

A Global Account of Potential Carbon Trade Based on Kyoto Mechanism

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Abstract : In order to restrict global warming within a limit, the maximum allowable emission of Greenhouse Gases (GHG) in the atmosphere has been determined. To keep the actual emission within permissible limit the countries at different emission levels are required to set different emission reduction targets. Initiated by the Kyoto Protocol, the setting of emission reduction target by the industrialized countries has unfolded new dimensions in the domain of emissions trade. This paper tries to give an account of potential demand of carbon credits on the basis of excess emission of industrialized countries. It is an estimate of potential trade because Kyoto target has been set to be met during 2008-2012 while this paper applied the emission target of Kyoto on the basis of 2006 emission level. Although USA did not ratify the Kyoto treaty and undertook no obligation to bring down emission to below 1990 level, this paper included USA in accounting of global emission and potential trade of carbon credit. The Clean Development Mechanism (CDM) under Kyoto has unfolded opportunity for the developing countries to produce carbon credits for being used by the industrialized countries to meet their Kyoto target. The study has also estimated the supply of credits from CDM projects with particular reference to India. The study indicated the responsibility of the polluter nations to pay and assessed the reward accruing to the countries pursuing emission reduction.

Key words: Global warming; emission reduction target; Kyoto Protocol; Clean Development Mechanism; carbon credit; carbon market.

1. Introduction

In view of the colossal risk of global warming, the urgent necessity is to limit the emission of Greenhouse Gases (GHG) by setting emission reduction target and by ensuring compliance to the target. Kyoto Protocol set emission reduction targets for the industrialized countries and introduced flexible mechanisms for economically achieving the targets. It created market of the carbon credits representing saving of emission of GHG in the atmosphere equivalent to one ton of carbon dioxide. If a country's emission exceeds the target level, the excess has to be accounted for by securing carbon credits from the emission saving sources. This gives rise to demand of carbon credits and its price in turn attracts supply of carbon credits through saving of emission. The motivations behind the present study are:

1. To present a chronology of the emission reduction targets in order to limit global warming
2. To present an account of the growth of global carbon market

3. To study the supply of carbon credits through CDM projects, in particular.
4. To estimate potential demand for carbon credits on the basis of Kyoto target.
5. To indicate the responsibility of the nations making excess emissions.
6. To estimate India's prospect in response to this global opportunity.

Accordingly, the paper has been arranged in the following order:

- Emission reduction target
- Emission reduction policy
- Kyoto mechanism
- Carbon market growth
- Potential demand from the leading Kyoto based "Emission Excess" countries
- Generation of carbon credits in developing countries including India
- Concluding observations

2. Emission Reduction Target

The 1995 Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) upheld the risk of severe climate change impacts for a temperature rise beyond 2°C above pre-industrial levels. Consequently, the European Commission set 2°C as the European Union's target ceiling (Niklas Höhne, Christian Ellermann, 2008). The world has already experienced a temperature increase of 0.8 °C and IPCC noted further addition of 0.6°C unavoidable due to past emission. To ensure 50% probability of restricting the temperature rise within 2°C, the concentration of Greenhouse Gases (GHG) in the atmosphere must be stabilized at or below 450 ppm CO₂e. In order to meet these targets worldwide, cumulative emissions of GHG must be limited to approximately 1700 Billion tCO₂e (ton of carbon dioxide equivalent) for the period 2000 to 2050. Out of the total of 1700 Billion tCO₂e, 330 Billion tCO₂e has already been emitted till 2007 (Mayer, 2007).

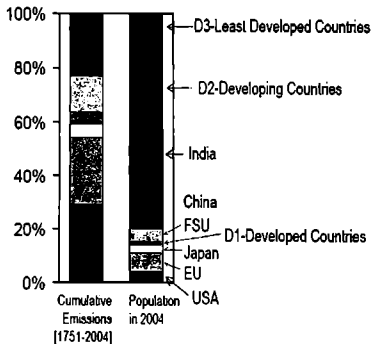
Carbon Budget 2007 issued by Global Carbon Project in September 2008 presented a global view of cumulative fossil fuel emission for different countries/group of countries, as shown in Figure 1. It appears that US, EU and Former Soviet Union (FSU) followed by other developed countries and Japan with less than 20% of global population are responsible for about 75% of global cumulative emission from fossil fuel. In order to equalize the per capita cumulative emission in the long run it is obvious that the industrialized countries should reduce their emission at a higher rate than the developing countries. Emission of CO₂ representing 77% of GHG has reached 383 ppm in 2007 at a growth rate of 2 ppm/y.

For achieving the overall goal, different emission reduction targets are fixed at different levels in different time frames. Two of them are binding upon the agreed parties: Kyoto Protocol (KP) target and European Union (EU) target, while the others are guidelines or suggestions.

Figure 1

A Global View of Cumulative Emission and Population

Source : <http://www.globalcarbonproject.org>



The Kyoto Protocol sets targets for industrialized countries to reduce their GHG emissions to be measured in ton of carbon dioxide equivalent by an average of 5.2% below 1990 levels in the period 2008-2012, known as the first commitment period.

At the European Council, the EU set the unilateral target to cut its greenhouse gas emissions by 20% by 2020 compared to 1990 levels (Höhne and Ellermann, 2008).

The European Council agreed that developed countries should commit to collectively cutting their emissions by about 30% by 2020, compared to 1990 levels, as part of an international agreement, and by 60% to 80% by 2050. The Council supported a 30% cut in the EU's emissions by 2020, provided that this international agreement is successfully concluded (Europa, 2007)

The IPCC states that emissions in Annex I countries need to be -25% to -40% below the 1990 level in 2020. In addition, emissions in non-Annex I countries need to be reduced by 15% to 30% below the baseline—i.e. below the most current business-as-usual GHG emission projections.

Starting in 2012, the American Clean Energy and Security Act (ACES) is intended to establish annual tonnage limits on emissions of carbon and other global warming pollutants from large U.S. sources like electric utilities and oil refiners. Under these limits, carbon pollution from large sources must be reduced by 17% below 2005 levels by 2020 and 83% below 2005 levels by 2050.

The Union of Concerned Scientists estimated the required reduction in the order of

40%–50% globally below the 2000 levels by 2050 (Luers, 2007). For the industrialized nations cumulative emission during 2000–2050 must be no more than 700 billion tCO₂e (40% of global budget). The required reduction is estimated at 70%-80% for the industrialized countries. Out of the total budget of 160-265 billion tCO₂e during 2000-2050 US had already emitted 45 billion tCO₂e by 2007 and it requires reducing emission at least at 80% from 2000 level by 2050. Average developing nation must reduce GHG emission by 25% below 2000 level by 2050. However China alone accounting for 1/3rd of the total emission of the developing countries should reduce emission at a rate higher than the average of 25%.

The following table (Table 1) shows a list of emission reduction targets. The first column shows the name of the authority fixing the target. The status of the target i.e., whether it is binding on the parties or it is mere expression of desirable behavior, is stated in the second column. The countries for which the targets are set have been mentioned in the third column. The rate of emission reduction has been given in the fourth column. The target reduction has been set with respect to a base-year level of emission. That base year is shown in column five. Lastly, the year by which the target reduction should be achieved has been stated in column six.

Table 1 : Target Reduction Calendar

Authority	Status	For Countries	Target reduction	Base level	Compliance by the year
KP	Binding	Industrialised Countries	5.2%	1990	2012
EU	Binding	EU	20%	1990	2020
ACES	Binding or enactment	US (Eqv to 4% 1990)	17%	2005	2020
EU	Desirable	Industrialised Countries	30%	1990	2020
EU	Desirable	Industrialised Countries	60%-80%	1990	2050
IPCC	Desirable	Industrialised Countries	25-40%	1990	2020
IPCC	Desirable	Developing Countries	15-30%	Baseline 2007	2020
UCS	Desirable	Global	40-50%	2000	2050
UCS	Desirable	Industrialised Countries	70-80%	2000	2050
UCS	Desirable	US	Atleast 80%	2000	2050
UCS	Desirable	Developing Countries	25%	2000	2050

[KP: Kyoto Protocol; EU : European Union; ACES: The American Clean Energy and Security Act; IPCC : Intergovernmental Panel on Climate Change; UCS : Union of Concerned Scientists]

3. Emission Reduction Policy

The policies resorted to for achieving emission reduction are :

- ♦ *Command and control policy* is used by national governments to control emission by command and enforcement where the economy has two options: incur necessary cost for abating emission or stop the emission generating production/use/consumption.

- ♦ **Taxation policy** includes emission tax, output/consumption tax, incentives, subsidies and other direct and indirect taxes whereby the emitter has to pay tax on emission or has to abate emission. The producer can continue production along with emission above the limit by making payment of appropriate tax. This leaves more space to the producer for choosing economic alternative between tax and cost of abatement.
- ♦ **Market policy** (Cap-and-trade policy) fixes a cap or ceiling on the emission. Emission in excess of the limit attracts penalty or tax. But there is another alternative made available to the producer. He may purchase the emission reduction achieved at any other source at a lower cost from the emission market and use that to account for the excess emission. By the process actually he can outsource the abatement at a lower cost. The Kyoto Protocol through flexible mechanisms and EU through EU ETS have made use of the Cap and Trade or market policy.

4. Kyoto Mechanism

Kyoto Protocol (1997) has designed three market-based “flexible mechanisms”: (i) Emissions Trading (ET), (ii) Joint Implementation (JI) and (iii) the Clean Development Mechanism (CDM). ET is called “allowance-based” mechanism because allowances are allotted to the sources of the greenhouse gas (GHG) emissions whereas JI and the CDM are called “project-based” mechanisms because actual projects are undertaken for emission reduction. CDM projects can only happen in developing countries which do not have an emissions reduction target under the Kyoto Protocol. As such, CDM is the only part of the Kyoto Protocol which directly involves developing countries like India in reducing greenhouse gas emissions. CER is the credit for GHG emission reduction of one ton of carbon dioxide equivalent. Under CDM mechanism industrialized countries get CER from developing countries; developing countries get revenue (for transfer of CER), investment and technology from the industrialized countries and the global environment gets emission reduction from CDM projects (Figure 2).

Figure 2 : CDM : Role of Industrialised and Developing Countries

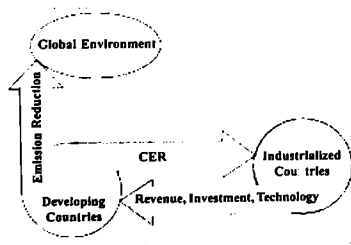
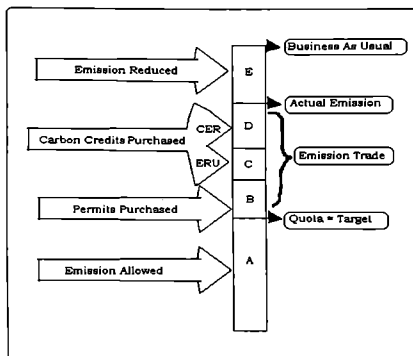


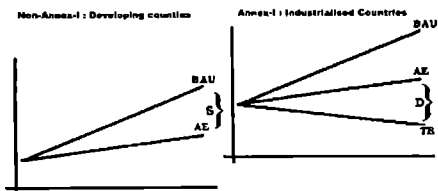
Figure 3 shows the use of allowances or credits in accounting for the shortfall in agreed reduction of emission. While emission under business-as-usual is $A+B+C+D+E$ and target or quota of emission is only A , actual emission can be reduced to $A+B+C+D$ resulting in a shortfall of $B+C+D$. B is accounted for by purchase of allowances or permits, while C and D are accounted for by purchase of carbon credits, C being the emission reduction units (ERU) from JI projects and D being CER from CDM projects.

Figure 3 : How is the Demand for Carbon Credit Created?



Carbon trading as per Kyoto market mechanism takes place by fixing a target emission for industrialized (Annex-I) countries, which create demand of carbon credits, which in turn induces emission savings for developing (Non-Annex-I) countries. Figure 4 helps explain the process.

Figure 4 : Position of Annex-I and Non-Annex-I Countries In Generating Demand and Supply of Carbon Credits



BAU (business as usual) is the emission level for business-as-usual. AE is the actual emission. S is supply of carbon credits arising from saving in emission when AE is less than BAU. TE is target emission. When actual emission exceeds target emission, such emission-reduction-deficit gives rise to demand for carbon credits. S of Non-Annex-I countries can be traded for meeting D of the Annex-I countries.

5. Carbon Market

The world greenhouse gas emissions market are classified into three groups:

- The Kyoto market:
- The European Union Emission Trading System (EU ETS) and
- Regional and voluntary markets in places.

The global emission market has shown a significant growth particularly from the first phase of the EU ETS, 2005-2007. Table 3 shows the volume (million tCO₂e) and value (million US \$) of the emission market, popularly referred to as 'carbon market' over a period of five years 2005, 2006, 2007, 2008 and 2009.

Table 3 : Global Carbon Markets

Markets	2005		2006		2007		2008		2009	
	M tCO ₂ e	MUS\$	M tCO ₂ e	MUS\$	M tCO ₂ e	MUS\$	M tCO ₂ e	MUS\$	M tCO ₂ e	MUS\$
Primary CER	341	2417	537	5804	552	7433	404	6511	211	2678
Secondary CER	10	221	25	445	240	5451	1072	26277	1055	17543
JI ERU	11	68	16	141	41	499	25	367	26	354
Voluntary	20	187	33	146	43	263	57	419	46	338
EU ETS	321	7908	1104	24436	2060	49065	3093	100526	6326	118474
NSW	6	59	20	225	25	224	31	183	34	117
CCX	1	3	10	38	23	72	69	309	41	50
RGGI							62	198	805	2179
UK ETS	0	1								
AAUs							23	276	155	2003
Global Total	710	10864	1745	31235	2984	63007	4811	126345	8700	143735

Source: The World Bank: State and Trend of Carbon Market (2007, 2008, 2009& 2010)

A major part of Kyoto carbon credits are also traded through the EU ETS. Although the CER can be used for meeting emission reduction commitment of Kyoto Protocol from 2008, the European Union Emission Trading System (EU ETS) has started operation in 2005 and it allows the use of CER for EU ETS compliance. The primary CDM market refers to the forward market of un-issued CER and the secondary CDM market refers to the market of guaranteed or issued CER.

Over the five year period 2005-2009 carbon market has grown from 710 million tCO₂e to 8700 million tCO₂e in volume and from US\$10.86 billion to US\$ 143.74 billion in value. The Regional Green House Gas Initiative (RGGI) in US made a significant growth in first two years of its starting, 2008 and 2009, although EU ETS alone maintains over 80% share in the global market throughout the period. The Kyoto market had grown significantly up to first

half of 2008 and thereafter on the face of recession worldwide the market started to fall sharply in 2009 and farther due to indecisiveness of the Copenhagen Accord in December, 2009 the declining phase continues in 2010.

6. The Potential Demand of Carbon Credits

The Kyoto Protocol had set emission reduction targets for the Annex B countries including US, taking 1990 emission level as the base. Accordingly GHG emission data of the Annex B countries for the years 1990 and 2008 (latest available) were considered in the study. The target reduction has been applied on the 1990 level to find the target emission level. The 2008 actual has, then, been compared with the Kyoto target level and excess emission countries were identified. The actual emission of 2008 for the leading emission countries are compared to the Kyoto target and the excess is measured and presented in Table 4.

Table 4 : Excess over KP Target

Countries	1990	KPTarget	Target	2008 Actual	Excess Emission
	(MtCO ₂ e)	%	(MtCO ₂ e)	(MtCO ₂ e)	(MtCO ₂ e)
United States	6112	93	5684	6925	1241
European Union (15)	4245	92	3905	3970	65
Japan	1269	94	1193	1282	89
Canada	592	94	556	735	178
Australia	418	108	452	550	98

[http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3841.php accessed on 02-12-10]

The excess emission needs be accounted for and offset by 'Carbon Credits'. Taking the average price of 2008 the value of demand of carbon credits for 2008 for the leading emission excess countries has been shown in Table 5.

Table 5 : Potential Demand from Leading Emission Excess Countries at 2008 Average Price

Country	Excess GHG	Demand 2008
	M. tCO ₂ e	M. US\$
United States	1241	32577
European Union (15)	65	1717
Japan	89	2346
Canada	178	4680
Australia	98	2566

The average prices of carbon credits and allowances are observed to rise over the period of first three and half years till mid of 2008 and following the world recession it declined sharply in 2009 and in 2010. The global average price data up to 2009 are shown in the table 6.

Table 6 : Average Price Growth (US\$)

Carbon Market	2005	2006	2007	2008	2009
Primary CER	7.09	10.81	13.47	16.12	12.69
Secondary CER	22.10	17.80	22.71	24.51	16.63
Jl ERU	6.18	8.81	12.17	14.68	13.62
Voluntary	9.35	4.42	6.12	7.35	7.35
Credit Market	7.48	11.06	16.07	21.55	15.63
EU ETS	24.64	22.13	23.82	32.50	18.73
NSW	9.83	11.25	8.96	5.90	3.44
CCX	3.00	3.80	3.13	4.48	1.22
RGGI				3.19	2.71
Global Total	15.30	17.90	21.11	26.26	16.52

Source: State and Trend of Carbon Market 2007, 2008, 2009& 2010, The World Bank

Although EU, Australia and Japan agreed to participate in the buyers' market as per Kyoto Protocol USA and Canada did not. Had USA agreed to undertake their obligation for meeting the Kyoto target the global demand for carbon credits could have risen by about 1241 Million tCO₂e p.a. at an approximate value of US\$ 32.6 billion p.a. at the average price of US\$ 26.26 per tCO₂e for 2008.

7. Supply of Carbon Credits through CDM

In the supply side CDM is a major source of carbon credits. As on 02-12-2010, 70 developing countries have 2565 registered CDM projects with annual CER generation capacity of 403 million with expected CER until end of 2012 estimated at 1870 million.

China came first contributing 61% of global total alone and India came second with annual emission reduction of 45 million CER (11% of the global total). Table 7 presents the global supply of CER with country wise break up for the top five countries.

Table 7 : Expected Annual Supply from CDM Projects Registered Till 02-12-2010

Country	No. of Projects	MillionCERs pa
China	1065	249
India	572	45
Brazil	179	21
Mexico	124	10
Malaysia	86	5
Total	2565	403

Source: <http://cdm.unfccc.int/Statistics/index.html> accessed on 02-12-2010

It appears that India stood second in number of projects and annual CER generation capacity although it is lagging far behind China. The project approval being granted for 10 years the

total amount of CER to be generated by India by the 572 projects registered till 02-12-2010 amounts to 450 million. Secondary Market price of CER in December 2010 is around US\$11.67 (Source: <http://www.pointcarbon.com>). At current price India's CER pa valued at 521 million US\$ i.e. about Rs. 23.58 billion.

8. Conclusion

This paper has tried to establish that Kyoto emission reduction target and EUETS are the two major forces that started operation in 2005 and till 2009 they contributed to raise the carbon market from 10 billion US\$ in 2005 to 144 billion US\$ in 2009. The corresponding trade of carbon credits and allowances represent 710 M tCO₂e GHG in 2005 and 8700 M tCO₂e in 2009. As the carbon credits and allowances are supposed to attest saving of GHG emission at any sources on the planet the growth of carbon market is also indicative about the global saving in GHG emission. The Kyoto Protocol attempted to make the industrially developed countries pay for emission in excess of the target. The developing countries having no target are rewarded for achieving emission reduction. European Union made actual reduction from 1990 level and undertook the lion's share in the buyers' market. US having the largest share in the industrialized countries total emission and having over 13% emission increase during 1990-2008 did not accede to Kyoto reduction target. The present study estimated their Kyoto obligation at US\$ 32.6 Billion for the year 2008.

India as a supplier of carbon credits stood second to China with 11% share in global CDM capacity and at the current market price the sale value of its annual capacity is estimated at Rs. 23.58 billion.

The second compliance period of Kyoto and the third phase of EUETS i.e., the period from 2012 to 2020 are very much important for the industrialized countries including US to undertake the responsibility of accepting the cap (target) and for the developing countries to achieve emission reduction and to promote carbon trade so as to ensure a sustainable global climate.

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