

The GHG Market after Bonn

By Dr. Jürg M. Grütter

The decisions taken in Bonn at CoP 6/2 as well as the non-participation of the USA have consequences for how the future global GHG reduction market will take shape. Based upon an updated version of CERT (vs. 1.2.) the implications of these changes, possible seller strategies and possible changes in the surrounding conditions are discussed. The changes that occurred in 2001 result in a clear downward trend of prices and traded quantities, with a negative impact on Non-Annex B countries who receive less revenue from CERs. "Hot air" becomes the dominant issue. The price and traded volumes depend to a considerable extent on the real quantity of "hot air" of Russia and Ukraine, of the sales strategy these countries follow, partial participation of the USA and of banking opportunities for the second commitment period. Some form of cartelistic behavior, restraining the Russian and Ukrainian offer of "hot air", a limited implementation rate of CDM projects in China due to lack of absorption capacity and a partial participation of the USA is considered as the most plausible scenario. According to various modeling scenarios as well as taking into consideration "real" prices paid currently a price of around 15 USD per ton of carbon (around 4 USD per ton of CO₂) is thus considered as the most realistic price projection.

| | |
|--|----------|
| 1. THE KYOTO PROTOCOL AND FLEXIBLE MECHANISMS..... | 2 |
| 2. THE GHG MARKET AFTER BONN..... | 2 |
| 3. PRICE TRENDS..... | 2 |
| 3.1. TRENDS UNDER PERFECT COMPETITION | 2 |
| 3.2. TRENDS UNDER MONOPOLISTIC BEHAVIOR | 3 |
| 3.3. TRENDS UNDER PRICE LEADERSHIP / OLIGOPOLISTIC BEHAVIOR..... | 4 |
| 3.3.1. FSU alone (restriction of "hot air" quantities)..... | 4 |
| 3.3.2. "Cartel" China and FSU (restriction of supply of "hot air" and Chinese CERs)..... | 4 |
| 3.4. TRENDS WITH (PARTIAL) PARTICIPATION OF THE USA..... | 5 |
| 3.4. CURRENT MARKET PRICES | 5 |
| 3.5. OVERVIEW AND CONCLUSIONS CONCERNING PRICES | 5 |
| 4. SENSITIVITY OF MARKET PROJECTIONS | 6 |
| 4.1. AUTARCHIC GHG DEVELOPMENT IN EUROPEAN COUNTRIES | 7 |
| 4.2. "HOT AIR" QUANTITIES | 7 |
| 4.3. MONOPOLISTIC OR RESTRICTED SELLER MARKET | 8 |
| 4.4. PARTIAL PARTICIPATION OF THE USA | 8 |
| 5. CONCLUSIONS | 8 |
| REFERENCES | 9 |

1. The Kyoto Protocol and Flexible Mechanisms

The Kyoto Protocol (KP) sets legally binding emissions targets for a basket of six greenhouse gases (GHG) for Annex B countries¹. Together, they must reduce their emissions by 5.2% below 1990 levels over the commitment period 2008-2012 (KP to the UNFCCC, 1997). The Protocol will become effective once it is ratified by at least 55 parties whose CO₂ emissions represent at least 55% of the total from Annex I Parties in the year 1990.

Reflecting the underlying principles in Article 3.3 of the UNFCCC, which states “policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost”, the KP incorporates a variety of provisions for flexibility mechanisms through which the costs of abating emissions can be lowered. In providing a mechanism for this exchange, joint emissions reduction not only reduces the cost of meeting the Kyoto goals for Annex B parties, but also establishes a new market and provides a new source of export earnings as well as a potential for the implementation of modern technologies in many areas for non-Annex B parties. Trading happens due to different marginal abatement costs of CO₂ in different countries. Through trade worldwide abatement costs can be minimized, while still achieving the target of reduced carbon emissions, since the location of CO₂ emissions does not matter from a global warming perspective.

2. The GHG Market after Bonn

The decisions taken in Bonn at CoP 6/2 as well as the non-participation of the USA have consequences for how the future global GHG reduction market will take shape. Based on these developments new projections of the future market in emissions reductions were developed based upon CERT (Carbon Emission Reduction Trade)² version 1.2. This version includes also new Business As Usual (BAU) estimates based upon recent publications of the US Department of Energy (DOE). Data used for calculating the projections is based upon 8 scenarios using as BAU estimates basically the data published by US DOE (low, reference and high growth scenarios) plus additionally a BAU estimate for all GHG realized by GTEM (ABARE, Australia). The MACs (Marginal Abatement Cost Curves) used are from EPPA and GTEM for CO₂, for GTEM for an all GHG scenario and from GTEM for MACs using a “bottom-up” approach. The CERT projections were made for the period 2008 – 2012, the first commitment period of the KP and prices are in USD 2000.

In the calculations the following decisions agreed upon at the CoP6/2 session in Bonn July, 2001 were included³:

- no quantitative complementarity rules
- unrestricted ‘hot air’ trading
- 2% levy on the share of proceeds of CERs (Certified Emission Reductions)
- the use of sinks in Annex B countries based on appendix Z

Additionally it was assumed for the basic calculations that the USA would not participate in the process, although results are also presented for a full and a partial participation.

3. Price Trends

3.1. Trends under Perfect Competition

The main result is a downward trend in GHG market prices compared to earlier projections (for the numerical output of the model see Table 1). Former moderate estimates had prices of US\$ 15 to 20 per ton of carbon⁴, a market volume of 500 MtC and export revenues of non-Annex B

countries of 3,000 – 10,000 million US\$⁵. The decrease in price is mainly due to the absence of the USA in the market as a major buyer and because of unrestricted 'hot air' trade in the new scenarios of the model. The absence of quantitative complementarity rules on the other hand increases the world market price and reduces costs of abatement. The additional 0-cost sinks included only have a minor impact. Significant is also that new estimates of BAU projections 2010 are in general at the lower end compared to former ones, especially for the FSU (Former Soviet Union), due to a slower economic recovery together with a reduced energy and carbon intensity of GDP growth.

Table 1: Market Scenarios Combining Factors (assuming perfect competition)⁶

| Scenario | World market price in USD | Traded volumes in MtC | Export revenues Non-Annex B in million USD |
|-------------------------------------|---------------------------|-----------------------|--|
| Low price estimates ⁷ | 0-1 | ~ 300 | 0 |
| Medium price estimates ⁸ | 3 | ~ 400 | ~ 400 |
| High price estimates ⁹ | 7 | ~ 400 | ~ 800 |

Source: Grütter using data of CERT 1.2.

The major supplier of GHG offsets are the countries of the FSU with a participation of between 50 and 90% of the total GHG market. The adaptation fund would receive an income from proceedings of 0 to 16 million USD per year.

Clearly the low-price solution is unrealistic as Russia and Ukraine will not sell their "hot air" at a 0-price tag.

3.2. Trends under Monopolistic Behavior

When monopolistic behavior of the major sellers of GHG offsets is assumed, the model's outputs are as shown in Table 2. The probability of some type of monopolistic behavior of potential seller countries is higher now without quantitative complementarity rules and unrestricted 'hot air' trading. The dominance of countries such as Russia and the Ukraine as sellers of 'hot air' and China as the largest and cheapest host country for CDM (Clean Development Mechanism) projects is much larger in the post-Bonn scenario. However, the upward range of the price is also limited, among others because of the presence of a large quantity of potential suppliers of GHG offsets.

Table 2: Market Scenarios Combining Factors (assuming monopoly)¹⁰

| Scenario | World market price in USD | Traded volumes in MtC | Export revenues Non-Annex B in million USD |
|--------------------------------------|---------------------------|-----------------------|--|
| Low price estimates ¹¹ | 0-1 | ~ 300 | 0 |
| Medium price estimates ¹² | 30 | ~ 300 | ~ 1 300 |
| High price estimates ¹³ | 240 | ~ 200 | ~ 4 100 |

Source: Grütter using data of CERT 1.2.

The major seller would be the countries of the FSU with a participation of between 60 and 90% of the total GHG market.

Clearly the low-price solution is unrealistic as Russia and Ukraine will not sell their "hot air" at a 0-price tag. At the same time especially the high price as well as the medium price estimate seem unrealistic as they assume a perfect cartel restricting strongly the supply to maximize their joint profits. This would necessitate a sophisticated internal redistribution of profits to ensure that countries would not act as free-riders of high prices to sell GHG. In the following chapter a type of price/leadership of the Russia/Ukraine with or without China is thus assumed.

3.3. Trends under Price Leadership / Oligopolistic Behavior

Russia, Ukraine and China dominate up to 90% of the supply assuming perfect competition. Some sort of cartel or price-leadership behavior is thus possible. Basically two versions are calculated:

- Russia and Ukraine limit unilaterally their "hot air" supply.
 - Russia, Ukraine and China form a cartel to limit the supply of GHG
- China alone has not other market power to act as price-leader due to the large quantities of "hot air" available in the market.

3.3.1. FSU alone (restriction of "hot air" quantities)

The assumption is that countries of the FSU, basically Russia and Ukraine would together reduce their offer of "hot air" on the market to gain better prices. No Non-Annex B country would follow this example – they would however profit as free-riders from increased prices. Table 3 shows us that this leads to an upward trend in price, with CDM countries profiting considerably.

Table 3: Price Leadership FSU (restriction of "hot air" sold)¹⁴

| Scenario | World market price in USD | Traded volumes in MtC | Export revenues Non-Annex B in million USD |
|--|---------------------------|-----------------------|--|
| Low "hot air" reduction ¹⁵ | ~ 3 | ~ 300 | ~ 200 |
| Moderate "hot air" reduction ¹⁶ | ~ 4 | ~ 300 | ~ 500 |
| High "hot air" reduction ¹⁷ | ~ 7 | ~ 300 | ~ 1 000 |

Source: Grütter using data of CERT 1.2.

Russia and Ukraine as "hot air" exporters would profit financially in all scenarios from restricting their supply unilateral even to levels of 25%.¹⁸ The high or at least moderate "hot air" reduction scenarios are thus clearly be more realistic than no or a low restriction on sales. This scenario is even more realistic if banking is allowed fully or at least to a considerable and undiscounted extent. Russia could thus reduce its current sales of "hot air", increase its current revenues and still have "hot air" banked for a second commitment period thus either avoiding costly national reductions in a second period or permitting a sale to a higher price in the second period.

3.2.2. "Cartel" China and FSU (restriction of supply of "hot air" and Chinese CERs)

The assumption is that countries of the FSU reduce their offer of "hot air" and at the same time China reduces its offer of CERs on the market to gain better prices. Additionally a transaction cost of 2 USD is assumed per ton of carbon CERs to make prices more realistic. The Chinese restriction can be voluntarily or simply implied through limitations on the implementation of CDM projects. It is assumed that no other countries would follow this example – they would however profit as free-riders from increased prices. Table 4 shows us that this leads to an upward trend in price, with CDM countries profiting considerably.

Table 4: Cartel FSU and China (restriction of "hot air" and Chinese CERs)¹⁹

| Scenario | World market price in USD | Traded volumes in MtC | Export revenues Non-Annex B in million USD |
|----------------------------------|---------------------------|-----------------------|--|
| Low reduction ²⁰ | ~ 4 | ~ 300 | ~ 300 |
| Moderate reduction ²¹ | ~ 6 | ~ 300 | ~ 500 |
| High reduction ²² | ~ 12 | ~ 300 | ~ 1 300 |

Source: Grütter using data of CERT 1.2.

We see a very clear and strong positive trend in profits and prices for all countries selling GHG. The countries of the FSU, China as well as all CDM countries would profit significantly from a restrained offer. The moderate reduction is a very plausible scenario due to limited implementa-

tion potentials of China and a move to secure profits from Russia and Ukraine. Even the high reduction scenario seems fairly plausible under this scenario. When reading the prices from table 4 we must take into consideration also that they already include 2 US\$ transaction costs for CERs.

3.4. Trends with (partial) Participation of the USA

A partial participation of the USA in the GHG market is a fairly realistic possibility. This might take the form of agreeing on the KP with a reduced target or participating in the GHG market under national or state regulations with similar criteria as those used in the flexible mechanisms or even voluntary participations of US-firms. While latter would lead to two market mechanisms the product price would be fairly homogeneous. Calculations presented in table 5 are based upon a full participation / partial participation with full competition and a cartelistic solution based upon moderate reductions of China and the FSU.

Table 5: Participation of the USA²³

| Scenario | World market price in USD | Traded volumes in MtC | Export revenues Non-Annex B in million USD |
|--|---------------------------|-----------------------|--|
| Full participation, competition | ~ 18 | ~ 700 | ~ 5 600 |
| Partial participation, competition ²⁴ | ~ 8 | ~ 500 | ~ 1 100 |
| Full participation, cartel ²⁵ | ~ 34 | ~ 700 | ~ 11 100 |
| Partial participation, cartel ²⁶ | ~ 16 | ~ 500 | ~ 3 100 |

Source: Grütter using data of CERT 1.2.

A partial participation of the USA would increase the price considerably - together with a fairly probable cartelistic situation the price tag for GHG offsets would be around 16 US\$ per ton of carbon (equivalent to about 4.4 USD per ton of CO₂).

3.4. Current Market Prices

Current market prices are very volatile and depend to a considerable extent on the quality of the certificates. An analysis made by Natsource of around 60 transactions involving 15 million tons of carbon had prices between 2 and 11 USD per ton of carbon (0.6 and 3 USD per ton CO₂) for verified emission reductions and between 15 and 44 USD per ton of carbon (4 and 12 USD per ton CO₂) for permits which had gained approval by the respective buyer country²⁷. The Dutch ERUPT tender in its first phase in the year 2000 (5 projects, 4 million tons CO₂, all JI projects) had an average price of around 28 USD per ton of carbon (7.5 USD/ton CO₂²⁸). The Prototype Carbon Fund PCF of the World Bank pays and intends to pay a price of around 10 USD per ton of carbon (around 3 USD per ton of CO₂).²⁹

3.5. Overview and Conclusions Concerning Prices

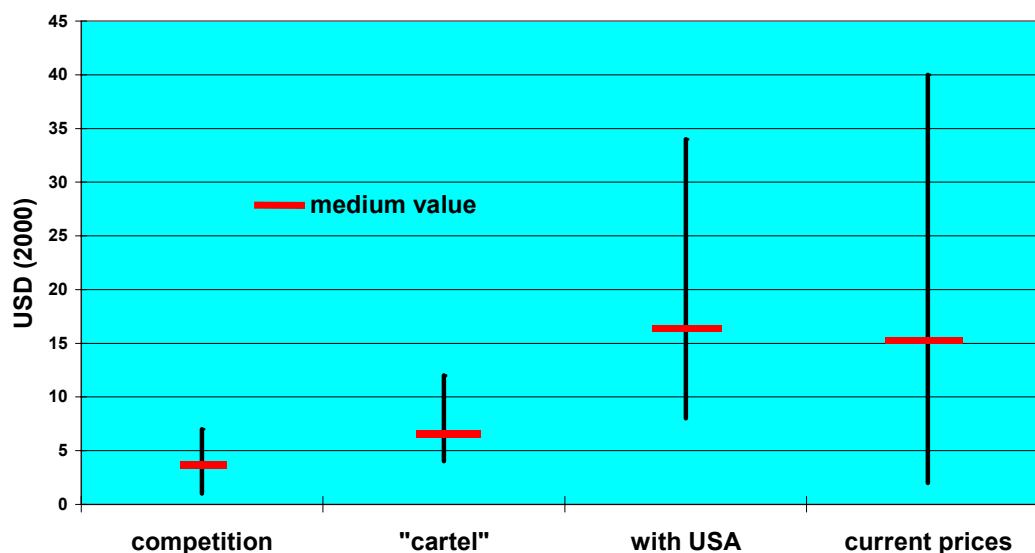
In graph 1 we see an overview of different market scenarios and prices. Under current conditions the most realistic scenario is a projection with a partial (voluntary) participation of the USA a limited implementation rate of China as well as a restriction of "hot air" sales by 50% through Russia and Ukraine as a "cartel". Such a scenario would of course be boosted considerably by allowing unrestricted banking in a second commitment period. Unlimited and undiscounted banking for a second period³⁰ would increase considerably current prices due to a twofold trend:

- Increased demand from Annex B countries to prevent high cost reduction options in a second commitment period.
- Reduced sale of "hot air" from Russia and Ukraine to maximize revenues in the first period and to have a reserve for a second period (either to avoid high cost domestic measures or for sale at higher prices).

Price reactions of decisions concerning banking and limits to banking would of course be influenced considerably on estimates concerning emission reduction commitments for the second

period, an eventual re-entry of the USA as well as an eventual inclusion of Developing Countries in a second commitment period and their possible obligations.³¹

Price Range USD per carbon ton



Source: Grütter using CERT 1.2.

A price of around 15 USD per ton of carbon (around 4 USD per ton of CO₂) is considered as most probable projection under current circumstances.

A lower offset price can be expected if following changes occur:

- Non-ratification of the KP
- Definitely no and not even partial participation of the USA
- Banking is strictly limited or heavily discounted which would increase the incentive for Russia and the Ukraine to sell-off all "hot air" in the first period
- Economic recession especially in the FSU and large Annex B countries reducing their GHG offset demand while increasing the "hot air" supply
- Expansion of domestic abatement programs in Annex B countries and inclusion of supplementary rules in many countries (e.g. the EU as well as Switzerland are discussing internal supplementary rules limiting imports to 50% of emission reductions required, independent of the text of the KP which does not include quantified import limits)
- Perception of a second commitment period with "weak" reduction targets and/or including significant quantities of "hot air" as a "ticket" for DCs to agree upon emission reduction targets.

A higher price would result by reversing above listed arguments.

4. Sensitivity of Market Projections

The projected market price is sensitive to some key assumptions or projections such as autarchic GHG development in European countries, the development of Russia and Ukraine, the development of some form of cartelistic behavior, the eventual partial participation as buyer of the USA and perceptions of the second commitment period.

4.1. Autarchic GHG Development in European Countries

Estimates concerning BAU GHG emissions for the first commitment period of European countries vary considerably between different sources (RIIA, Cicero, Zhang, EPPA, GTEM). BAU estimates used to calculate the emission reductions required depend to a considerable extent on projections of GDP and population growth, energy and carbon elasticity, energy prices and policies implemented by governments. Policies also include the future scope of usage of nuclear energy. These factors account basically for the large differences of various estimates concerning BAUs. The lower projections or estimates such as those from Zhang are based on a compilation of National Communications. For the EU, e.g., there is a sharp difference between some economic modeling studies which project large emissions gaps and projections based on a compilation of the National Communications with no sharp discrepancy between the Kyoto targets and the official projections of BAU GHG emissions in 2010³². Reasons for the low EU BAU projections used in the National Communications are basically due to internal burden sharing of the Kyoto commitments among the member countries and the impact of energy policies that are currently being either implemented or negotiated in response to climate change. These are incorporated in the National Communications but not in the economic models. Examples for such policies are the change to an environmental tax system based on energy instead of labor, the introduction of carbon taxes or voluntary agreements such as the ones made between the EU and the European Automobile Manufacturers Association (ACEA) with the target to reach an average for the new car fleet, of 120 grams CO₂ per kilometer by 2005/ 2010 at the latest (COM (1998) 495 final). Most European countries have already introduced and are implementing such policy shifts thus reducing BAU GHG emissions. Other differences can result from assumed elasticity energy/GDP and energy/carbon, prices of fuels as well as the assumed speed of introduction of new technologies. The scenarios represented in CERT 1.2. reflect the BAU differences through the "low", "medium" and "high" BAU estimates.

4.2. "Hot Air" Quantities

Estimates basically for Russia and Ukraine differ considerably between sources. The scenarios used in CERT 1.2. have basically "low", "medium" and "high" estimates of "hot air" incorporated. Table 6 gives an overview of different projections made for Russia, Ukraine and the FSU in total concerning "hot air" for the year 2010.

Table 6: Estimates of "Hot Air" (in MtC 2010)

| Source | Russia | Ukraine | FSU |
|---|--------|---------|------------|
| IIASA/WEC scenario A1 ³³ | 20 | 6 | 26 |
| IIASA/WEC scenario A2 | 2 | 1 | 3 |
| IIASA/WEC scenario A3 | 73 | 20 | 93 |
| IIASA/WEC scenario B ³⁴ | 175 | 48 | 223 |
| IIASA/WEC scenario C1 | 106 | 29 | 135 |
| IIASA/WEC scenario C2 | 110 | 30 | 140 |
| IES, low growth ³⁵ | 157 | | |
| IES, favorable growth | 124 | | |
| IEA reference scenario ³⁶ | 179 | | |
| US DOE, low growth³⁷ | | | 365 |
| US DOE, medium growth (reference scenario) | | | 324 |
| US DOE, high growth | | | 204 |
| GTEM all GHG³⁸ | | | 275 |

The last 4 scenarios are included in CERT 1.2. which thus covers a range from 200 to 350 carbon tons approximately of "hot air". Most other estimates are inside this range, albeit more at the lower end equal to the US DOE high growth or the GTEM scenario.

The emissions reductions required by the remaining parties of Annex B (without the USA) is between 250 and 400 MtC according to different estimates of BAU emissions. Assuming uniform low growth (leading to large quantities of "hot air" and low emission reduction demand from Annex B countries) "hot air" would be sufficient to cover easily all reduction requirements while with high growth "hot air" would still be able to cover 50% of emission reduction requirements. The KP will thus realistically achieve a reduction of 100 to 200 MtC per year during the first commitment period. World GHG emissions in 1990 were 5 821 MtC of which Annex I countries had 3 890 MtC. Estimates for world GHG emissions 2010 are at 7 835 MtC of which Annex I account for 4 276 MtC³⁹. This shows clearly that the KP in its first commitment period means simply a slightly reduced growth of GHG emissions compared to BAU and no stabilization or even reduction.

4.3. Monopolistic or Restricted Seller Market

The probability of having some form of cartelistic market or unilateral price leadership behavior is high as the market share of Russia is very high. Although "hot air" has virtually zero-cost in its generation it cannot be expected that the respective countries will sell it for free. Next to this a high implementation rate of China is unrealistic as institutions are not yet in place to absorb the large quantity of potential projects. Price reactions to cartelistic behavior were discussed in former chapters.

4.4. Partial Participation of the USA

The USA might decide to establish a national GHG goal and also participate in trading. While it is not expected that this would occur in the magnitude as agreed upon with the Kyoto goal it still might be in a scale with a significant impact upon prices. Uncertainties considering this participation also tend to have a clear upwards influence on the price.

5. Conclusions

Following conclusions can be drawn:

- The changes that occurred in 2001 result in a clear downward trend of prices and traded quantities, with a negative impact on Non-Annex B countries who receive less revenue from CERs than formerly assumed.
- "Hot air" becomes the dominant issue. The price and traded volumes depend to a considerable extent on the real quantity of "hot air" of Russia and Ukraine, of the sales strategy these countries follow and of banking opportunities for the second commitment period.
- Due to the limited market volume and the low market price the adaptation fund would have to rely basically on other finance sources than the 2% levy on the share of proceeds of CERs. Estimates based upon full competition lead to an adaptation fund of annually around 10 million US\$ resulting from proceeds of CERs. When taking into consideration a cartelistic supply including FSU and China the adaptation fund would have between 10 and 50 million US\$ annually.
- Some form of cartelistic behavior, restraining the Russian and Ukrainian offer of "hot air" seems fairly probable. China will probably not reach a higher implementation rate than 50% so its offer would also be reduced significantly. All seller countries would profit strongly from such a move even when assuming free-rider behavior of the rest of the world. Price leadership on an unilateral base of Russia is clearly profitable for Russia as well as other seller countries independent of the behavior of other countries. This scenario has thus a high probability to get realized as we do not have to assume a cartel of many countries who restrain the offer and have to keep track of the sold supplies.
- A partial participation of the USA (e.g. also possible due to some states having special regulations or a voluntary participation of US-firms) leads to a fairly strong price recovery.

- Unlimited and unrestricted banking as well as a second commitment period with significant GHG reductions would send a positive and strong price signal to the current market as the attractiveness to overbuy would increase for Annex B countries thus inducing higher demand while countries such as Russia would have a larger incentive to bank part of their "hot air" for a subsequent period thus reducing the market supply.

A price of around 15 USD per ton of carbon (around 4 USD per ton of CO₂) is considered as the "best guess" under current circumstances and with current data.

References

CICERO (1998), Emission Trading under the Kyoto Protocol

EU (2000), Green Paper on GHG Emissions Trading within the EU

Grütter, Kappel, Staub (2001), CERT 1.2.

Grütter (2001), World Market for GHG Emission Reductions

GTEM (2000), pers. comm., Cain Polidano ABARE

IEA (2001), World Energy Outlook 2000

IES (2001), Osnovnie Polozheniya Energeticheskoye Strategii Rossii na period do 2020 goda [see RIIA Workshop Report Energy and Climate: Russian-European Partnership, 2001]

IIASA (1998), The Kyoto Protocol Carbon Bubble: Implications for Russia, Ukraine and Emissions Trading by David Victor, Nebojsa Nakicenovic, Nadejda Victor; Interim report IR-98-094

MIT, report 41 (1998), The Effects on DCs of the KP and CO₂ Emissions Trading by A.D. Ellermann, H.D. Jacoby, A. Decaux

Natsource (2001), Review and Analysis of the Emerging International Greenhouse Gas Market

Polidano, C (2000), Developing the Infrastructure for the CERT Model,

RIIA (2000): Vrolijk Christiaan, Quantifying the Kyoto Commitments, 2000.

US Department of Energy / EIA (2001), International Energy Outlook 2001

Vrolijk Christiaan (2000), Quantifying the Kyoto Commitments

ZhongXiang Zhang (1999), Estimating the Size of the Potential Market for All Three Flexibility Mechanisms under the Kyoto Protocol

¹ The KP includes carbon dioxide (CO₂) emissions from fossil fuels, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons, and sulfur hexafluoride.

² CERT is a computational framework to assess the GHG market under different scenarios developed by Grütter Consulting together with the ETH Zürich for the World Bank, 2001. Free copies of the software are available upon request to j.gruetter@bluewin.ch

³ based upon FCCC/CP/2001/L.7

⁴ Note, that all calculations are based upon tons of carbon, not tons of CO₂. To calculate prices in tons of CO₂ multiply by 12/44

⁵ see Grütter, World GHG market, 3/2001

⁶ Assumptions: non-participation of the USA, 2% CERs into the adaptation fund, 0-cost sinks according to Appendix Z, no supplementarity, full "hot air" trading, no impact of retainment rate, 0 transaction cost, 100% implementation rate CDM, convention fund financed not through the GHG market; USD of 2000

-
- ⁷ scenarios using low and medium growth BAU estimates and GTEM all GHG
- ⁸ high growth BAU estimate with EPPA MACs
- ⁹ high growth BAU estimate with GTEM MACs
- ¹⁰ Assumptions: non-participation of the USA, 2% CERs into the adaptation fund, 0-cost sinks according to Appendix Z, no supplementarity, full "hot air" trading, no impact of retainment rate, 0 transaction cost, 100% implementation rate CDM, convention fund financed not through GHG market; USD of 2000
- ¹¹ scenarios using low and medium growth BAU estimates and GTEM all GHG
- ¹² high growth BAU estimate with EPPA MACs
- ¹³ high growth BAU estimate with GTEM MACs
- ¹⁴ modeled with CERT by reducing the sale volume of "hot air" from 100% to 75% and 50% respectively; perfect competition; price range of all scenarios excluding the highest and lowest price ones; same conditions as table 1 for scenarios
- ¹⁵ 25% reduction of volume of "hot air" compared with perfect competition
- ¹⁶ 50% reduction of volume of "hot air" compared with perfect competition
- ¹⁷ 75% reduction of volume of "hot air" compared with perfect competition
- ¹⁸ If only Russia or Ukraine would restrain their sales then results may vary. Even then an unilateral restriction of 50% would be profitable however
- ¹⁹ modeled with CERT by reducing the implementation rate of China only from 100% to 75%, 50%, and 25% respectively together with "hot air" traded from 100% to 75%, 50%, and 25% respectively; comparing result with perfect competition; inclusion of 2 USD transaction cost per ton of carbon CER; non-participation of the USA, 2% CERs into the adaptation fund, 0-cost sinks according to Appendix Z, no supplementarity, no impact of retainment rate, 100% implementation rate CDM other countries than China, convention fund financed not through GHG market; USD of 2000; price range of all scenarios excluding the highest and lowest price ones
- ²⁰ 25% reduction of volume of "hot air" and 75% implementation rate China compared with perfect competition
- ²¹ 50% reduction of volume of "hot air" and 50% implementation rate China compared with perfect competition
- ²² 75% reduction of volume of "hot air" and 25% implementation rate China compared with perfect competition
- ²³ modeled with CERT (version 1.2. with USA); perfect competition includes 2 USD transaction cost per ton of carbon CER, 2% CERs into the adaptation fund, 0-cost sinks according to Appendix Z, no supplementarity, no impact of retainment rate, 100% implementation rate CDM other countries than China, convention fund financed not through GHG market; cartel solution with implementation rate of China 50% together with "hot air" traded by 50%; participation of the USA 100% and 50% of reduction required (BAU - Assigned Amount); USD of 2000; price range of all scenarios excluding the highest and lowest price ones
- ²⁴ the USA reduces emissions by 50% of BAU - Assigned Amount according to KP
- ²⁵ 50% reduction of volume of "hot air" and 50% implementation rate China compared with perfect competition
- ²⁶ the USA reduces emissions by 50% of BAU - Assigned Amount according to KP; Cartel: 50% reduction of volume of "hot air" and 50% implementation rate of China compared with perfect competition
- ²⁷ Natsource, Review and Analysis of the Emerging GHG Market, 2001
- ²⁸ see www.senter.nl/erupt/projects.htm
- ²⁹ see PCF PIN template
- ³⁰ Unlimited banking would of course reduce the real environmental impact of the KP for the first commitment period as "hot air" implies no additional GHG reductions - any "elimination" of "hot air" quantities e.g. by restricting banking thus implies increased real emission reductions assuming that not all "hot air" would be sold in the first period.
- ³¹ Eventually DCs could receive fairly high emission allowances thus creating Developing Country "hot air" in a second commitment period as a political mean to facilitate the entry of DCs into a commitment obligation.
- ³² Zhang, Cicero and RIIA report e.g. low reduction requirements of the EU
- ³³ Institute for Applied Systems Analysis, 1998
- ³⁴ considered by IIASA as most probable scenario
- ³⁵ IES, 2001, table 8
- ³⁶ International Energy Agency, 2001
- ³⁷ US Department of Energy, 2001
- ³⁸ GTEM, 2001
- ³⁹ US DOE, 2001