Kyoto Protocol & Emissions Economics

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United Nations Framework Convention on Climate Change (UNFCCC)

- A global legal instrument (international agreement) to protect the climate system and stabilize GHG emissions
- The ultimate objective of the Convention is **"to achieve stabilization of atmospheric concentrations of greenhouse gases at levels that would prevent dangerous anthropogenic interference with the climate system**...
- Adopted in 1992, entered into force in 1994
- Status of participation: 189 Parties
- Contains 2 annexes:
  - Annex 1: countries with obligations to take measures to mitigate the effects of climate change
  - Annex 2: countries with obligations to provide financing to developing countries for their obligations under UNFCCC

UNFCCC Principles

- Convention's principles of "equity" and "common but differentiated responsibilities" respond to the fact that, although climate change is a global issue and must be tackled as such, industrialized countries have historically contributed the most to the problem and have also more resources to address it. Developing countries are more vulnerable to its adverse effects and their technological, economic and institutional capacity to respond is generally lower.

- The "precautionary principle" responds to the dilemma that although many uncertainties still surround climate change, waiting for full scientific certainty before taking action would be too late to avert its impacts

Kyoto Protocol – key points

- Adopted at third Conference of Parties (COP) to the UNFCCC in Kyoto in 1997
- Entered into force on February 16th, 2005 after ratification of the Russian Federation
- Until June 2007, 174 countries covering 61.6% of global emissions have ratified the protocol
- Six emissions: CO2, CH4, N2O, PFCs, HFCs, SF6
- Binding emission reduction targets for Annex I countries of 5.2% below 1990 over 2008-2012
- Non-Annex I countries have no binding targets but must report on their actions
- Annex I countries can achieve targets through domestic policies and three market mechanisms
- Non-Annex I countries can participate to facilitate sustainable development

key points

- 1988 - Intergovernmental Panel on Climate Change (IPCC) established, body of scientists advising UN on climate change
- 1997 - Representatives of 161 nations met in Kyoto, Japan for a UN meeting on climate change
- Kyoto Protocol - agreement reached during meeting to reduce CO2 emissions from 39 developed countries to 5.2% below 1990 levels by 2012.
- 2001 US pulled out of the agreement.
- Russia's recent ratification was enough for the Kyoto Protocol to take effect.

Kyoto Protocol Mechanisms

- **ET - Emissions Trading**

  AAU (Assigned Amount Units) are exchanged between Annex I countries

- **JI - Joint Implementation**

  Annex I investors receive ERUs (Emission Reduction Units) by investing in a project in another Annex I nation which reduces GHG emissions

- **CDM - Clean Development Mechanism**

  Annex I investors receive CERs (Certified Emission Reductions) by investing in a project in a non-Annex I nation which reduces GHG emissions

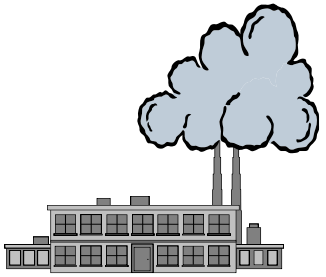
As the emission reductions from CDM projects are certified, unlike those for JI projects, they are termed Certified Emission Reductions (CERs). **one CER is equivalent to one ERU, assigned for a saving in any of the greenhouse gases equivalent in impact to one tonne of carbon dioxide emissions.**

Tonne Equivalent

- The different GHGs have different potentials to impact on Climate Change, so one ERU is awarded for emission reductions in any of the greenhouse gases equivalent in impact to one tonne of carbon dioxide (CO_2) emissions (1 t CO_{2e}).

- For example, methane (CH_4) has a global warming potential of 21; this means that one tonne of methane has the same climate change impact as 21 tonnes (t) of CO_2, and hence 1 t CH_4 = 21 t CO_{2e}. This means that landfill gas projects involving methane emission reductions can be particularly attractive, because they can generate large amounts of ERUs.

What Annex I countries can do . . . ?

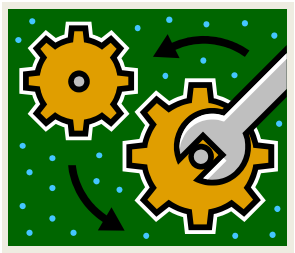


Limitations of CO2 emissions in developed countries (Annex I)

4 options for companies

1/ Pay expensive **fines.**

2/ Carry out carbon reduction through **processes improvement**.



3/ Buy emissions credits on the **CO_2 market (ETS).**

4/ Carry out carbon reduction through technology transfers in **CDM or JI project.**

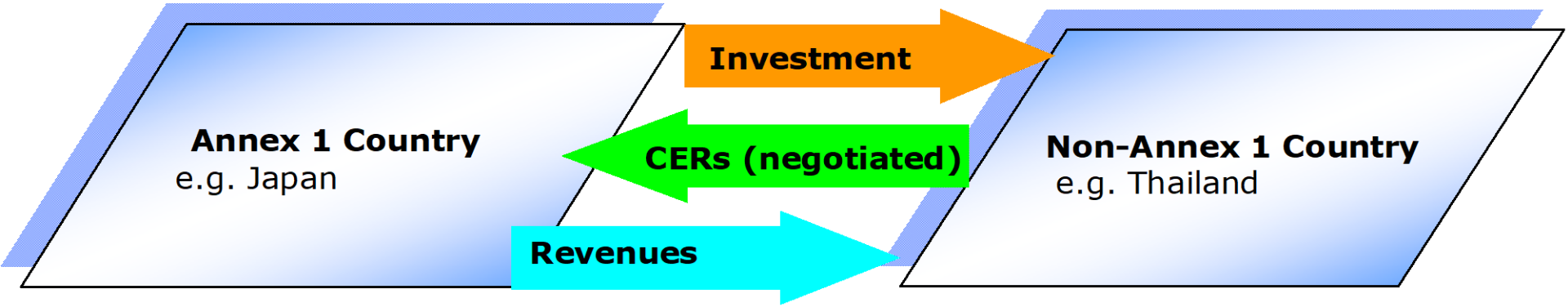
JI Project example

A UK company might seek to build a hydro power plant in New Zealand, that will displace electricity from the national grid. The project must replace an existing high greenhouse gas emitting source with a lower emitter; i.e. the reduction in emissions must be 'additional' to that occurring under a 'business as usual' scenario. The project would not, for example, generate emission reductions if it replaced a national electricity mix that was mostly composed of hydropower. Each project must have an agreed baseline against which the ERUs are calculated.

A UK company will be able to use the credits towards its emission reductions target under the EU Emission Trading Scheme (if it has such a target), or it could choose to sell the credits, either now (as a futures option or contract) or once they have been verified

How CDM works?

- Annex I country invests in GHG reduction project in non-Annex I country
- Annex I country receives CERs
- Non-Annex I country receives revenues from CERs

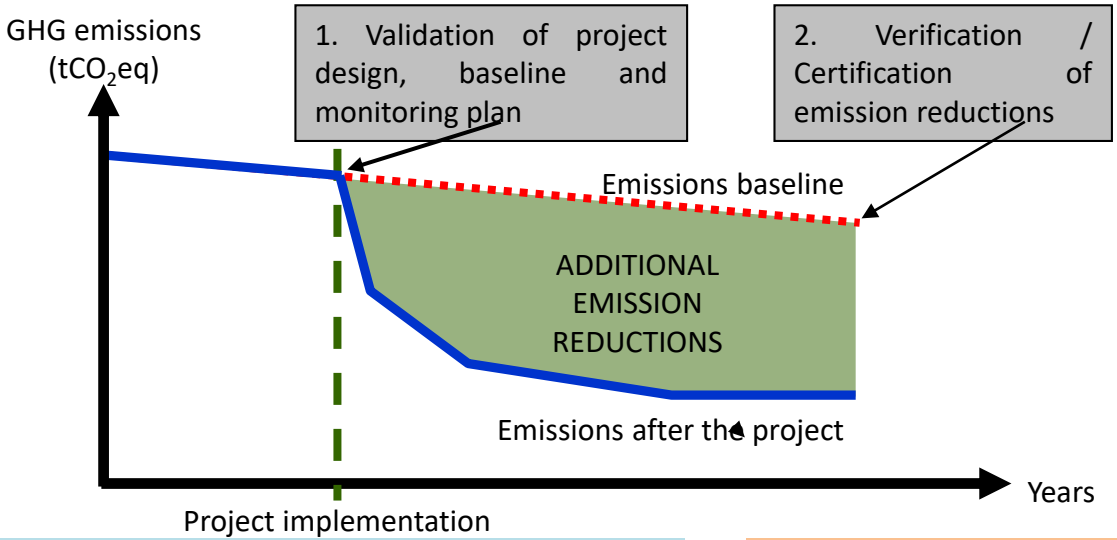


CDM Project example

An example of a CDM project would be the use of biomass to displace the use of diesel for electricity generation in the sugar production process in a developing country. To be eligible, a CDM project must replace a planned or existing high greenhouse gas emitting source with a lower emitter, and the reduction in emissions must be 'additional' to that which would occur under a 'business as usual' scenario. Each project will have an agreed baseline against which credits are calculated. Each project will also need to demonstrate its contribution to sustainable development in the host country, as determined by the host country Government.

CDM Eligibility

- Will the project reduce emission types under the Kyoto Protocol?
  CO2, CH4, N2O, HFCs, PFCs, SF6
- Does the country meet sustainable development requirements of the host country?
  - **Economy, e.g. creation of employment**
  - **Ecology, e.g. reduction of air pollution**
  - **Social, e.g. improved availability of public services**
- Are emission reductions additional?



CDM Eligibility

- Does the project fall into one of the seven project type categories?
  - End-use energy efficiency
  - Supply-side energy efficiency
  - Renewable energy
  - Fuel switching
  - Methane reduction
  - Industrial processes
  - Sequestration and sinks
- Does the project result in significant negative environmental impacts?
  - If “yes”, then environmental impact assessment (EIA) required
  - Covers non-GHG impacts
  - Significant impacts may disqualify project for CDM
  - EIA brings additional costs to the company

The opportunities for reducing energy usage and lowering environmental impact

- Managing energy more efficiently performing energy assessment/audits, utilizing energy management training, and implementations programs
- Upgrading existing equipment < shifting to more energy-efficient processes (e.g. from wet to dry)
- Utilizing biomass fuels
- Utilizing waste fuels
- Replacing high-carbon fuels by low-carbon fuels (e.g. shifting from coal to natural gas)

Example 4.12: Say, a proposed CDM project involves use of ethanol to substitute 10% gasoline in a fleet of 1000 private cars. Assume that on average cars consume 0.1 litre of gasoline per km and the average annual travel is 10,000 km. Substitution of gasoline by ethanol does not result in any change in fuel use efficiency; therefore, the reduction in gasoline is equal to the amount of ethanol used in the cars.

The baseline for example 4.12 can be estimated as shown below.

Fuel consumption of a car per km (A)	= 0.1 litre gasoline (0.074 kg)
Average annual distance traveled per car (B)	= 10,000 km
Number of cars covered in the project (C)	= 1000
Emission factor of gasoline(kgC/ tonne) (D)	= 847 (IPCC default for gasoline)
Emission baseline (tonne CO_2) (E = AxBxCxDx44/12)	= (0.074x10,000x1000x0.847)x 44/12 = 2298.2
Project emission (tonne CO_2)	= 0.9x2298.2 = 2068.4*

**: In project case 10% of gasoline consumption is replaced by ethanol, which is produced from organic sources and has zero GHG emissions. Therefore, only 90% of baseline gasoline used in baseline results in emissions during project case.*

Pollution Permit Trading

- It is a market-based approach to controlling pollution. By creating tradable pollution permits it attempts to add the profit motive as an incentive for good performance, unlike traditional environmental regulation based solely on the threat of penalties.

- Developed in the 70s and 80s, emissions trading was introduced in the US in 1990 to combat acid rain, but more recently it has grown in prominence as a way of tackling greenhouse gas emissions linked to climate change.

- Emissions trading is a central element of the Kyoto protocol in the form of the Clean Development Mechanism (CDM) and is the cornerstone policy of the EU, whose Emissions Trading System (ETS) is the largest in the world.

- Marketable pollution permits equate marginal abatement cost (MAC) across polluters so each firm compares their MAC with the price of the permit.

  - If MAC > price of permit: buy more permits, pollute more (cheaper to pollute)

  - If MAC < price of permit: sell more permits, pollute less (cheaper to clean up)

Example

There are three industrial firms in a cluster, with the following profiles:

Firm	Initial Pollution Level [units]	Marginal Abatement Cost [$]
A	70	20
B	80	25
C	50	10

The government wants to reduce pollution in the cluster to 120 units. It gives each firm 40 tradable pollution permits.

- Each firm has 40 permits. Therefore**, if no trading:**

A abates 70 – 40 = 30 x $20 = $600
B abates 80 – 40 = 40 x $25 = $1,000
C abates 50 – 40 = 10 x $10 = $100

Total abatement cost: $1700

However, if the equilibrium permit price is $20. so $20/permit:

both A and C want to sell permits to B since it is cheaper for them to clean-up rather than pollute – excess supply of pollution permits (not equilibrium).

A is indifferent since price = MAC, abates 70 – 40 = 30 x $20 = $600 (A has 40 permits)
B buys all permits from C, so ***zero*** abatement costs (B has 80 permits)
C sells all permits, so has to abate all original emissions 50 x $10 = $500
(C has 0 permits)

Total abatement cost: $1100