooding. While some parts of the world are projected to experience increased precipitation, others may experience higher levels of drought as places that are typically dry, such as the centres of continents, experience even more evaporation as global temperatures climb. Scientists, however, are trying to determine whether drought is actually increazing or if we are experiencing a shift in areas of drought.

3) **Warmer Winters** mean that many deaths related to cold temperatures might be avoided and that the growing season will last longer, a possible upside to global warming. More people around the world die because of winter cold than because of summer heat. A decreaze in winter deaths could offset a potential increase in summer heat-related deaths, or even lead to more lives saved as a result of the changed temperatures. With respect to longer growing seasons, there is already evidence in Europe that their growing season has been extended since the 1960s, with spring plants now blooming about 6 days earlier and fall colours coming 5 days later.

   With drought affecting some regions and heat intensifying in the tropics, many areas will become unsuitable for agriculture. In tropical areas that are already dry and hot, the ability to harvest food will likely decreaze even with small increazes in warming. However, warmer temperatures and increazed precipitation can also make previously marginal land more suitable for farming. Therefore, it is likely that, with a changing climate, a global change in the agricultural pattern will occur. Yet, it is unknown whether or not the increaze in the usefulness of marginal lands will counterbalance an increaze in drought and desertification.

4) **Human Health Implications** of increased global warming are very concerning. Extreme heat waves in 2003 and 2006 led to thousands of deaths in Europe, North America, and India and are likely to increaze. We are also witnessing a renewed spread of diseases, likely to increaze if temperatures continue to rise, including a spread of illnesses that were previously limited only to tropical areas.

Check Your Progress 13.4

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What is the main goal of GHG emissions calculation?

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.....

2) What factors should be considered when using aggregated values for fertilizers?

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.....

3) What are the types of emissions considered in GHG calculations?

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4) What are the main factors determining a gas's Global Warming Potential (GWP)

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13.23 LET US SUM UP

The main goal of GHG emission calculation is to estimate and verify emissions along the supply chain from biomass production to transport and distribution, and to assess emission reductions compared with fossil fuels. This helps in maintaining transparency and traceability for sustainable biofuels and bio-liquids.

The calculation process involves collecting on-site data such as fuel consumption, fertilizer use, electricity use, raw materials, and waste generation. Reliable data from government statistics, scientific literature, or emission factor databases (like ISCC) are used to ensure accuracy. Aggregated values can also be used when regional data are consistent and updated periodically. Emissions from transport and distribution are calculated based on distance, transport mode, fuel type, and emission factors. Different types of emissions – direct and indirect, on-site and off-site – are considered to cover all sources within the project boundary.

The 2006 IPCC Guidelines provide a standardized framework for estimating national GHG inventories, helping countries report emissions accurately under the UNFCCC. *For example,* India's 2007 GHG inventory highlighted that the energy sector contributed the most (58%) to national emissions, while the LULUCF sector acted as a carbon sink.

The Global Warming Potential (GWP) indicates how much heat a gas traps compared to CO_2 over a specific time horizon, with methane and nitrous oxide having much higher GWP values. Finally, the environmental impacts of GHG emissions include rising sea levels, coral bleaching, extreme weather events, shifting agricultural patterns, and health hazards.

13.24 KEY WORDS

Baseline Methodology : A method used to estimate the emissions that would have occurred in the absence of the CDM project.

Certification : The written confirmation by a DOE that a CDM project has achieved real and measurable emission reductions.

Certified Emission Reductions (CERs) : A unit equivalent to one metric ton of CO_2 emissions reduced, earned through a registered CDM project.

Clean Development Mechanism (CDM) : A mechanism under the Kyoto Protocol allowing developed countries to invest in emission-reducing projects in developing countries and earn Certified Emission Reductions (CERs).

CPA (Component Project Activity) : An individual emission reduction activity under a registered Programme of Activities (PoA).

Crediting Period : The timeframe during which a CDM project can earn CERs, either 7 years (renewable twice) or a single 10-year period.

Designated National Authority : A national body responsible for approving CDM projects and ensuring they align with local sustainable development goals.

Designated Operational Entity : An independent third-party body that validates and verifies CDM projects.

Emission Factors : Coefficients that quantify emissions per unit of activity (*e.g.,* kg CO_2 per kWh of electricity generated).

Global Warming Potential (GWP) : A measure of how much heat a greenhouse gas traps in the atmosphere compared to carbon dioxide over a specified period.

Monitoring Plan : A component of the PDD that outlines how data on greenhouse gas emissions will be collected, managed, and reported during the crediting period.

PDD (Project Design Document) : A mandatory document submitted for CDM project validation and registration, containing technical, environmental, and financial details of the project.

PoA (Programme of Activities) : A coordinated policy or set of actions under the CDM that allows for multiple similar projects (CPAs) to be registered and implemented under one umbrella.

Registration : The formal acceptance of a validated CDM project by the CDM Executive Board enables it to begin earning CERs.

Validation : The process of assessing a CDM project's design against eligibility criteria before its registration.

Verification : The periodic independent review of monitored emissions reductions from a CDM project to confirm their authenticity.

13.25 SUGGESTED FURTHER READINGS/ REFERENCES

- Capoor, K., & Ambrosi, P. (2007). *State and Trends of the Carbon Market 2007.* The World Bank.
- EcoSecurities (2002). *The Emerging Carbon Market: A Guide to CDM Project Development and Transaction Costs.*
- Lecocq, F., & Capoor, K. (2005). *State and Trends of the Carbon Market 2005.* The World Bank.
- Michaelowa, A. (2004). *CDM: Current Status and Possibilities for Reform.* Hamburg Institute of International Economics.
- World Bank (2004). *Clean Development Mechanism Investment Guide.* Washington, D.C.

13.26 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 13.1

1) The PDD is a standardised document developed by the CDM Executive Board that contains detailed information about a proposed project, including its design, baseline, monitoring plan, and environmental impacts. It serves as the key document for project validation and registration.

2) Design and formulation (includes preparation of PDD), National approval, Validation, Financing, Monitoring, Verification/Certification and Issuance of CERs.

3) Single government department model, Two-unit model and Inter-departmental government model.

4) Receive and process CDM project applications, Issue Letters of Approval for CDM projects and maintain a register of validated, verified, or certified CDM projects.

Check Your Progress 13.2

1) The DOE checks whether:
   - Parties have ratified the Kyoto Protocol.
   - The PDD has been publicly accessible for 30 days for comments.
   - Environmental impacts have been assessed.
   - Baseline and monitoring methodologies are approved or newly developed.

2) Energy industries, Transport, Chemical industries, Agriculture, and Waste handling and disposal.

3) The objective is to secure adequate funding for project implementation, ensuring emission reduction credits are generated, and financial risks (project, political, and market) are managed effectively.

4) To maintain independence and avoid conflict of interest, the same DOE is not normally allowed to conduct both validation and verification of a CDM project.

Check Your Progress 13.3

1) Only project activities under a defined PoA boundary that use approved baseline and monitoring methodologies, ensuring real, measurable, and verifiable reductions can qualify— not general local or national policies.

2) Reduces transaction costs and risks for small projects, enables inclusion of smaller projects not viable alone and allows continuous expansion by adding new CPAs later.

3) To ensure that the funding does not divert Official Development Assistance (ODA) and that it supports genuine emission reduction efforts.

4) Existing actual or historical emissions, emissions from economically attractive alternative technology and average emissions of the top 20% of similar projects in past five years.

5) Baseline data may become outdated; thus, revalidation by a DOE is needed to update data and maintain accuracy.

Check Your Progress 13.4

1) The main goal of GHG emissions calculation is to calculate and verify greenhouse gas emissions along the supply chain, including emissions from biomass production, conversion processes, transport, and distribution, ensuring traceability of sustainable biomass and bio-liquids.

2) The data must represent the typical fertilizer type and quantity used regionally, and emission values should be based on the most conservative (highest) emission numbers available for the production facilities.

3) Emissions are classified as: Direct on-site emissions (from fuel combustion), Direct off-site emissions (from heat/electricity generation), Indirect on-site emissions (*e.g.,* dam construction), and Indirect off-site emissions (from raw material production).

4) *The three main factors are:* Absorption of infrared radiation, Spectral location of absorbing wavelengths, and Atmospheric lifetime of the gas.

UNIT 14 CDM PROJECT MANAGEMENT

Structure

14.0 Objectives

14.1 Introduction

14.2 CDM Project Viability

- 14.2.1 Assessing Project Viability in CDM
- 14.2.2 Challenges and Considerations

14.3 Quantity and Price OF CERs

- 14.3.1 Quantity of CERs
- 14.3.2 Price of CERs

14.4 Transaction Costs

14.5 Impact of CER on the Project

- 14.5.1 Impact of CERs on Project Viability

14.6 Securing Project Funds

14.7 Sources of Project Funds

14.8 Risk Management

14.9 Let Us Sum Up

14.10 Key Words

14.11 Suggested Further Readings/References

14.12 Answers to Check Your Progress

14.0 OBJECTIVES

After going through this Unit, you will be able to:

- discuss the Project viability of the Clean Development Mechanism (CDM);
- estimate the transaction costs of CDM;
- determine the project funds sources and how to secure them;
- identify the CERs factors impacting the projects; and
- determine risk management and its types.

14.1 INTRODUCTION

You must be aware that nowadays, the great usage of fossil fuels such as coal, oil, and natural gas, the fast industrialization and unparalleled global economic growth observed over the past century have resulted in major environmental effects. Although they are vital for development, these energy sources have caused a sharp rise in greenhouse gas (GHG) emissions, therefore posing serious environmental problems, including acid rain, bad air quality, and— most importantly— climate change. Rising global temperatures, sea-level rise,

and extreme weather events define the latter, which has become one of the most urgent problems facing the world community in the twenty-first century.

Acknowledging these difficulties, the world community enacted the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, therefore providing a framework for worldwide cooperation to slow down climate change and minimise its effects. Building on the UNFCCC's ideas, the Kyoto Protocol was adopted in 1997 as a legally binding international agreement pledging industrialised nations (Annex I parties) to measurable objectives for lowering their GHG emissions over the first commitment period from 2008 to 2012. Among the various creative strategies the protocol offers to enable affordable compliance with these standards, the Clean Development Mechanism (CDM) is one of the more original ones.

Defined in Article 12 of the Kyoto Protocol, the CDM lets industrialized nations fund initiatives for emission reduction or removal in developing nations (non-Annex I parties) and, in turn, get Certified Emission Reductions (CERs). Under the agreement, each CER— equivalent to one tonne of carbon dioxide (CO_2)— can be utilized by the investing nation to help fulfil part of its emission-reducing responsibilities. By means of investment in clean energy, efficient technology, and environmentally friendly behaviours, this mechanism not only gives developed nations flexibility in reaching their commitments but also fosters sustainable development in host nations.

The strategic relevance of the CDM in global climate policy is highlighted by its twin goals of helping developed nations in reaching sustainable development and assisting them in attaining their emission-reducing targets. The CDM has evolved into a crucial tool for connecting the developmental and environmental agendas of countries at various phases of economic growth by helping to transfer cleaner technologies and capacity-building projects.

The application of the CDM has not been without controversy, notwithstanding its promise. Often favoring emerging economies over the least developed nations, concerns have been voiced about the actual sustainability advantages of CDM projects, the additionality of emissions reductions, and the unequal geographical distribution of programmes. Still, the CDM has set a significant foundation for later climate policy tools and provided a forum for learning for the next international bodies, including the Sustainable Development Mechanism (SDM) under the Paris Agreement.

This Unit explores the fundamental ideas, operational framework, objectives, and results of the Clean Development Mechanism. It seeks to give a thorough knowledge of how CDM operates inside the larger framework of international climate agreements and its part in tackling the worldwide challenge of climate change by cooperative, market-based solutions.

14.2 CDM PROJECT VIABILITY

CDM project produces both conventional project output and carbon benefits (CERs). The value of the carbon benefits and its impact on project viability are influenced by several factors such as the amount of CERs generated by the project, the price of CER and the transaction costs involved in securing CERs. The CDM, established under the Kyoto Protocol in 1997, allows developed countries (Annex I parties) to invest in emission-reduction projects in developing

countries as an alternative to more expensive emission reductions in their own countries. In return, they earn certified emission reduction (CER) credits, which can be used to meet Kyoto targets. CDM aims to promote sustainable development in host countries while assisting industrialized nations in meeting their climate obligations.

14.2.1 Assessing Project Viability in CDM

Project viability within the CDM framework refers to the economic, environmental, technical, and institutional feasibility of proposed projects. Ensuring the viability of a CDM project involves a multi-dimensional evaluation that aligns with both climate goals and host country development priorities.

1. Economic Viability

From an economic perspective, a CDM project must demonstrate cost-effectiveness and the ability to generate sufficient financial returns. Key considerations include:

- Initial capital investment and access to financing.
- Projected CER revenues which depend on the volume of greenhouse gas (GHG) reductions and the market price of CERs.
- Operational and maintenance costs.
- Payback period and return on investment (ROI).

2. Environmental Viability

Projects must contribute to real, measurable, and long-term environmental benefits, particularly in terms of GHG emission reductions. The additionality criterion is essential — the project must prove that the emission reductions are additional to what would have occurred in the absence of the CDM.

Examples of Viable CDM Projects Include:

- Renewable energy generation (*e.g.,* solar, wind, hydro).
- Energy efficiency improvements.
- Methane recovery and waste management.
- Afforestation and reforestation.

3. Technical Viability

A CDM project must be technically sound, with proven technologies and reliable implementation mechanisms. Factors to consider include:

- Availability of appropriate technology and technical know-how.
- Capacity to maintain and operate the project infrastructure.
- Compatibility with local conditions (*e.g.,* climate, geography, energy infrastructure).

Feasibility studies are typically conducted to assess technical risks and operational feasibility.

4. Institutional and Regulatory Viability

Institutional viability assesses the regulatory framework, stakeholder engagement, and governance structures supporting CDM projects. The host country must:

- Have a designated national authority (DNA) for CDM.
- Provide necessary approvals and documentation.
- Support the integration of CDM into national development and climate strategies.

Political stability, legal protections, and transparency are also critical for ensuring investor confidence and project sustainability.

14.2.2 Challenges and Considerations

Despite the potential benefits, CDM projects face several challenges:

- Uncertain carbon market prices can affect revenue projections.
- Lengthy and complex approval procedures can delay implementation.
- Verification and monitoring requirements add to operational complexity and costs.
- Evolving global climate policy, especially post-Kyoto mechanisms like the Paris Agreement, may affect the future of CDM.

14.3 QUANTITY AND PRICE OF CERS

The quantity and price of Certified Emission Reductions (CERs) are critical factors influencing the overall viability and profitability of a Clean Development Mechanism (CDM) project.

14.3.1 Quantity of CERs

The amount of CERs generated by the project depends on the greenhouse gas displaced by the project and the crediting period selected. Renewable energy and energy efficiency projects displace carbon-intensive electricity and/or heat generation. Grid-based or off-grid projects that displace more carbon-intensive coal and diesel fuels generate more CERs than those that displace natural gas. Projects that capture methane and greenhouse gases other than CO_2 produce more CERs since the global warming potential (GWP) of methane and other gases is several times higher than that of carbon dioxide.

As discussed earlier, the Marrakech accord stipulates two crediting period options: 7 years with twice the option of renewal (totalling 21 years) or 10 years without renewal.

14.3.2 Price of CERs

The price of CERs is determined by the carbon market. At present, the carbon market is a 'loose collection of diverse transactions' where emission reductions are exchanged.

There are three main markets where greenhouse gas emission reductions are traded: (i) project-based or "baseline and credit" system; (ii) allowance market or "cap and trade" system, and (iii) voluntary market.

The pricing of CER is highly speculative. The PCF considers several parameters in determining its price in the PCF's carbon purchaze agreement. Moreover, certain project parameters command price premiums under the PCF programme. These include:

i) the existence of government guarantees,

ii) project generation of social benefits, and

iii) the exclusion of preparation costs from the total project cost.

In the CERUPT programme, prices are also differentiated according to technology type. CER from renewable energy projects forms the reference price (maximum price of EUR 5.5 per CER). CERs from sustainably grown biomass projects as well as from energy efficiency projects are priced 20% lower (the maximum price of EUR 4.5), while those from fuel switching and methane recovery projects are 40% cheaper (the maximum price of EURO 3.3)

At present, there is no single CER price but differentiated according to risks, technology type and social development components. The current PCF CER rate ranges from US$3 to 4 per ton of CO2; under the C-ERUPT programme, it revolves around US$4 to 4.5 per ton of CO2. Several economic models forecast a single carbon price since these models assume competitive and unfettered markets. With the US presence in the GHG market, these models projected very high carbon prices. After the Bonn Agreement and Marakkech Accords, and with the absence of the US in the market, these models projected low carbon prices. In reality, the carbon markets are fragmented, and prices generated by these markets are differentiated.

Check Your Progress 14.1

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What does project viability in CDM mean?

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2) List the four types of viability assessed in CDM projects.

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3) What determines the quantity of Certified Emission Reductions (CERs) produced by a project?

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Table 14.1: CDM Transaction Costs

Transaction Cost Component		Description
Pre-operational Phase Design	Search Costs	Costs incurred by investors and hosts as they seek out partners for mutually advantageous projects.
	Negotiation Costs	Includes those costs incurred in the preparation of the Project Design
		A document that also documents the assignment and scheduling of benefits over the project time period. It also includes expenses for organising public consultations with key stakeholders.
	Baseline Determination	Development of a baseline
	Approval Costs	Development of a baseline country
	Validation Costs	Costs incurred in reviewing and revising the Project Design Document by the operational entity.
	Review Costs	Costs of reviewing a validation document
	Registration Costs	Registration by UNFCCC Executive Board / JI Supervisory Committee
Operational Phase	Monitoring Costs	Costs to collect data
	Verification Costs	Costs to hire an operational entity and to report to the UNFCCC Executive Board/Supervisory Committee.
	Review Costs	Costs of reviewing a verification
	Certification Costs	Includes costs in the issuance of Certified Emission Reductions (CERs for CDM) and Emission Reduction Units (ERUs for JI) by the UNFCCC Executive Board
	Enforcement Costs	Includes administrative and legal costs incurred in enforcing transaction management
Trading	Transfer Costs	Brokerage costs
	Registration Costs	Costs to hold an account in the national registry

14.4 TRANSACTION COSTS

Transaction costs are those that arise from initiating and completing transactions to secure CERs. These consist of pre-operational costs (or upfront costs), implementation costs (*i.e.,* costs spread out over the entire crediting period), and trading costs (Table 14.1). Pre-operational costs include direct expenses for search, negotiation, validation, and approval. Implementation costs are those incurred for monitoring, certification, and enforcement, while trading costs are those incurred in trading CERs, such as brokerage costs and costs to hold an account in the national registry.

PCF's pre-operational transaction costs amount to 229 thousand Euros (265 thousand dollars) while Ecosecurities (2002) estimates the minimum up-front transaction cost at around 70 thousand Euros (£42,000), shown in Table 14.2.

Several studies show that the transaction cost per ton of CO_2 for large projects is very small or even negligible, while that for small-scale projects is quite significant. Given this, it is obvious that investors would prefer large-scale projects. Fast-tracking small-scale projects (simplifying the procedures and standardizing the information and reporting requirements) not only reduces transaction costs but also improves project financial viability. According to Eco Securities (2002), fast-tracked procedures lead to around 67% reductions in transaction costs.

Table 14.2: CDM Transaction Cost Estimates

	Project Cycle	Eco Securities, 2002 (£)	PCF (US$ $)
Pre-operational Phase Design	Preparation and		40,000
	Review		
	Baseline Study	12,000 - 15,000	20,000
	Monitoring Plan	5,000 - 10,000	20,000
	Environmental Assessment	-	
	Stakeholder Consultation	-	
	Approval	-	
	Validation	10,000 - 20,000	30,000
	Consultation and		105,000
	Project Appraisal		
	Legal and Contractual Arrangements	15,000 - 25,000	50,000
Operational Phase	Sales of CERs	5% - 15% of CER Value	
	Adaptation Levy*	2% of the CER value	
		annually	
	Risk Mitigation	1%-3% of CER value	
		annually	
	Verification	5,000 per audit	25,000 (initial)
			10,000-25,000
			(periodic)
			10,000-20,000
			(periodic supervision)
	Executive Board	To be determined (X% of CER value)	
	Administration		

"Projects in least developed countries are exempted from the 2% adaptation levy.

Sources: *Eco Securities, 2002; PCF presentation COP 8, Side Event, New Delhi, 24 October 2002"*

14.5 IMPACT OF CER ON THE PROJECT

14.5.1 Impact of CERs on Project Viability

The net financial gain derived from the sale of CERs is the difference between the project CER value and the transaction costs. Three elements influence the net impact of CERs on project profitability: the value of CERs (low CER value implies low net benefits), overall transaction costs (high transaction costs yield low net benefits), and up-front transaction costs (high upfront payments could also result in low benefits). Project developers generally expect up-front transaction costs within the range of 5 to 7% of the net present value of the revenue or total transaction costs around 10 to 12% of the net present value of revenue (Eco-securities, 2002). A positive net financial gain means that CER revenues improve the financial viability of the project. Table 14.3 below shows the impact of CERs on IRRs in selected projects.

Table 14.3: Impact of CERs on Project IRR

Country	Project	IRR without Carbon Finance (%)	IRR with Carbon Finance (%)	Change in IRR (%)
Costa Rica	wind power	9.7	10.6	0.9
Jamaica	wind power	17.0	18.0	1.0
Morocco	wind power	12.7	14.0	1.3
Chile	Hydro	9.2	10.4	1.2
Costa Rica	Hydro	7.1	9.7	2.6
Guyana	bagasse	7.2	7.7	0.5
Brazil	biomass	8.3	13.5	5.2
India	solid waste	13.8	18.7	5.0

Source: *PCF Annual Report 2001*

The effect of CER cash flow on project IRRs varies by project type. The impact of CERs on wind power project IRR is relatively small (a few percentage points increaze), while it is substantially important for fugitive methane capture projects. More CERs are generated by methane capture projects since the global warming potential of methane is 21 times higher than carbon dioxide. This makes methane capture projects relatively attractive to CDM project developers. In fact, for the first 45 projects submitted to the CDM Executive Board for methodology review, 27% (12 projects) are methane gas capture projects.

14.6 SECURING PROJECT FUNDS

CER Generation and Trading: Governments and private companies from non-Annex. 1 parties are the main buyers of CER. CERs are developed and exchanged in fewer than three main models:

1. **Unilateral Model:** The host country develops and invests in a project, and sells or banks CERs. The project developer bears all risks and benefits related to the preparation and sale of CERs.

2. **Bilateral Model:** This involves a partnership between a project developer and Annex 1 country. The objective of the partnership is for the Annex. 1 country to receive the CERs realized from the project through an emission reduction purchaze agreement (ERPA) or as a result of some other financial consideration.

3. **Multi-lateral Model:** This is considered as a variant of the bilateral model. CERs are sold to a fund, which manages a portfolio of projects. The fund spreads the risk of investment, while the investors spread their risks by investing in several different funds.

The carbon finances at the World Bank (Prototype Carbon Fund, Community Development Fund, and BioCarbon Fund) are *examples* of multi-lateral funds using the World Bank as fund manager. The Dutch Government adopts several means of procuring emission reduction credits, through multi-lateral organisations such as the World Bank and International Finance Corporation, through banks (*e.g.,* Rabo Bank), through bilateral contracts and via its own tender (C-ERUPT). Japan, Germany and Denmark use banks and other financial institutions in managing their CDM funds. More recently, Canada and several European countries have initiated bilateral transactions with several developing and Eastern European countries.

14.7 SOURCES OF PROJECT FUNDS

CDM projects require upfront investments that are normally obtained from different sources, such as loans, equity, grants, and upfront payments for emission reductions.

1. Loans or debts refer to funds lent to CDM project owners by financiers. Debt can be obtained through public markets (bonds) or private placements (bank loans and institutional debt).
2. Equity refers to funds funnelled to the CDM project by company shareholders. Equity may be sourced from internal sources (sponsors) or external investors (public or private markets). The return on equity is obtained either from dividends or from the sale of shares.
3. Grants are funds provided by institutions and governments to CDM project owners and developers who contribute to donors' objectives. Grants need not be repaid and oftentimes, cover only a percentage of project costs.
4. Upfront payment for CER purchaze. The carbon purchase agreement often stipulates payment at an agreed price upon delivery of CERs, but CER buyers sometimes provide upfront payment upon purchase. For example, the PCF provides upfront payment up to 25% of the total CER value. However, to compensate for increased risk, upfront payments are discounted.

Like conventional projects, financing CDM projects can be arranged either through corporate or project financing. These are described as follows:

1. In project financing, a project company is formed, and investments are viewed as assets of the company. Investment funds are sourced either from equity or debt. Assets and cash flow secure debts. Creditors do not have recourse to the other resources of sponsors.
2. Under corporate financing, new projects are undertaken as an extension of the assets of the existing company. Capital investments and borrowing are not placed under the project account. Loans are considered as company debts, and lenders have full recourse to all the assets and revenues of the company over and above those generated in the new project.

Additional project revenues (*i.e.,* CER) could be used to service debts and leverage debt financing. Guest *et al* (2003) present that the carbon cash flow can help increaze debt carrying capacity: The carbon revenues could help increase the debt leverage of the project by increazing the debt service coverage ratio (DSCR) levels of the project. In addition to improving debt capacity, there are other options for debt service through the carbon cash flow. These include: pre-pay-ing debt based on Forward Emission Reduction Purchaze Agreements (ERPAs); depositing carbon cash flow directly with banks for credit against debt service thereby lowering liability on electricity cash flow; and using ERPAs and/or forward carbon sales as collateral for loans (this is the case for Plantar Project in Brazil where the CER purchaze agreement with the PCF was used as collateral for commercial bank financing).

The existence of CER has important implications for stakeholders. For project sponsors and partners, it implies improved project profitability and, in cases where upfront CER payment is obtained, less equity and debt requirements. Those involved in the risk transfer process, such as contractors and suppliers, will have to bear increazed risks. For agencies that provide risk mitigation, this offers an opportunity to expand services to emission reduction components. For project lenders, this entails additional analysis on the quality of the financial flow from the CER value. For CER buyers, this requires assessment of the overall project since project performance is correlated with CER delivery.

Check Your Progress 14.2

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What are the three main types of transaction costs in CDM projects?

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2) How do CERs affect a project's Internal Rate of Return (IRR)?

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3) What happens under the unilateral model?

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4) What is a bilateral model in CER trading?

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14.8 RISK MANAGEMENT

CDM Projects Face Two Types of Risks: conventional project risks and CDM-related risks. Conventional project risks relate to uncertainties in project performance and in the market of project output, while CDM-specific risks refer to uncertainties in the Kyoto process and its implementation, as well as the market performance of carbon assets.

Project risks may be broadly classified into i) construction risks (referring to time and cost overrun), and ii) operational risks (involving technology performance, fuel, or product supply, market, operation, political, legal, environmental, and financial factors). Though these risks are generic to projects, they relate to project performance, which affects its ability to deliver the expected quantity of CERs.

On the other hand, CDM-related risks contain the following risk categories:

1. *Policy Risks:* this includes the risk that the Kyoto Protocol will not be ratified; the risk that the host country will not comply with its obligations; and the risk that specific baselines and procedures used in the project will not be approved.
2. *Market Risk:* CER pricing is highly speculative, and the development of the CER market and the evolution of CER prices are highly unpredictable.

Risk management principles apply to both categories of project risks,

1. Allocation of risks to contracting parties who best understand the risks, and
2. Transfer of risks to a third party who uses financial tools.

There are several financial tools for risk management; these include hedging, guarantees and insurance products. In financial hedging, the derivative markets are used to fix future prices of commodities, currencies and interest rates. The financial derivatives market can also be used for emission commodities. These include: call and put options, collars, swaps and forward contracts. With insurance, a third party is paid to bear a particular risk. Insurance is often used to mitigate political risks and natural hazards.

A number of international agencies provide political risk insurance and guarantees. The European Investment Fund, *for example,* offers guarantees on debt financing to infrastructure projects, including those in the energy sector. The International Bank for Reconstruction and Development (IBRD) likewise provides guarantees against interest rate conversions or swaps; interest rate caps and collars, currency conversions or swaps and commodity swaps. Several other risk mitigation organizations provide or broker mitigation products in the SO_2, NO^X emission reduction markets.

The PCF assumes CDM-specific risks and assigns project equity sponsors and creditors to bear project risks. In managing the Kyoto risk, the PCF i) seeks commitment from host countries for Kyoto Protocol ratification and compliance, and for the transfer of CERs; ii) shares this risk with project sponsors (in the case of Chile *for example,* PCF commits to a higher CER price once the Government ratifies the Kyoto Protocol and provides a letter of approval to PCF); and in some cases, requires the Kyoto ratification as a requirement in the carbon purchaze agreements. Exposure to baseline risks is managed by commissioning a rigorous

baseline study, monitoring plan and third-party validation. For market risks, the PCF assumes market risks and agrees to pay the contract price regardless of the actual market price at the time of delivery.

Project risks are assessed by commissioning rigorous and independent assessments of baseline and project risks, and structuring emission reduction purchase transactions to either mitigate risks or transfer them to parties that are best able to manage them. Tools in structuring transactions used by the PCF include over-collateralization (limiting the amount of emissions reductions that PCF commits to purchasing in a transaction), payment upon delivery, restrictions on upfront purchazes, structural seniority (purchasing emissions reductions generated in earlier years of the project), seniority in the purchase (establishing structurally that PCF has a senior interest in emissions reductions generated by the project), and credit enhancement through insurance, guarantees and other risk management tools.

Equity fund providers that target carbon credits include: DexiaFondElec, Energy Efficiency and Emission Reduction Fund (71 million Euros, since 2000). FondElec Latin American Clean Energy Services Fund (US$31 million, since 2001). Global-Asia Clean Energy Services Fund, FE Clean Energy Group (US$100-150 million) (seeking 20-25 % returns). Private-public partnerships that provide upfront financing to CDM projects include Climate Investment Partnership.

The Danish Government offers grants to firms in Thailand to kick-start CDM projects. In addition, the European Investment Bank intends to launch a Transaction Assistance Facility, which will help in project identification and preparation and carbon credit marketing. The facility will provide a grant, which is repayable from the revenue generated by the sale of carbon.

Check Your Progress 14.3

Note: a) Write your answer in the space given below.

b) Match your answer with the answer given at the end of the unit.

1) What are CDM-specific risks?

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2) What are policy risks in CDM projects?

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3) What are the two key principles of risk management in CDM projects?

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14.9 LET US SUM UP

The Clean Development Mechanism (CDM) was introduced under the Kyoto Protocol to support developed countries in achieving their greenhouse gas (GHG) emission reduction targets while promoting sustainable development in developing countries. CDM projects offer dual benefits— conventional outputs and additional income through the generation of Certified Emission Reductions (CERs), each equivalent to one tonne of carbon dioxide avoided or reduced.

The viability of CDM projects depends on several interrelated factors, including the quantity and market price of CERs and the associated transaction costs. These projects often involve high pre-operational, operational, and trading costs, which can significantly influence the net financial gain. Transaction costs tend to be higher for small-scale projects unless streamlined through fast-tracking procedures.

CER prices vary significantly across markets due to factors like technology type, project risk profile, and co-benefits. While wind and hydro projects yield moderate CER-related returns, methane capture and solid waste management projects can generate higher Internal Rates of Return (IRR) due to the higher global warming potential of methane.

CDM project financing can be structured through debt, equity, grants, or upfront CER payments. Financing arrangements may follow corporate or project finance models, and CER-related revenues are often used to enhance debt leverage or as collateral for additional funding. Risk management is an essential component of CDM project execution. Risks can be broadly categorized into conventional (*e.g.,* construction and operational) and CDM-specific (e.g., policy and market risks). Effective risk mitigation strategies include hedging, guarantees, insurance, and contract structuring.

CDM project management involves careful planning of project design, cost management, funding mechanisms, risk mitigation, and CER market engagement to ensure both environmental benefits and financial viability.

14.10 KEY WORDS

Additionality : The concept that a CDM project must result in emissions reductions that are additional to what would have happened without the project.

Baseline : The scenario or reference level of emissions that would have occurred in the absence of the CDM project.

Bilateral Model : A CDM project involving collaboration between a developing country and an industrialized country (Annex I) for CER generation.

Carbon Finance : Financial resources are provided in return for the reduction of GHG emissions, usually through CERs.

CDM (Clean Development Mechanism) : A mechanism under the Kyoto Protocol allowing industrialized countries to invest in emission reduction projects in developing countries and receive Certified Emission Reductions (CERs) in return.

Certified Emission Reduction : A certificate representing the reduction of one tonne of carbon dioxide (CO_2) equivalent, issued under the CDM.

IRR (Internal Rate of Return) : A measure of the profitability of a project, including financial gains from CERs.

Multilateral Model : A CDM financing model where emission reductions are purchased through a pooled investment fund managed by an institution such as the World Bank.

Project Viability : The ability of a project to be financially sustainable, taking into account both traditional revenue and income from CERs.

Risk Management : Strategies and tools used to minimise or transfer project and market-related risks in CDM projects.

Transaction Costs : All costs associated with designing, validating, registering, monitoring, verifying, and trading CERs.

Unilateral Model : A CDM project approach where the host country develops and finances the project independently.

14.11 SUGGESTED FURTHER READINGS/ REFERENCES

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14.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 14.1

1) Project viability refers to the economic, environmental, technical, and institutional feasibility of a CDM project to ensure it aligns with both climate goals and development priorities.

2) Economic viability, Environmental viability, technical viability and Institutional and regulatory viability.

3) The quantity depends on the amount of greenhouse gas displaced and the selected crediting period.

Check Your Progress 14.2

1) Pre-operational costs, Implementation (operational) costs and Trading costs.

2) CER revenues increase project IRRs by improving cash flow, though the effect varies by project type.

3) The host country develops and invests in the project, selling or banking the CERs and bearing all risks.

4) A partnership between a project developer and an Annex I country where CERs are exchanged through an Emission Reduction Purchaze Agreement (ERPA).

Check Your Progress 14.3

1) These are uncertainties related to the Kyoto process, its implementation, and the market performance of carbon assets.

2) Policy risks include: The risk that the Kyoto Protocol is not ratified, the host country may not comply with obligations, and Baselines and procedures may not be approved.

3) Allocation of risks to parties best able to manage them and Transfer of risks to third parties using financial tools.

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