VII. POTENTIAL OF CARBON MARKETS

7.1. INTRODUCTION

544. This chapter provides an analysis of the carbon market to 2030. The carbon market is the market for GHG emission reductions (credits) and rights to release GHG emissions (allowances).[57]

545. CHAPTER VII.2 reviews the existing markets. The largest markets are those established by the Kyoto Protocol and Parties that have emissions limitation commitments under the Protocol. CHAPTER VII.3 focuses on prospects for those markets in the short term – 2008 to 2012. CHAPTER VII.4 develops estimates of the potential size of the carbon market in 2030.

7.2. CARBON MARKETS

7.2.1. EXISTING CARBON MARKETS

546. The Kyoto Protocol established emissions limitation commitments for industrialized country (Parties included in Annex B to the Kyoto Protocol or Annex B Parties) Parties for the period 2008 – 2012 and established three mechanisms – the CDM, JI and International Emissions Trading – they can use to help meet those commitments. Most Annex B Parties plan to use emissions trading systems to regulate the emissions of fossil-fired electricity generators and large industrial emitters to help comply with their Kyoto Protocol commitments for the period 2008 – 2012. Those emissions trading systems are already operational in the Member States of the EU and Norway. The United Kingdom of Great Britain and Northern Ireland has sources that participate in the emissions trading scheme (ETS of the EU) and that participate in a domestic scheme.

547. The EU ETS is by far the largest market in terms of number of participants and trading activity. Trading activity is shifting from allowances that can be used for compliance during Phase I (2005 – 2007) to allowances that can be used for compliance during Phase II (2008 – 2012). Credits created by CDM projects (certified emissions reductions or CERs) are the second largest market. The CDM was the first of the three Kyoto mechanisms to be implemented.

548. Emissions trading systems are also operating in Australia (the New South Wales–Australian Capital Territory GHG abatement scheme) and the United States (the Chicago Climate Exchange). The quantities traded in the markets established by these systems and the voluntary market[58] are much smaller than those in the EU ETS and the CDM market.

549. FIGURE VII-33 at the end of this CHAPTER VII.2.8 and TABLE 18-ANNEX V provide an overview of the existing carbon markets in 2006.

7.2.2. KYOTO PROTOCOL MARKETS

550. Annex B Parties can meet their Kyoto Protocol commitments for the period 2008 – 2012 through a combination of domestic emission reduction and sink enhancement actions and purchases of various allowances and credits from other countries, through the three Kyoto mechanisms. Each of these mechanisms creates a market for specific units (allowances/credits). These markets are at different stages of development, with the CDM market being the most advanced.

7.2.2.1. CLEAN DEVELOPMENT MECHANISM

551. The CDM enables a project to mitigate climate change in a non-Annex I Party to generate CERs.[59] The CDM was launched in November 2001, the first project was registered about three years later, and the first CERs were issued in October 2005. CERs can be issued for verified emission reductions achieved since 1 January 2000. Rules for some categories of CDM projects were adopted later; afforestation and reforestation projects (December 2003), small-scale afforestation and reforestation projects (December 2004) and programmes of emission reduction activities (December 2005).

552. CDM projects must use an approved methodology and be validated by an accredited designated operational entity (DOE). CERs are issued by the CDM Executive Board only after the emission reductions achieved have been verified and certified by an accredited DOE. Thus a CDM project incurs costs (validation of the project) before it can be registered, and further costs (certification of the emission reductions) before CERs are issued.[60]

ANNUAL EMISSIONS REDUCTIONS AND REVENUE FROM CERS

553. To help defray the cost of implementing the project, proponents often agree to sell some of the expected CERs before the project has been implemented. Capoor and Ambrosi (2007) indicate that expected CERs from projects at an early stage command 2006 USD 10.40–12.40, registered project transactions command close to 2006 USD 14.70 and issued CERs are trading at 2006 USD 17.75. The lowest prices reflect risks that the proposed project might not be registered and might not deliver the expected emission reductions. Once a project is registered the uncertainty is limited to the timing and size of the emission reductions.[61] Once CERs are issued, delivery to an Annex B Party registry where they can be used for compliance is the only uncertainty and they therefore command the highest prices.[62]

554. At the end of 2006 the 1,468 projects in the CDM pipeline were expected to yield annual emission reductions of 251 Mt CO_2 eq.[63] Experience to-date suggests that CDM projects achieve about 85 per cent of the projected emission reductions (Fenhann, 2007).

[57] Allowances and credits are also called permits, quotas, offsets, and names unique to the specific market.

[58] For details, see CHAPTER VII.2.8.

[59] Afforestation and reforestation projects under the CDM can generate temporary certified emission reduction (tCERs) or long term certified emission reduction (lCERs), which have limited lifetimes. For ease of exposition CERs will include tCERs and lCERs unless explicitly stated.

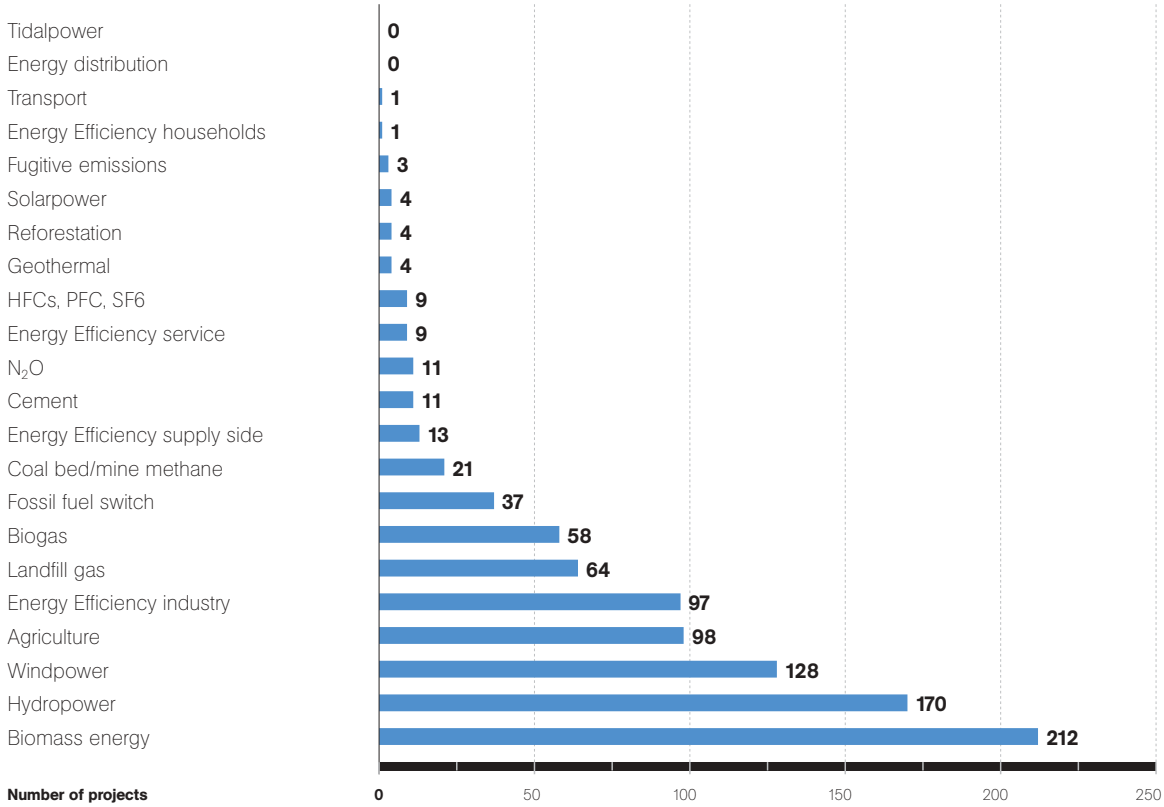
[60] This staged approach to issuing CERs increases environmental integrity and reduces financial risks for project proponents.

[61] In each, the price also depends on how the risks are shared between the buyer and the seller, through penalty provisions or requirements to replace CERs that could not be delivered.

[62] CERs issued are delivered to the buyer in a special account in the CDM registry by the CDM Executive Board, but they cannot be transferred to an account in an Annex B Party national registry until the International Transaction Log (see CHAPTER II.2.2) is operational.

[63] The number of projects in the pipeline at the start of the year was 513, with estimated annual emission reductions of 107 Mt CO_2 eq.

Figure VII-26. **Projects that entered the clean development mechanism pipeline in 2006, by project type/sector**



555. FIGURES VII-26 and -27 provide the sectoral distribution of projects under the CDM pipeline and related emission reductions.

556. Because the CDM is still in its infancy, the number of projects registered and the projects entering the CDM pipeline (having a public project design document) are used as measures of activity.[64] The distribution of projects registered and those that entered the pipeline during 2006 are shown in TABLE 19-ANNEX V together with the estimated annual emission reductions, and potential revenue from the sale of the CERs (see FIGURES VII-28 and VII-29).

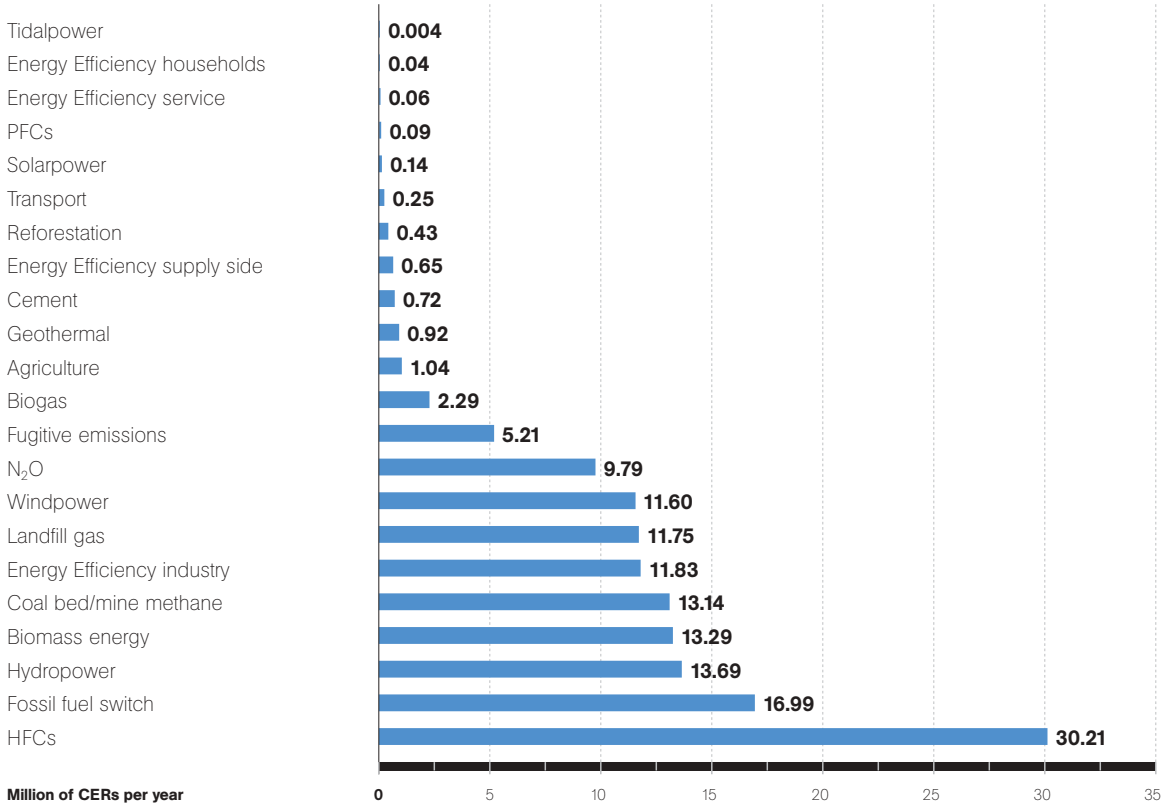
557. The estimated annual emission reduction from the projects registered during 2006 is 88 Mt CO_2 eq and from projects that entered the pipeline during 2006 is 144 Mt CO_2 eq. The estimated revenue from the sale of CERs generated by the CDM projects registered during 2006 is USD 1–1.5 billion per year and the estimated revenue from the sale of the CERs generated by the CDM projects that entered the pipeline during 2006 is USD 1 billion higher. Capoor and Ambrosi report transactions for about 450 Mt CO_2 eq in this market during 2006 at an average price of about USD 10.70 per t CO_2 eq. Thus the transactions averaged about three to five years of projected emission reductions for the new projects.

558. China dominates the CDM market, as it is the source of over 53 per cent of the estimated annual emission reductions of the projects that entered the pipeline during 2006. Capoor and Ambrosi note that, as the dominant supplier in the CDM market, China's informal policy of requiring a minimum acceptable price (around USD 10.40–11.70 or EUR 8–9 in 2006) before providing approval to projects had a significant stabilizing impact on the market price.

ANNUAL INVESTMENT IN CDM PROJECTS

559. The capital[65] that is, or will be, invested in CDM projects registered during 2006 is estimated at about USD 7 billion whereas the capital that is, or will be, invested in projects that entered the CDM pipeline during 2006 is estimated at over 2006 USD 26.4 billion (TABLE 19-ANNEX V).[66]

Figure VII-27. **Estimated certified emission reductions from projects that entered the clean development mechanism pipeline in 2006, by project type/sector**



560. Of the USD 26.4 billion approximately 50 per cent represents capital invested in unilateral projects by host country project proponents. Unilateral projects are these for which the project proponent in the developing country Party bears all costs before selling the CERs. At the end of 2006, about 60 per cent of the projects, representing about 33 per cent of the projected annual emission reductions, were unilateral projects.[67] India is home to the most unilateral projects (33 per cent of projected annual emission reductions of projects in the pipeline at the end of 2006), followed by China (20 per cent), Brazil (11 per cent) and Mexico (6 per cent).

561. Over 80–90 per cent of the capital, USD 5.7 billion for registered projects and almost USD 24 billion for projects that entered the pipeline, went into renewable energy and energy efficiency projects. Although these projects represent only about 20 per cent of emission reductions, as can be seen in TABLE 20-ANNEX V, they have high capital costs per unit of emission reductions.

562. The estimated investment of USD 5.7 billion for CDM renewable energy and energy efficiency projects registered during 2006 is roughly triple the ODA support for energy policy and renewable energy projects in the same countries – about USD 2 billion (TABLE 20-ANNEX V). It is almost as much as the private investment in renewable energy and energy efficiency (2006 USD 6.5 billion) in the same countries.[68] China and India receive most of the CDM investment and private investment.

[64] Almost all projects that enter the pipeline get registered. Only 10 of the 1,478 projects to enter the pipeline by the end of 2006 had been rejected or withdrawn.

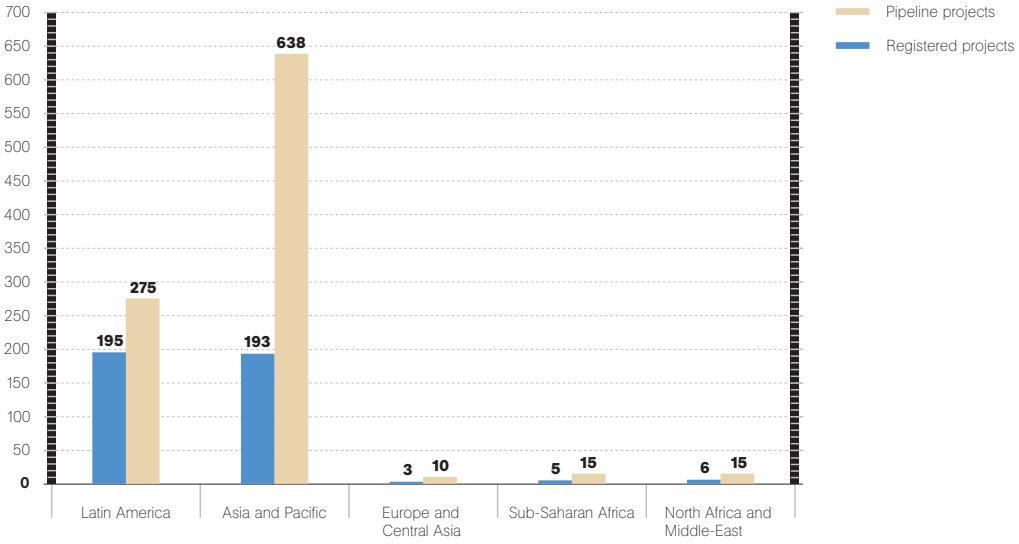
[65] Capital costs as reported in Project Design Documents (PDDs) (data from 250 projects and from the World Bank).

[66] Many of the projects that entered the pipeline during 2006 will not have been completed by the end of the year, so some of the investment will occur during 2007 and 2008. For further information, see Ellis and Kamel, 2007.

[67] These figures indicate that unilateral projects are about half the size of the average CDM project.

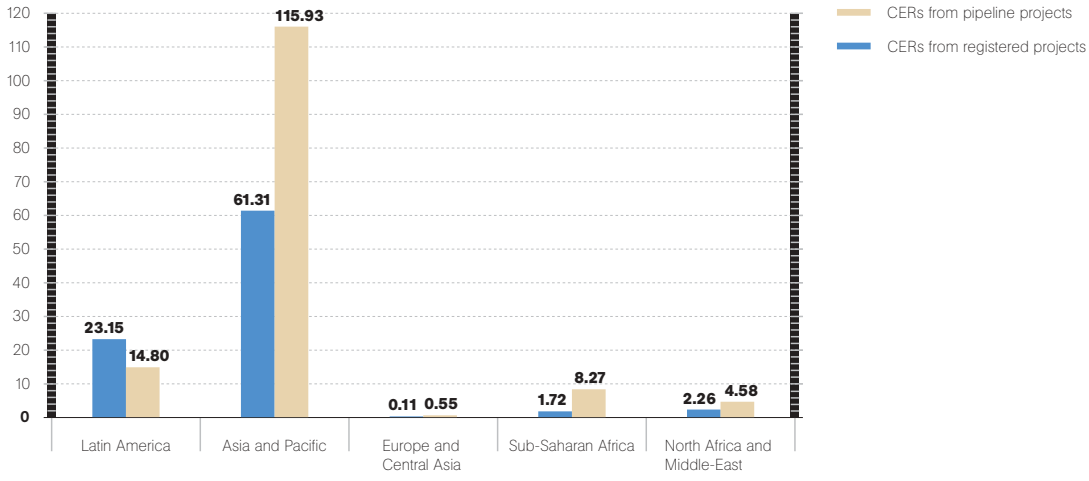
[68] This does not mean that most private investment in renewable energy and energy efficiency in developing countries took the form of CDM projects. The investment for CDM projects registered during 2006 may not have been made during 2006.

Figure VII-28. **Regional distribution of clean development mechanism project activities registered and in the pipeline in 2006**



Note: Central Asia includes Kyrgyzstan, Tajikistan and Uzbekistan which are not considered under Asia and Pacific region

Figure VII-29. **Volume of certified emission reductions from clean development mechanism project activities registered and in the pipeline in 2006, by region**



Note: Central Asia includes Kyrgyzstan, Tajikistan and Uzbekistan which are not considered under Asia and Pacific region.

563. The capital invested in afforestation and reforestation has been very low. Only three afforestation and reforestation projects were among the 1,468 projects in the pipeline at the end of 2006. The recent authorization of such projects is part of the explanation. But the attractiveness of these projects is reduced by uncertainty stemming from the temporary nature of temporary CERs (tCERs) and long term CERs (lCERs) and the fact that installations in the EU ETS can use CERs, but not tCERs or lCERs, for compliance.

564. The revenue earned from the emission reductions credits has very different impacts on the profitability of different types of projects. Table VII-54 shows the effect of different CER prices on the profitability, measured by the internal rate of return, of HFC-23, methane from landfill, and renewable energy projects. The sale of CERs makes HFC-23 projects, which have a low capital cost per unit of emissions reduced, much more profitable. In contrast, the sale of CERs has little effect on the profitability of renewable energy projects, which have a high capital cost per unit of emissions reduced. Thus the carbon market alone is unlikely to provide a significant stimulus to the deployment of renewables in developing countries.

Table VII-54. Incremental impact of the CER price on the internal rate of return (IRR) of the project (percentage per purchase period)

CER prices (in USD)	Five years (2008 to 2012)	Seven years	Ten years	Fourteen years	Twenty-one years	Impact per unit (in USD)
Renewable energy IRR						
5	0.5	0.6	0.8	1.0	1.2	3.16/MWh
10	1.0	1.4	1.7	2.1	2.3	6.33/MWh
15	1.6	2.1	2.7	3.1	3.3	9.49/MWh
20	2.2	2.9	3.6	4.1	4.5	12.65/MWh
Solid waste IRR						
tSW (ton solid waste)	**tSW**	**tSW**	**tSW**	**tSW**	**tSW**	
5	17.9	24.1	29.2	31.7	32.8	41/MWh
10	52.3	59.1	62.4	63.5	63.8	82/MWh
15	88.2	93.3	95.4	95.9	96.0	124/MWh
20	123.7	127.3	128.6	128.8	128.9	165/MWh
HFC/23 IRR[a]						
5	110.8	112.3	112.7	112.7	112.7	–
10	176.7	177.3	177.4	177.4	177.4	–
15	227.3	227.6	227.7	227.7	227.7	–
20	270.0	270.2	270.2	270.2	270.2	–

Source: World Bank.

[a] Sixty-five per cent tax applied on revenue from sale of CERs.

TECHNOLOGY TRANSFER AS IDENTIFIED IN CDM PROJECT DESIGN DOCUMENTS (CDM-PDDS)

565. Roughly one-third of all CDM projects accounting for almost two thirds of the annual emission reductions in 2006, identify some technology transfer in their project design documents (CDM-PDDs)[69] (Haites, *et al.*, 2006). TABLE 21-ANNEX V shows that technology transfer varies widely across project types: cement, coalbed/coalmine methane, fossil fuel switching, and transport involve very little technology transfer whereas almost all energy supply, household energy efficiency and solar projects claim technology transfer. Technology transfer is more common for larger projects and projects with foreign participants. Equipment transfer only is more common for larger projects whereas smaller projects involve transfers of both equipment and knowledge or knowledge only.

566. Statistical analyses reported by Haites, *et al.* (2006) find that the host country has a significant impact on technology transfer for 12 of the 23 countries analysed. Technology transfer was found to be more likely for projects in China, Ecuador, Guatemala, Honduras, Malaysia, Mexico, Peru, South Africa, Thailand and Viet Nam and less likely for projects in Chile and India. The reasons for the higher or lower level of technology transfer are not given.[70] Since the host country must approve each project, it can influence the extent of technology transfer involved in its CDM projects.

SECONDARY MARKET [71]

567. Trades of CERs issued do not involve project or registration risks. The higher price, USD 17.75 per t CO_2 eq, reflects the absence of these risks. The first CERs were issued during 2005 and many of these had already been purchased (through forward contracts). The volume traded is approximately equal to the quantity of CERs issued.

568. The secondary market has been growing rapidly and this is expected to continue as more CERs are issued and as the international transaction log links the CDM and Annex B Party national registries in 2007.[72]

569. As the quantity of CERs issued rises, exchanges are beginning to trade them. This will facilitate trades of CERs on an exchange, with the assistance of a broker, or directly between the buyer and seller.

7.2.2.2. JOINT IMPLEMENTATION

570. Joint implementation (JI) enables a project to mitigate climate change in an Annex B Party to generate emission reduction units (ERUs) that can be used by another Annex B Party to help meet its emission limitation commitment. Projects can be implemented under rules established by the host country (Track 1) or international rules administered by the Joint Implementation Supervisory Committee (JISC) (Track 2). The JISC was established in December 2005 and no national track 1 process had been established by the end of 2006, therefore JI is just starting.[73]

571. At the end of 2006 there were 146 JI projects in the pipeline with expected annual emission reductions of 25 Mt CO_2 eq[74] (see FIGURES VII-30 and -31). Of these, 53 projects with estimated annual reductions of 15 Mt CO_2 eq entered the pipeline during 2006. No JI projects had yet been approved. Capoor and Ambrosi report JI transactions totaling 16 Mt CO_2 eq at an average price of USD 8.80 per t CO_2 eq. In effect, the purchases were equivalent to the expected annual emission reductions of the projects that entered the pipeline during the year.

572. ERUs are equivalent to CERs for purposes of compliance with Annex B Party commitments under the Kyoto Protocol and for compliance use by industry during Phase II of the EU ETS. Thus the price of ERUs is expected to be very similar to that of CERs. During 2006 the price of ERUs was lower than the primary market[75] price for CERs because the regulatory structure for JI was still being developed, and therefore the risks were higher.

573. The distribution by country of the 53 JI projects that entered the pipeline during 2006 is shown in TABLE 22-ANNEX V together with the estimated annual emission reductions, potential revenue from the sale of ERUs and estimated capital invested. The Russian Federation dominates the market, being the source of over 80 per cent of the estimated annual emission reductions of the new projects in 2006. The Russian Federation's dominance of the supply of ERUs does not have much impact on the overall market price because ERUs and CERs are substitutes and the JI emission reductions are much smaller than those for the CDM.

574. The estimated revenue from the sale of the ERUs generated by the JI projects that entered the pipeline during 2006 is 2006 USD 0.1–0.3 billion per year. Applying the same estimation method for investment by project type for CDM projects to the JI projects that entered the pipeline during 2006 yields an estimated capital investment for JI projects of 2006 USD 6 billion.

575. Only about 30 per cent of the JI investment, almost USD 2 billion, was for renewable energy and energy efficiency projects. This compares with 2006 USD 4.5 billion of private investment in renewable energy and energy efficiency in the same countries during 2005 (see TABLE 22-ANNEX V). However, this comparison is distorted by Germany, which accounts for over 90 per cent of the total private investment in renewable energy and energy efficiency in these countries. In all of the other countries renewable energy and energy efficiency JI projects generate more investment. The only JI host country to receive ODA for renewable energy and energy efficiency during 2005 was Ukraine, which received USD 143 million.

[69] See chapter A.4.3 of the CDM-PDD, available at: <http://cdm.unfccc.int/Reference/Documents/Guidel_Pdd_most_recent/English/Guidelines_CDMPDD_NM.pdf>.

[70] The results are based on a statistical analysis which cannot explain the causes. The analysis includes project size and type therefore the result is not due to the project mix of the different countries. Other analyses indicate that host country population, GDP and per capita GDP are not statistically significant.

[71] The secondary market is the resale of CERs that have already been purchased.

[72] Transfers of issued CERs are governed by the rules for international emissions trading. Annex B Parties must meet specified conditions before they are eligible to participate in international emissions trading.

[73] Contracts to purchase ERUs generated by projects that expect to be approved as JI projects have been announced since 2002.

[74] A current list of JI projects is available at: <http://cdmpipeline.org/>.

[75] The primary market is the initial purchase of CERs or ERUs.

Figure VII-30. **Number of joint implementation projects that entered the pipeline in 2006, by type of project/sector**

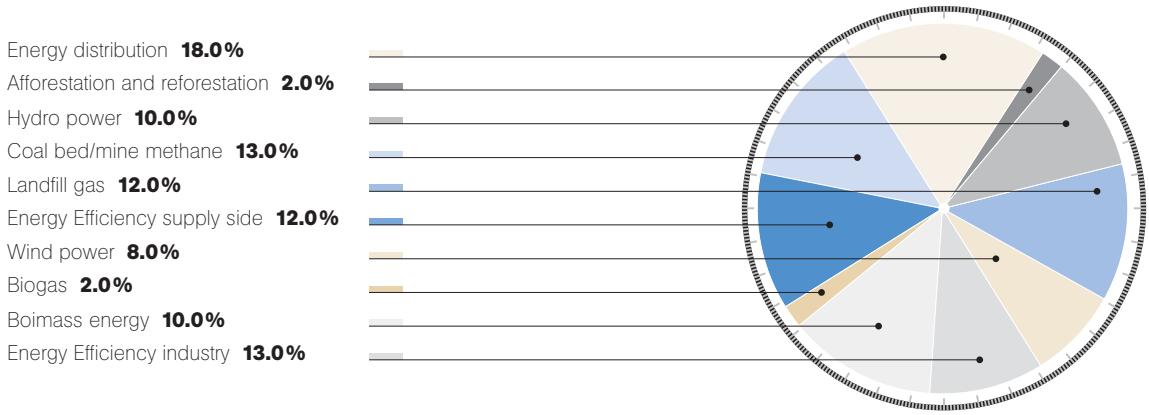
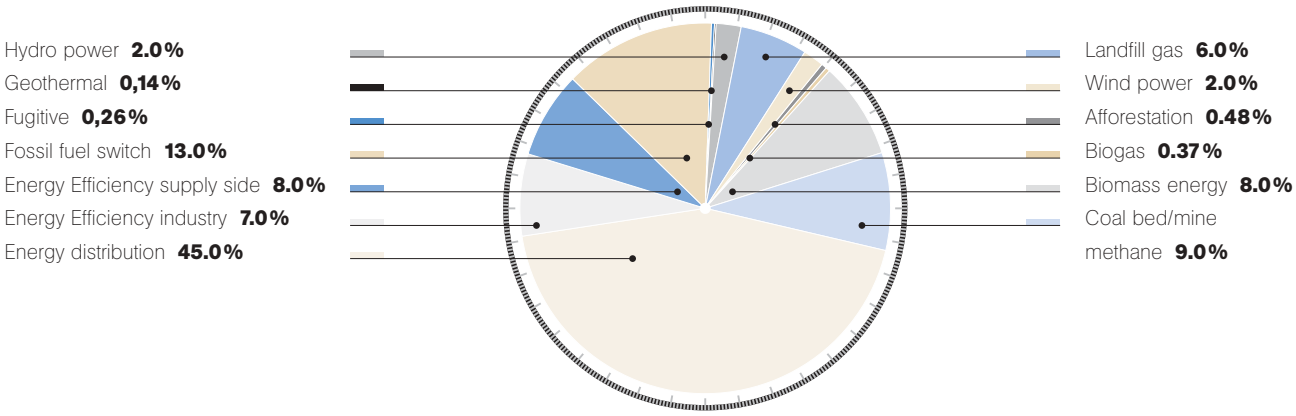


Figure VII-31. **Annual emission reduction units from joint implementation projects that entered the pipeline in 2006, by type of project/sector**



7.2.2.3. INTERNATIONAL EMISSIONS TRADING

576. International emissions trading allows an Annex B Party to transfer some of its allowable emissions to another Annex B Party. This is enacted through transferring Kyoto units (assigned amount units (AAUs), ERUs, CERs, lCERs, tCERs and removal units (RMUs)), from one Party's national registry to that of another, and may include units originally issued by that Party or any units acquired earlier from another Party. Some Parties have allowed the participation of companies and other entities in trading by establishing national or regional trading schemes.

7.2.3. EUROPEAN UNION EMISSIONS TRADING SCHEME

577. Almost all EU Member States are Annex B Parties and hence have emission limitation commitments for 2008–2012. To help meet those commitments, each Member State is required to implement an ETS covering CO_2 emissions by electricity generators and specified industrial sources. Allowances issued by a Member State can be used for compliance by an installation in any Member State.

578. The ETS is being implemented in phases: from 2005 to 2007, and from 2008 to 2012 and in five-year periods thereafter. To facilitate compliance with Kyoto Protocol commitments, surplus Phase I allowances cannot, with very limited exceptions, be carried over to Phase II.[76] Beginning in 2008, surplus allowances can be carried over indefinitely with no restrictions. During Phase I, installations can use CERs, but not tCERs or lCERs, for compliance. During Phase II, installations can also use ERUs for compliance.

7.2.3.1. PHASE I: 2005–2007

579. During 2005 the ETS covered about 10,500 installations responsible for about 45 per cent of the EU's CO_2 emissions,[77] and approximately 2,088 million allowances were issued. Actual emissions were about 2,007 Mt CO_2, leaving about 80 million surplus allowances (Ellerman and Buchner, 2006). The 2005 emissions data, released in April 2006, confirmed the likelihood of a surplus of Phase I allowances causing the price to drop from over EUR 30 to EUR 12 and to decline to EUR 4 by the end of the year (see FIGURE VII-32).

580. During 2006 actual emissions increased to 2,028 Mt CO_2, but that still left a surplus of about 61 million allowances for the year (Point Carbon, 2007b). With only one year remaining, this confirmed that a surplus of allowances was virtually certain for Phase I. Since Phase I allowances cannot be carried over for use in Phase II, surplus allowances at the end of the compliance period for 2007 will have no value. As a result, the price of Phase I allowances continued to decline, reaching EUR 0.25 on 1 June 2007.

581. Was the surplus due to allocation of too many allowances or due to larger than anticipated emission reductions? Ellerman and Buchner (2006) estimate that emissions were reduced by between 50 and 200 Mt CO_2 and that up to 100 million excess allowances were issued. They conclude that at least part of the price decline is due to the excess allocation, but over half, and perhaps all, of the surplus is due to emission reductions. Responses to surveys conducted by Point Carbon suggest that 65–75 per cent of installations have implemented some emission reduction measures, but that the reductions are not large (Point Carbon, 2007b).

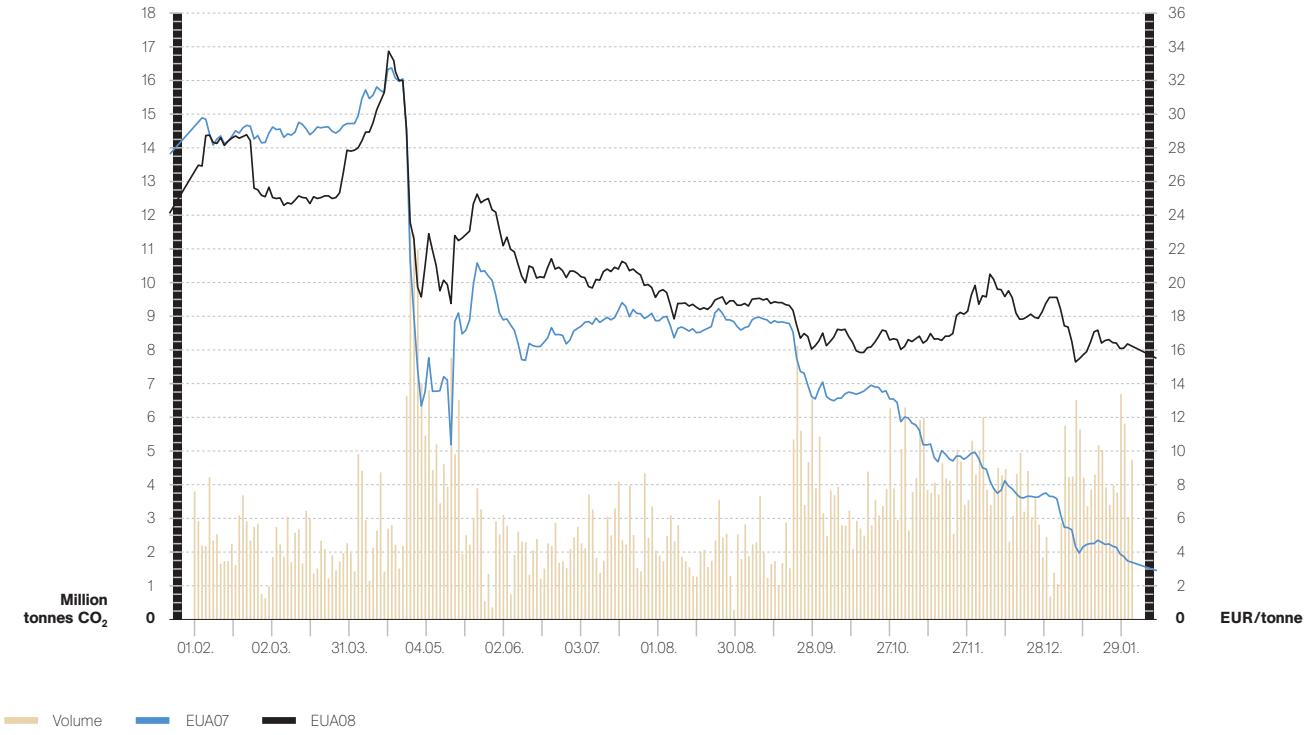
582. As can be seen in FIGURE VII-32, with the decline in the price of Phase I allowances, trading started to shift to Phase II allowances.[78] Of the 1,101 million allowances traded during 2006, about 820,000 were Phase I allowances and 220,000 were Phase II allowances. Phase I allowances traded at prices ranging between EUR 4 and EUR 30 whereas the Phase II allowances traded at prices between EUR 16 and EUR 30.

[76] If installations can bank surplus Phase 1 allowances for use after 2007, their emission reductions during the period 2008–2012 can be smaller. That would make compliance with the Kyoto Protocol commitments for 2008–2012 more difficult.

[77] New installations increased the total allocation for 2006 and 2007. In addition, Bulgaria and Romania joined the ETS when they entered the European Union on 1 January 2007.

[78] Phase II allowances had not yet been issued. These trades are contracts to deliver Phase II allowances in December 2008.

Figure VII-32. **Daily EU allowance prices and traded volumes, February 2006 – January 2007**



Source: Point Carbon, 2007c.

7.2.3.2. PHASE II: 2008 – 2012

583. As shown in FIGURE VII-32, the price of Phase II allowances remained between EUR 16 and EUR 20, whereas the price of Phase I allowances declined, reflecting the expectation that allocations for Phase II would be more stringent. Based on national allocation plans approved through 15 May 2007, Phase II allocations will be about 8 per cent lower than in Phase I. As a result, a shortage of Phase II allowances expected, which has kept the price of Phase II allowances over EUR 20 through 18 May 2007.

584. Installations will be able to use CERs and ERUs for compliance in Phase II.[79] The limits established by the 21 national allocation plans approved by 18 May 2007 would allow the use of over 200 million CERs or ERUs per year.[80] If the price of CERs or ERUs is lower than the price of Phase II allowances, an installation can profit by selling some of its allowances and buying as many CERs or ERUs as it can use for compliance.[81] Given this incentive, the use of CERs and ERUs could approach the overall limit even though the quantity each installation can use is limited. As a result, the prices of Phase II European Union allowances (EUAs) and those of CERs and ERUs in the secondary market are expected to converge, but not necessarily become equal.

7.2.4. NORWAY

585. Norway implemented an emissions trading system, the design of which is very similar to that of the EU ETS on 1 January 2005 for 51 onshore installations with annual emissions of about seven Mt CO_2. Actual emissions were lower than the allocations for both 2005 and 2006. There has been little trading. Prices are not disclosed, but were probably equal to or lower than those for Phase I EU allowances. On 1 January 2008 Norway's ETS is expected to be integrated into the EU ETS, with coverage expanded to 104 installations with annual emissions of about 23 Mt CO_2.

7.2.5. UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

586. At the start of 2002 the United Kingdom launched an emissions trading system with two components – Direct Entry and Climate Change Levy Agreements (CCLA).[82]

587. Direct Entry participants submitted bids for declining absolute emission targets for the years 2002 through 2006 in return for incentive payments. The 32 successful bidders promised emission reductions of 20.78 Mt CO_2 eq over the five years.[83] Actual allocations declined from slightly over 30 Mt CO_2 eq for 2002 to just over 20 Mt CO_2 eq for 2005 (Enviros, 2006). The Direct Entry component of the scheme concluded at the end of 2006 and many of those participants are now covered by the United Kingdom component of the EU ETS.

588. CCLAs with energy efficiency improvement or GHG emission reduction targets for two-year intervals through 2012 were negotiated with roughly 10,000 establishments in 43 energy-intensive sectors. Compliance with the target reduces its climate change levy, an energy tax, for the period by 80 per cent. CCLA participants can earn tradable allowances for the difference between their target and their actual CO_2 emissions.

589. The number of trades peaks every two years in advance of the compliance deadline for CCLA participants. Direct Entry participants have annual compliance deadlines and are, on average, much larger emitters so the quantity traded has an annual peak. The price increased from GBP 5 in April 2002 to GBP 12 in September 2002, and then fell to GBP 4 by the end of the year, and has remained between GBP 2 and GBP 4 since. The price spike was due to a limited supply of allowances, caused by administrative delays, at the time of its first compliance deadline.

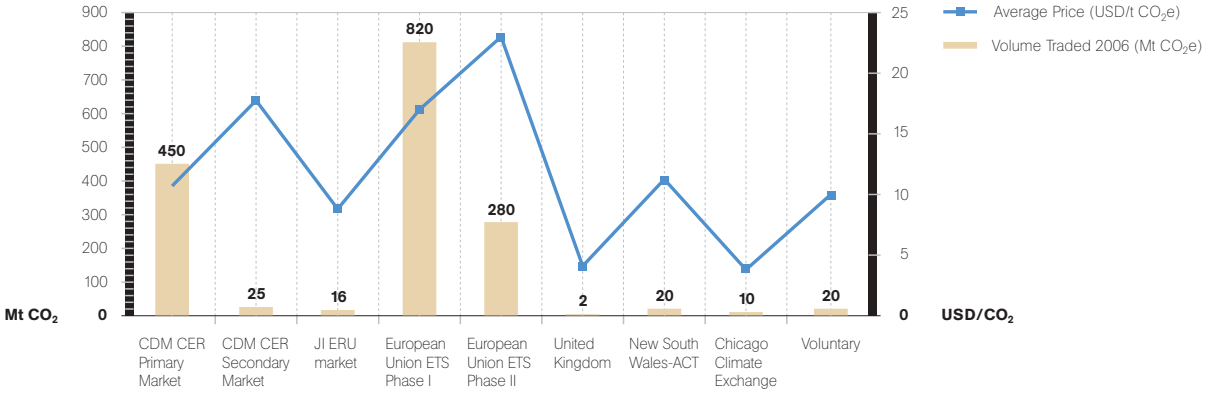
7.2.6. NEW SOUTH WALES–AUSTRALIAN CAPITAL TERRITORY GREENHOUSE GAS ABATEMENT SCHEME

590. This scheme establishes a cap on GHG emissions associated with electricity consumption in New South Wales, and since 1 January 2005, the Australia Capital Territory (ACT).[84] Electricity retailers and industries supplied directly by the grid (33 firms) must purchase GHG abatement certificates equal to the emissions associated with the electricity they sell/use. Abatement certificates can be generated by accredited projects that reduce emissions or enhance removal of GHG. During 2005 about 10 million certificates were generated by 206 accredited projects and about eight million were used for compliance. About 20 million certificates were traded during 2006 at an average price of USD 11.25.[85] This price is close to the non-compliance penalty.[86]

7.2.7. CHICAGO CLIMATE EXCHANGE

591. Members of the Chicago Climate Exchange (CCX) made a voluntary, legally-binding commitment to reduce their GHG emissions by 1 per cent per year from their 1998 to 2001 baseline, a 4 per cent reduction during

Figure VII-33. **Trade volumes and prices in the world's carbon markets in 2006**



Abbreviations: CDM = clean development mechanism, JI = joint implementation, CER = certified emission reduction, ERU = emission reduction unit, ACT = Australian Capital Territory.

2006.[87] The members had an overall emissions limit of 221 Mt CO_2 eq for 2006.[88] The CCX transacted 10.3 Mt CO_2 in 2006 at an average price of about USD 3.80.[89]

7.2.8. VOLUNTARY MARKET

592. Many companies and non-profit organizations offer to offset emissions from vehicle use, air travel, and other energy consumption for individuals and entities not subject to a regulatory obligation to reduce their emissions (Bayon *et al.*, 2007). The integrity of the offsets offered varies significantly and is determined by:

- Additionality of the project (making sure the project is not claiming reductions that would already occur);
- Actual existence of the emission reductions (making sure the project activity is monitored and the emission reductions claimed are verified);
- Exclusion of double-counting (making sure the same emission reductions are not sold to several buyers);
- Permanence of the reduction, and;
- Existence of community benefits.

593. To address these issues a voluntary standard for emission reductions is being developed and regulations are being considered in some countries.

594. The voluntary market has existed for more than a decade, but grown significantly since 2003 to 2004. Bellassen and Leget report that prices range from USD 1–78 per t CO_2 eq. Capoor and Ambrosi estimate the size of the market during 2006 at about 20 million tonnes with an average price of about USD 10 per t CO_2 eq. Hamilton, *et al.* (2007) estimate that 13.4 Mt CO_2 eq were traded at an average price of USD 4.10 during 2006 for a total value of USD 54.9 million.

[79] In Phase I CERs can be used for compliance, but this option is unlikely to be used because the price of allowances is much lower than the price of CERs.

[80] Point Carbon, *Carbon Market Europe*, 18 May 2007a estimates the limit as 217.23 million per year relative to emission caps of 1,859.27 Mt CO_2.

[81] Actual emissions are expected to exceed the EUA allocation by more than the overall limit on the use of CERs and ERUs. Therefore CERs and ERUs are expected to be purchased for compliance during Phase II. Currently there are no restrictions on carry over of EUAs after 2008, but there are limits on carry over of both CERs and ERUs, therefore CERs and ERUs should be used before EUAs for compliance. If the price of CERs or ERUs is lower, net of transaction costs, than the price of EUAs it will be profitable for an installation to sell (or bank) surplus EUAs and purchase CERs or ERUs for compliance.

[82] During the first four years of the scheme, Direct Entry participants received about 96 per cent of the 122 million allowances allocated (Enviros, 2006).

[83] Establishments not covered by a CCLA were eligible to offer emission reduction commitments in return for incentive payments through an auction. Bids by 32 firms promised emission reductions of 11.88 Mt CO_2 eq over the five years. At the end of 2004 six of the firms agreed to revised commitments, bringing the total emission reduction to 20.78 Mt CO_2 eq.

[84] See also IPART, 2006.

[85] See in TABLE 18-ANNEX V.

[86] The average price of USD 11.25 is equal to about AUD 14.95. The non-compliance penalty is AUD 11 which is not tax deductible. The cost of purchasing certificates is a tax deductible business expense. Given the 30 per cent corporate income tax rate, the penalty of Australia AUD 11 is equivalent to a purchase price of AUD 15.70. This is only 5 per cent above the average price.

[87] CCX Members who emit above the targets comply by purchasing CCX Carbon Financial Instrument™ (CFI™) contracts.

[88] About 33 of the 237 members have emissions limitation commitments. Their actual emissions during 2005 were about 197 Mt CO_2 eq and over 70 Mt CO_2 eq were banked from previous years.

[89] When trading began in 2003 the price was about USD 1 per t CO_2. The price remained roughly constant for about a year and then rose to USD 1.70 per t CO_2 at the end of 2004 and remained at that level through 2005. During 2006 the price rose to USD 4 per t CO_2.

7.2.9. LINKS AMONG EMISSIONS TRADING SYSTEMS

595. Although there are a number of different carbon markets, they can be, and to a limited extent are, linked. At present the trading systems are linked as follows:

- The national systems that comprise the EU ETS are fully linked with each other and all allow the use of CERs, but not tCERs or lCERs, and, beginning in 2008 to use of ERUs;
- Norway's ETS allows the use of Phase I EU allowances and CERs, but not tCERs or lCERs, for the period 2005–2007. It is expected to become part of the EU ETS in 2008;
- The NSW–ACT greenhouse gas abatement scheme has no links to other systems;
- The United Kingdom domestic scheme has no links to other systems;
- The CCX allows the use of CERs and EU allowances for compliance, but suspended imports of Phase I EU allowances in December 2006.

596. The surplus of Phase I allowances in the EU ETS means that participants will not use CERs for compliance during the period 2005–2007. During Phase II of the EU ETS participants are expected to use CERs and ERUs for compliance, which should cause the prices of CERs, ERUs and Phase II allowances to converge.

7.2.10. CARBON FUNDS

597. Carbon funds are a significant feature of the carbon market, especially the market for CERs and ERUs. A carbon fund is a vehicle to pool investments in the carbon market. The first fund, the Prototype Carbon Fund (PCF), was established by the World Bank in 1999. Its investors, national governments and private firms from several Annex B Parties, provided capital of USD 180 million. The PCF played an important role in the development of the CDM and JI.

598. The number of funds has grown rapidly from three, with capital of EUR 351 million in 2000, to 54, with capital of over EUR 6,250 million early in 2007 (ICF International, 2007). Investors include Annex B governments (24 per cent), private firms (29 per cent) or both (47 per cent) (ICF International, 2007). Their structure and role vary. Some focus exclusively on purchasing CERs and/or ERUs for compliance use by their investors. Others purchase allowances and credits and hope to resell them at a higher price. More recent funds take equity stakes in emission reduction projects and provide both financial returns and credits to their investors.

599. The importance of carbon funds in the carbon market is illustrated in TABLE 23-ANNEX V. It shows the annual increase in secured capital relative to the market value of transactions for verified emission reductions for Kyoto compliance and the voluntary market. The capital contributed in 2003 was almost double that for previous years as the pace of CDM project development accelerated. Entry into force of the Kyoto Protocol in 2006 brought another doubling of the capital contributed.

600. From 2000 through 2004 the annual increase in contributed capital exceeded the value of the market transactions by a large margin. During the past two years the value of the transactions has exceeded the capital contributed to carbon funds, suggesting that the diversification and expertise provided by the funds has become less important for project development as the market has grown.

601. It is not possible to determine the quantities of CERs and ERUs that have been purchased by carbon funds because virtually all funds keep this information confidential for competitive reasons.

7.3. PROSPECTS FOR THE CARBON MARKET FOR THE PERIOD 2008 – 2012

602. The Kyoto Protocol mechanisms (CDM, JI and international emissions trading) and the emissions trading systems established by Annex B Parties (EU ETS) will be the dominant carbon markets for the 2008 to 2012 period. They are already the largest markets by far. The EU ETS is expected to expand to include Norway, Iceland and Liechtenstein in 2008, to link with a Swiss emissions trading system, incorporate Turkey if it joins the EU, and to cover aviation beginning in 2011.

603. The Regional Greenhouse Gas Initiative (RGGI), covering the CO_2 emissions of electricity generating units in 10 states in the northeastern United States, is scheduled to begin in 2009. Canada has announced a system for 2010. Proposals for a national emissions trading system are under consideration in Australia. New Zealand is working on the design of a system. And various regional and national systems have been proposed for the United States. Those systems are unlikely to begin operation before 2011.

604. Since the EU ETS allows Kyoto Protocol mechanisms to be used for compliance, this chapter focuses on the market for Kyoto Protocol compliance units. Capoor and Ambrosi conclude that the current projected demand-supply balance, excluding Canada, implies that the price of CERs/ERUs is likely to help set the market equilibrium price for EUAs during this period (Capoor and Ambrosi, 2007). The analysis considers 2010 as a representative year for the 2008 to 2012 compliance period.

7.3.1. DEMAND

605. Annex B Parties can use Kyoto Protocol units to help meet their commitments. The demand for these units is the difference between the actual emissions and the commitment for each Party whose emissions exceed its commitment. Thus the forecast demand depends on the forecast emissions of individual Annex B Parties and respective success of their policies and measures.

606. Three recent estimates of the demand are presented in TABLE 24-ANNEX V. The estimates vary widely, from about 400 Mt CO_2 eq per year to over 850 Mt CO_2 eq per year. The Canadian demand is a significant uncertainty for the estimates. In April 2007 the Canadian government stated that it does not plan to purchase Kyoto units, but firms covered by the emissions trading system will be able to use specified types of CERs for up to 10 per cent of their total emissions.[90] If purchases by the Canadian government are excluded, the Point Carbon and Capoor and Ambrosi estimates are virtually identical at 400 Mt CO_2 eq, whereas the ICF International range of 500 – 671 Mt CO_2 eq is somewhat higher.

607. Annex B governments have already committed to purchase CERs and ERUs equivalent to 917 Mt CO_2 eq, 183 Mt CO_2 eq per year, which is over 45 per cent of the demand as estimated by Point Carbon and Capoor and Ambrosi (2007).

608. The estimates of the demand by EU ETS installations are all close to the maximum use of CERs and ERUs allowed by the national allocation plans.

609. The demands estimated in TABLE 24-ANNEX V are unlikely to change significantly. Canada's decision reduced the projected demand substantially, but no further reductions are anticipated. Any growth in demand will be limited and come after 2010. Expansion of the EU ETS to include aviation could increase the demand for CERs/ERUs and new emissions trading systems in Australia or the United States could allow the use of Kyoto units, which might also increase the demand. ICF International estimates an average demand of zero to 30 Mt CO_2 eq per year for CERs/ERUs from the United States (RGGI) during the period 2008 – 2012 (ICF International, 2007).

610. Capoor and Ambrosi estimate that half of the potential demand has been contracted or is yet to be contracted.

[90] Canada, 2007, p.14, "The Government of Canada will not purchase credits or otherwise participate in the carbon market." The proposed emissions trading system will begin in January 2010. It will allow participants to use approved CERs to cover up to 10 per cent of their total emissions. The Government will determine which types of CERs will be approved. Participants will use CERs only if their price is less than the price cap of CAD 15 per t CO_2 eq.

7.3.2. SUPPLY

611. FIGURE VII-34 shows Kyoto units supplied by CDM projects in 2010, JI projects and Annex B Parties with surplus allowances (AAUs). Detailed estimates of the supply are presented in TABLE 25-ANNEX V.

612. The flow of new projects and the CERs/ERUs they can generate by 2012 is uncertain because of delays in negotiating the post-2012 regime. Until a new international agreement is negotiated, the ability of emission reductions after 2012 to earn CERs or ERUs is uncertain. This means delays in negotiating a post-2012 regime will progressively reduce the period during which investors can recover their costs (Capoor and Ambrosi, 2007; Haites, 2004). Soon, only the most profitable projects, such as HFC and N_2O destruction projects, will be able to recover their investment prior to 2013.

613. The Russian Federation, Ukraine and some eastern European countries will have surplus AAUs they can sell to other Annex B Parties. Some of these countries are establishing green investment schemes, which use the revenue from the sale of AAUs to fund emission reduction measures. ICF International assumes that only AAUs from green investment schemes will be purchased by other Annex B Parties. Point Carbon and Capoor and Ambrosi estimate the surplus AAUs available, but do not assume they will be sold.

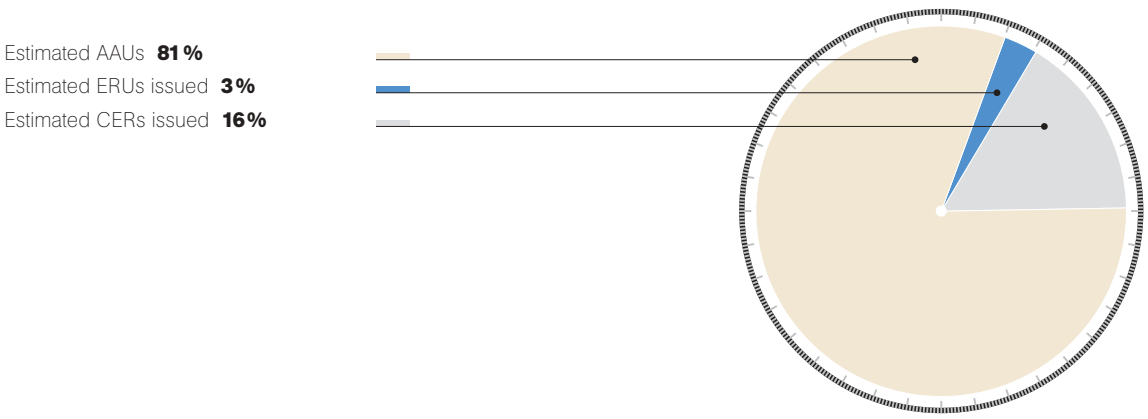
614. Point Carbon and Capoor and Ambrosi find that the projected supply of CERs and ERUs is almost sufficient to meet the estimated demand, excluding Canada. The supply of surplus AAUs is huge relative to the residual demand. In its mid-case, ICF International projects that, in addition to CERs and ERUs, some AAUs from green investment funds will be used to meet the estimated demand. All of the estimates suggest that supply will exceed the demand.

615. The supply of Kyoto units could increase further due to:

- CDM projects for "programmes of emission reduction activities". No project of this type has been registered yet, but such projects could generate relatively large emission reductions;
- HFC-23 destruction projects at new HCFC-22 plants. The eligibility of such projects has been under negotiation for a few years. If approved, they could generate large quantities of CERs;
- CO_2 capture and storage. The eligibility of such projects has been under negotiation for a few years. If approved, they could generate large quantities of CERs, although the time needed to implement such projects would limit the quantity issued before the end of 2012;
- Tradable credits for reduced deforestation. This has been proposed, but it now appears unlikely during the period 2008 – 2012;
- Emissions limitation commitments proposed by Belarus and Kazakhstan. The proposed commitments probably would leave each country with surplus AAUs, although it could take some time for them to meet the eligibility conditions to sell AAUs.

616. In summary, the analyses suggest the supply will be abundant relative to the demand. Demand for the period 2008 – 2012 is unlikely to change significantly, but the supply of Kyoto units could increase substantially.

Figure VII-34. Estimated supply of Kyoto units in 2010 (Mt CO_2 eq per year)



Abbreviations: CER = certified emission reduction, AAU = assigned amount unit, ERU = emission reduction unit.

617. The supply of CERs and ERUs will be affected by several factors over the next few years, including:[91]

- Uncertainty about the post-2012 regime. The value of emission reductions after 2012 is uncertain, so projects with longer payback periods become progressively less attractive, reducing the flow of new projects;
- Administrative uncertainty. Inconsistent decisions, possible review upon registration, and possible review on issuance present relatively small risks for project developers. Owing to the relative lack of experience, the risks are higher for JI projects than for CDM projects;
- Market liquidity. The secondary market for CERs is still small so accurate price information is not readily available. This should change over the coming year as the number of issued CERs rises. The secondary market for ERUs will lag by a year or more;
- Possible changes to the rules. The rules for the CDM could be changed to generate a wider geographic distribution of projects and/or to favour projects that have more development benefits.

7.3.3. PRICES

618. Will the surplus supply lead to a collapse of CER/ERU/AAU prices, as happened during Phase I of the EU ETS? Probably not. Phase I EU allowances cannot be carried over for use beyond 2007, so they have no value after the end of the period. In contrast, Kyoto units can be carried over (banked), so they should have a value at the end of the period provided they can be used for compliance after 2012. The EU ETS will allow the use of CERs and ERUs after 2012. A post-2012 international agreement is also expected to retain the Kyoto mechanisms and thus maintain the market for those units.

619. To date, all government purchases have been CERs and ERUs and participants in the EU ETS can only use CERs and ERUs for compliance. The supply of CERs and ERUs is still less than the demand, even without Canada. So long as these policies continue, the demand for AAUs from the Russian Federation, Ukraine and Eastern European countries will be limited to the demand not supplied by CERs and ERUs, causing them to carry over most of their surplus AAUs.

620. Banking (carry over) of different units by an Annex B Party is restricted as follows:[92]

- RMUs may not be carried over;
- ERUs which have not been converted from RMUs may be carried over up to a maximum of 2.5 per cent of the Party's assigned amount;
- CERs may be carried over up to a maximum of 2.5 per cent of the Party's assigned amount;
- tCERs and lCERs may not be carried over;
- AAUs may be carried over without restriction.

621. There are no provisions governing carry over of CERs, tCERs and lCERs by non-Annex I Parties or legal entities.

622. To comply with these rules EU ETS participants should use any issued CERs or ERUs they own for compliance by the end of 2012[93] and Annex B governments should comply by submitting CERs, RMUs, and ERUs and carrying over AAUs.

623. If the uncertainty relating to carry over by non-Annex I Parties and their legal entities is not resolved, it could cause the price to decline in 2012 as they try to sell the CERs they own. Early resolution of this uncertainty to avoid such a price drop is desirable.

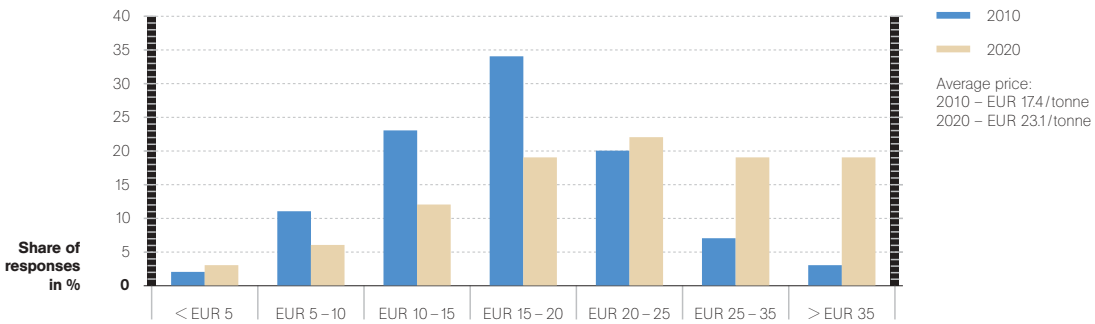
624. Since CERs and ERUs can, and probably will, be used for Phase II compliance by EU ETS installations the prices for issued CERs, ERUs and Phase II EU allowances should be similar if not identical. As of May 2007 there is still a substantial difference in the prices; CERs issued trade at EUR 12–13 whereas Phase II EU allowances trade at EUR 19. FIGURE VII-35 shows the price expectations for EU allowances in 2010 and 2020 of participants in an online survey conducted early in 2007. For 2010 the average is EUR 17.40, with a roughly symmetrical distribution ranging from less than EUR 5 to over EUR 35.

[91] See also Capoor and Ambrosi, 2006; Point Carbon, 2007; and ICF International, 2007.

[92] Decision 19/CP.7, annex paragraphs 15 and 16.

[93] Each installation has a limit on the quantity of CERs and ERUs it can use for compliance. An installation that owns fewer CERs/ERUs than its limit could buy more CERs/ERUs and sell or bank its surplus EU allowances.

Figure VII-35. Expected prices for EU allowances in 2010 and 2020, based on response to Point Carbon survey



Source: Point Carbon, 2007c.

625. ICF International forecasts the price for CERs/ERUs/ Phase II EU allowances at EUR 8, with a range of EUR 8 – 20 (ICF International, 2007, table 3). ICF recognizes, however, that market behaviour may lead to an average price over the period higher than forecast by market fundamentals. For example, industrial installations with surplus EUAs have tended to bank them, rather than sell them, and there may be delays in the delivery of CERs or ERUs into the EU ETS.

626. Based on the above information, the market price of issued CERs, ERUs and Phase II EU allowances is estimated to average EUR 17.50 (USD 23.60) with a range of EUR 10 (USD 13.50) to EUR 25 (USD 33.75) for the period 2008 – 2012.

7.3.4. MARKET SIZE

627. With an annual demand of 400 to 600 Mt CO_2 per year (excluding the Canadian government) the price of 2006 USD 23.60 suggests a market of USD 9.4 – 14.2 billion per year, say 2006 USD 10 – 15 billion per year (see FIGURE VII-36).

628. The above calculation assumes that all CERs, ERUs and AAUs bought for compliance are purchased at the market price. Many CERs and ERUs have already been purchased by Annex B governments in the primary market at lower prices, so the annual compliance cost should be somewhat lower. CERs and ERUs purchased by other buyers could be sold multiple times, so the annual value of transactions could be higher or lower.[94]

7.3.4.1. ANNUAL INVESTMENT

629. Annual sales of CERs are projected to be between 300 and 450 million. With an average capital cost of USD 137.39 per 1,000 t CO_2 eq of annual emission reductions (see TABLE 21-ANNEX V), that represents an annual investment of 2006 USD 40 – 60 billion. However, the remaining scope for low cost projects – HFC-23 and N_2O destruction – is limited. If such projects are excluded, the average capital cost rises to about USD 200 per 1,000 t CO_2 eq of annual emission reductions, and the annual investment would be 2006 USD 60 – 90 billion. Thus, the annual investment in CDM projects is estimated at 2006 USD 40 – 90 billion. At present about half of the capital invested in CDM projects is invested in unilateral projects by host country project proponents.

630. Annual sales of ERUs are projected to be between 40 and 100 million. Assuming the same range of capital costs per 1,000 t CO_2 eq of annual emission reductions yields an estimated annual investment in JI projects of 2006 USD 5 – USD 20 billion.

7.3.5. SHARE OF PROCEEDS FOR THE ADAPTATION FUND

631. The Adaptation Fund receives a "share of proceeds" equal to 2 per cent of the CERs issued for a CDM project activity to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to assist in meeting the costs of adaptation.[95] With annual sales of CERs of 300 – 450 million and a market price of USD 23.60 per t CO_2 eq (range USD 13.50 – 33.75) the Adaptation Fund would receive 2006 USD 80 – 300 million per year for 2008 to 2012[96] (see TABLE VII-55).

7.3.6. VOLUNTARY MARKET

632. The voluntary market accounted for sales of about 20 Mt CO_2 eq globally in 2006. Trexler estimated that United States demand for voluntary offsets could almost double annually to 250 Mt CO_2 eq by 2011 (Trexler, 2007).[97] ICF International projects an annual demand in the voluntary market of 250 Mt CO_2 eq (range 120–400) for the period 2008–2012 (ICF International, 2007). Assuming an average price of USD 10 per t CO_2 eq this represents an annual market of 2006 USD 1–4 billion. With a compliance market of 2006 USD 5–25 billion the voluntary market would represent about 15 per cent of the total market. This growth is contingent on satisfactory resolution of the integrity issues discussed in CHAPTER VII.2.8.

633. FIGURE VII-36 summarizes the estimates for demand for emission reduction units in 2010.

[94] The total value of primary and secondary CER and ERU transactions during 2006 is reported as USD 5.4 billion by Capoor and Ambrosi, 2007, annex 5, table 18.

[95] Decisions 3/CMP.1 and 28/CMP.1. CDM projects in least developed country Parties are exempt from the share of proceeds levy and small-scale afforestation and reforestation projects are exempt from the share of proceeds regardless of their location.

[96] The quantity of CERs issued for projects exempt from the share of proceeds is assumed to be negligible relative to the uncertainty of the estimates.

[97] This would be less than 1 tonne per person when per capita emissions are over 20 tonnes, offsetting about 4 per cent of total emissions.

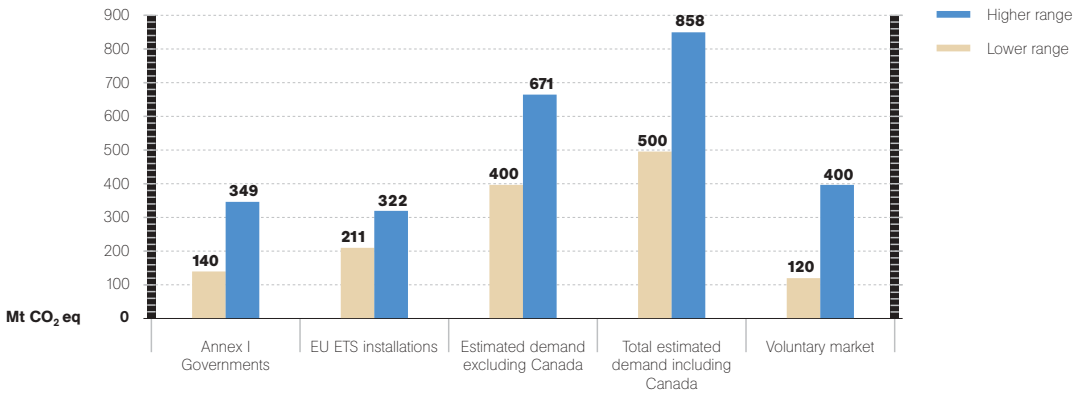
Table VII-55. Possible levels of funding for the Adaptation Fund trustee account to 2012

Total quantity of CERs issued through 2012 (million)	Total quantity of CERs collected by the Adaptation Fund holding account through 2012 (million)	Total revenue received by the Adaptation Fund trustee account at various prices per CER (million Euro)		
		Assumed price per CER		
		EUR 10	EUR 17.5	EUR 25
1,500	30	N.A.[a]	525	750
2,000	40	400	700	1,000
2,500	50	500	875	N.A.[a]

Abbreviations: CER = emission reduction unit.

[a] This comination of price an quantity is considered to be very unlikely

Figure VII-36. Estimated demand for emission reduction units in 2010



7.4. POTENTIAL SIZE OF THE CARBON MARKET TO 2030

634. Apart from the voluntary market, the carbon market depends on the demand for compliance units by national governments or entities that subject themselves to a regime with compliance obligation (e.g. the Chicago Climate Exchange) and the supply of units from countries with commitments or without commitments.

635. Analyses of the future carbon market focus on the potential demand by Annex I Parties that can be met cost-effectively with credits purchased from non-Annex I Parties.

636. This chapter begins with estimates of the potential demand in 2050. It then it reviews demand estimates for earlier periods. After the demand estimates are reviewed, the potential to expand the supply to meet the demand in 2030 is considered.

7.4.1. ESTIMATED DEMANDS

7.4.1.1. ESTIMATED DEMAND IN 2050

637. Two estimates of demand for credits from developing countries in 2050 are available.

7.4.1.2. REDUCTIONS AT 60 – 80 PERCENT

638. Assuming emission reductions by industrialized countries in the order of 60 – 80 per cent of their 1990 emissions by mid-century, half of which we anticipated to be met through investment in developing countries, generates emission reduction purchases of up to USD 100 billion per year, this reduction would correspond to stabilization of greenhouse gas concentrations at 450 – 500 ppmv CO_2 eq (i.e. multigas) or 350 – 400 ppmv CO_2 only.

639. Greenhouse gas emissions by all Annex I or Annex B Parties, including Australia and the United States, in 1990 were about 18,100 Mt CO_2 eq. A reduction of 60 – 80 per cent is 10,900 – 14,500 Mt CO_2 eq. If half of the reduction is purchased from developing countries, the annual purchases are 5,400 – 7,200 Mt CO_2 eq. Assuming the price of CERs issued remains at the current level of EUR 12 – 13, about USD 17 per t CO_2 eq, this represents a market value of USD 92 to USD 122 billion.

7.4.1.3. WORLD BANK (2006)[98]

640. The future flows to developing countries depend on four parameters:

- The objective and scope of post-Kyoto climate policies;
- Baseline emissions in each region of the world;
- Abatement costs in each region;
- The burden-sharing agreement between Parties.

641. IPCC stabilization paths for 450 and 550 ppmv are used as the objective of post-Kyoto climate policies. The 450 ppmv path allows total emissions of 272 GtC between 2000 and 2050, whereas the 550 ppmv path allows 333 GtC between 2000 and 2050.

642. The six IPCC SRES scenarios provide the baseline emissions. Cumulative emissions range between 392 and 574 GtC from 2000 through 2050.

643. Two sets of abatement costs are used – the emissions prediction and policy analysis (EPPA) model and higher costs based on bottom-up studies. Abatement costs are assumed to rise by 1 per cent per year from 2000 through 2050.

- Total discounted (at 4 per cent) abatement costs for the 450 ppmv path from 2000 through 2050 are between 1995 USD 1.2 and 14.9 trillion – annualized costs of USD 72 – 775 billion;
- For the 550 ppmv path total abatement costs from 2000 through 2050 are between 1995 USD 0.2 and 8.2 trillion – annualized costs of USD 12 – 427 billion.

644. Efficiency dictates that half to two-thirds of total abatement spending between 2000 and 2050 occur in developing countries (EPPA 67 – 72 per cent, other cost curves 58 – 65 per cent). This is due to existing opportunities and high growth of emissions in developing countries.

645. Distributing abatement expenditures on the basis of GDP yields annualized payments by developed countries between 2013 and 2050 of 1995 USD 20 – 130 billion for the 450 ppmv path; and 1995 USD 3 – 68 billion for the 550 ppmv path.

7.4.1.4. ESTIMATED DEMAND IN 2030

646. The Energy Modeling Forum[99] (EMF) examines topics to which many existing models can be applied. EMF 21 analysed the importance of non-CO_2 greenhouse gases and land use in climate policy.[100]

647. Each participating model developed a reference scenario that excludes any climate policies, including the Kyoto Protocol. Each model also developed a multi-gas mitigation scenario to stabilize radiative forcing at 4.5 Wm^2 relative to pre-industrial times by 2150 or to a comparable global emissions trajectory.[101] This corresponds to an equilibrium temperature increase of 3.8° C, for a climate sensitivity of 3° C per CO_2 doubling, which corresponds to a stabilization scenario under the IPCC of 650 ppmv.[102]

648. Results for 16 models with a regional structure were analysed. For each model developing countries were assumed to sell credits equal to the difference between their reference scenario and multi-gas mitigation scenario to Annex I Parties, including Australia and the United States. The implied commitments of Annex I Parties as a group are the sum of their reductions from the reference scenario plus their credit purchases. These are expressed as reductions from their 1990 emissions.

649. TABLE 26-ANNEX V shows the results for 2030; the implied commitment of Annex I and/or Annex B Parties as a group, their annual purchases, the projected market price, and the market size. The analysis ignores trading among Annex I and/or Annex B Parties – JI and international emissions trading – since this depends on arbitrary assumptions of how the overall commitment would be shared among these Parties.

650. The results correspond to the maximum demand for the mitigation scenario. Current Annex I and/or Annex B Parties, including Australia and the United States, are assumed to have commitments that induce them to purchase all cost-effective emission reductions available in non-Annex I Parties. Rules for credit creation, transaction costs, and other considerations would prevent all cost-effective reductions estimated by the models being realized in practice. Failure of some Annex I and/or Annex B Parties to ratify the agreement in place in 2030, or adopt equivalent commitments, would reduce the demand. Adoption of targets by some current non-Annex I Parties would reduce the estimated supply and hence the maximum demand.[103]

651. The results vary enormously due to differences in the reference scenario, marginal abatement costs and model structure. Estimates of the annual sales range from less than 2000 USD 1 billion to over USD 1,850 billion and estimates of the price range from less than USD 1 to over USD 100 per t CO_2 eq. The low estimate is due to both a small quantity and a low price, indicating that the reference scenario and mitigation scenario emissions are very similar. The high estimate is due to a reference scenario that has much higher emissions than the mitigation scenario, leading to a high marginal abatement cost and large purchases. The high estimate implies a commitment of Annex I and/or Annex B Parties greater than their 1990 emissions.

652. The median quantity traded is roughly 6,400 Mt CO_2 eq per year.[104] The corresponding commitment is a 30 per cent reduction from 1990 emissions for all Annex I and/or Annex B Parties including Australia and the United States. The market price is modelled to about 2000 USD 16.50 per t CO_2 eq. This is a little lower than the current price for issued CERs and in the lower half of the range estimated for 2010. The size of the market in 2030 is estimated at USD 107 billion with three quarters of the estimates falling between 2000 USD 17 and USD 314 billion.

7.4.1.5. ESTIMATED DEMAND IN 2020

653. Potential demand in 2020 can be estimated from the EMF 21 model results in the same manner as described in TABLE 26-ANNEX V. The median estimate of the market size is about 3,150 Mt CO_2 eq per year. The corresponding commitment is about a 20 per cent reduction from 1990 emissions for all Annex I Parties including Australia and the United States.

654. Because the EMF 21 scenarios exclude the Kyoto Protocol, emission reductions and marginal abatement costs rise gradually from 2000. The 2020 marginal abatement cost (price) – 2000 USD 6.50 per t CO_2 eq – is lower than both the current and projected 2010 price. Given the bias introduced by the scenarios, the best assumption is that prices remain roughly constant from 2010 through 2030 at 2000 USD 23.60 (range USD 13.50 – 33.75).

[98] Annex H, World Bank (2006).

[99] The EMF (Energy Modeling Forum) was established at Stanford University and provides for a forum for discussing energy and environmental issues, see: <http://www.stanford.edu/group/EMF/>.

[100] See de la Chesnaye and Weyant, 2006 for results of EMF 21.

[101] The emissions trajectory depends on the emissions sources covered by the model. For models that cover CO_2 emissions from fossil fuel use, cement and land use, CH_4 emissions and N_2O emissions, but exclude HFCs, PFCs and SF6, global emissions are slightly below 40 GT CO_2 eq in 2030.

[102] When the scenario was developed, a climate sensitivity of 2.5° C per CO_2 doubling was assumed, resulting in an equilibrium temperature increase of 3.0° C.

[103] The targets of non-Annex I Parties could take a variety of forms including "no lose" targets, sectoral targets, and national commitments similar to those of Annex I Parties. Such targets should represent a reduction from reference case emissions, so only the emission reductions beyond compliance with the target could be sold to current Annex I and/or Annex B Parties. To estimate the impact on the market price would require new model runs.

[104] When values cannot be symmetrically distributed as in this case – market size and price can not be less than zero – the median is a better indicator of the central value than the average. Half of the values are higher and half are lower than the median. The average (mean) is the sum of the values divided by 16 (the number of values).

655. The annual purchases in 2020 estimated from the EMF 21 scenarios are 2000 USD 25 billion (USD 2.5 – 70 billion). The low end of the range up to 2006 USD 25 billion per year is the same as the estimate for 2010.

7.4.1.6. ESTIMATED DEMAND IN 2015

656. ICF International projects the average demand of Annex I and/or Annex B Parties for the period 2013 – 2017 at 2,600 Mt CO_2 eq per year (1,200 to 3,100 Mt CO_2 eq per year) (ICF International, 2007). The high demand case includes additional demand of 4,400 Mt CO_2 eq per year by non-Annex I Parties that adopt sectoral targets. ICF International projects the 2013 to 2017 price at 2006 EUR 30 per t CO_2 eq (range EUR 18 – 40 per t CO_2 eq).[105] The implied annual purchases by Annex I and/or Annex B Parties are about 2006 EUR 75 billion (range EUR 2 – 120 billion) (ICF International, 2007 table 3).

7.4.1.7. SUMMARY OF DEMAND ESTIMATES

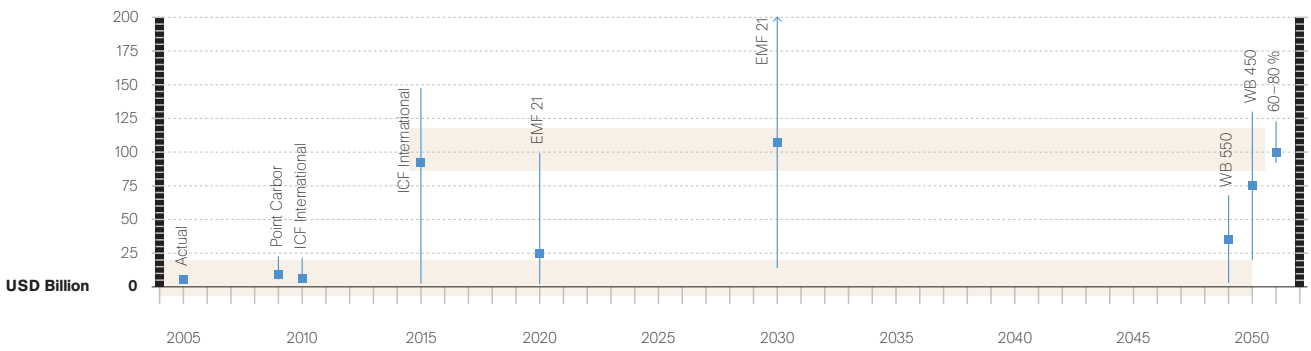
657. The foregoing estimates of demand are shown in FIGURE VII-37. The estimates cover only purchase credits by Annex I and/or Annex B Parties from non-Annex I Parties. The estimates do not include trades between Annex I and/or Annex B Parties, such as JI and international emissions trading. To estimate the size of those mechanisms requires arbitrary assumptions about the commitments of different Annex I and/or Annex B Parties. The estimates assume that all cost effective emission reductions in Annex I and/or Annex B Parties are implemented as domestic actions or for sale to other Annex I and/or Annex B Parties through JI or international emissions trading.

658. Each estimate spans a wide range. The low end of the ranges suggests that the demand remains in the range of 2006 USD 5 – 25 billion per year. TABLE 18-ANNEX V indicates that CDM transactions during 2006 were a little over USD 5 billion and the demand estimated in CHAPTER VII.3.4 for 2010 is USD 10 – 15 billion with a range 2006 USD 5 to USD 25 billion per year. The value of credit purchases by Annex I and/or Annex B Parties from non-Annex I Parties could remain in that range through 2050.

659. The high end of the ranges suggests that annual demand could reach USD 100 billion, but probably not much more. The high demand assumes commitments – 30 per cent below 1990 by 2030 and 60 – 80 per cent below by 2050 – by all current Annex I and/or Annex B Parties including Australia and the United States, no commitments of any type by any current non-Annex I Party, and purchase of all cost effective emission reductions available in non-Annex I Parties.

[105] ICF International, 2007.

Figure VII-37. Comparison of demand estimates



7.4.2. POTENTIAL SUPPLY

660. The demand estimates presented above are for purchases of emission reduction credits by Annex I and/or Annex B Parties from non-Annex I Parties. At present the only mechanism for such purchases is the CDM. The demand could also include credit sales under other mechanisms suggested in the literature, such as "no lose" targets and sectoral targets.

661. The potential supply is assessed relative to both the low and the high estimates of demand. The low demand of USD 5 – 25 billion represents purchases of 400 – 600 Mt CO_2 per year, ranging up to 1,000 Mt CO_2 per year. The high demand of about USD 100 billion corresponds to purchases of ten times the volume – about 4,000 Mt CO_2 per year at a price of USD 23.60 per t CO_2 eq and about 6,000 Mt CO_2 per year based on the model results presented in TABLE 26-ANNEX V.

7.4.2.1. LOW DEMAND ESTIMATE

662. A 20 – 200 per cent increase in emission reductions appears manageable. The existing project pipeline has developed largely in the past two years, so maintaining the current trend for a few months to a few years would be sufficient. Growth of the pipeline will involve a shift in the mix of projects because the potential of a few project types, notably HFC-23 destruction and N_2O destruction at adipic acid plants, has been largely exhausted. On the other hand, project types approved more recently, afforestation, reforestation and programmes of activities, are virtually absent from the pipeline.

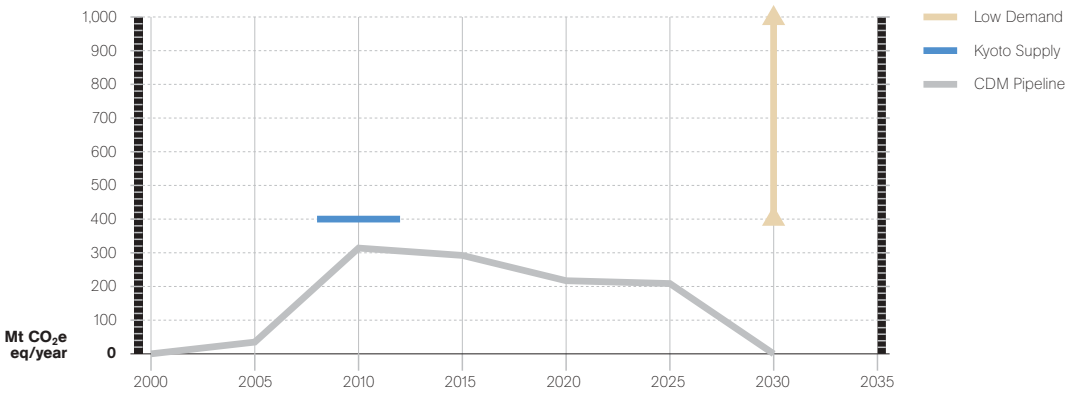
663. FIGURE VII-38 shows the estimated emission reductions of projects in the CDM pipeline as of May 2007 as a function of time. It assumes that each project with a renewable crediting period earns the same annual emission reductions for each renewable. The estimated annual reductions rise rapidly beginning in 2005 as new projects are implemented, reaching 315 Mt CO_2 eq in 2010. The emission reductions achieved by these projects decline between 2010 and 2020 as the projects with 10 year crediting periods lose their eligibility. After 2025 most of the remaining projects lose their eligibility as their third seven year crediting period concludes.

664. The data in FIGURE VII-38 are based on the estimated annual emission reductions reported in the PDDs. The experience to-date is that CERs are issued for approximately 85 per cent of the estimated reductions (Fenhann, 2007).

665. FIGURE VII-38 also shows the estimated average annual emission reductions available for the period 2008 – 2012, which includes reductions during the period as well as reductions prior to 2008. This is almost 400 Mt CO_2 eq, the low end of the range for 2030. Taking the experience to-date into account, meeting the low demand in 2030 would mean a 20 – 200 per cent increase in the emission reductions of projects already in the pipeline and then replacing the reductions in those projects as they come to the end of their crediting periods.

666. In summary, it appears that the current flow of projects under the CDM would be sufficient to meet the low demand estimate for 2030 although with some changes in the mix of projects.

Figure VII-38. Estimated supply from current CDM pipeline, 2000 – 2030



7.4.2.2. HIGH DEMAND ESTIMATE

667. The high demand would require credits for a large fraction of the potential emission reductions, from existing and some new categories of project types. To process the volume of emission reductions cost-effectively is likely to require new mechanisms, such as "no lose" targets, sectoral targets and policy CDM, in addition to the current types of CDM projects.[106]

668. The high demand is about ten times higher; some 4,000 – 6,000 Mt CO_2 eq per year in 2030. Estimates of the maximum annual emission reduction potential in non-Annex I Parties in 2030 are provided in TABLE 27-ANNEX V. The estimates indicate that current non-Annex I Parties could supply the high demand if a large fraction, 50 – 75 per cent, of the maximum potential is realized and additional categories of emission reductions, reduced deforestation and CCS, are included (see FIGURE VII-39).

669. Currently the average CDM project estimates an annual emission reduction of 165,000 t CO_2 eq per year. Annual reductions of 4,000 – 6,000 Mt CO_2 eq per year would require 25,000 – 35,000 registered projects. Roughly 1,000 projects entered the pipeline during 2006.[107] To have 25,000 – 35,000 registered projects would mean a four to five-fold increase in the flow of registration and renewal requests.

7.4.2.3. AAUS CARRIED OVER FROM THE PERIOD 2008 – 2012

670. It is expected that AAUs carried over by the Russian Federation, Ukraine and other Eastern European countries can be used to meet the commitments of Annex I and/or Annex B Parties for subsequent periods.[108] The amount carried over at the end of 2012 is projected to be 2,500 – 5,500 million AAUs. Under the high demand estimate, that surplus could be absorbed relatively quickly. With the low demand estimate, it could affect the market for a decade or more.

7.4.3. SUMMARY

671. Estimates of credit purchases by Annex I and/or Annex B Parties from non-Annex I Parties span a wide range. The low end of the ranges suggests that the demand remains in the range of USD 5 – 25 billion per year, with purchases of 400 – 600 Mt CO_2 eq. The current flow of projects under the CDM, with some changes in the mix of projects, would be sufficient to meet that demand. That would represent an annual capital investment of 2006 USD 50 – 120 billion. At 2 per cent the annual contribution to the Adaptation Fund would be 2006 USD 100 – 500 million.

672. The high end of the ranges suggests that annual demand could reach 4,000 – 6,000 Mt CO_2 eq per year with a market value of USD 100 billion, by 2030, but probably not much more. It assumes commitments by all current Annex I and/or Annex B Parties including Australia and the United States, and no commitments of any type by any current non-Annex I Party. To supply this demand a large fraction of the potential emission reductions from all existing and some new categories of projects would need to earn credits. That is likely to require new mechanisms in addition to the current types of CDM projects. The high demand would represent an annual capital investment of 2006 USD 500 – 1,200 billion. At 2 per cent the annual contribution to the Adaptation Fund would be 2006 USD 1 – 5 billion.

[106] As discussed above, such mechanisms have the effect of reducing the potential supply somewhat.

[107] The average crediting period is seven-and-a-half years (Fenhann, 2007, analysis sheet shows 86 per cent of project proponents choose a seven-and-a-half year crediting period and 14 per cent a 10-year crediting period, giving an average of seven-and-a-half years). Thus the current flow yields about 7,500 registered projects, thereafter crediting periods need to be renewed.

[108] Some, or all, of the surplus could be used by those countries to meet their post-2012 commitments and the balance could be sold to other Annex I and/or Annex B Parties.

Figure VII-39. **Estimated carbon market size for high demand estimate**