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Climate protection policy with China and the USA after 2012

Cost reduction through emissions trading and technological cooperation

Claudia Kemfert

Greenhouse gas emissions should be stabilized to today's level to prevent harmful climate damage.The countries that have signed the Kyoto Protocol committed themselves to reduce their greenhouse gas emissions over the period 2008 to 2012, but only to a very limited extent. The USA decided not to ratify the Kyoto Protocol for various reasons. Furthermore, fast-growing economies like China are about to catch up with the USA in terms of their energy consumption and gas emissions. Therefore, in the near future it is going to be essential to try and persuade both nations, the USA and China, to accept binding greenhouse gas emission reduction targets. The USA and China need to be convinced to enter a 'Kyoto Plus' Agreement after 2012.

In this respect, a clearly defined international trade in emission rights can play an important role. In the industrialized countries, costs of approx. 500 billion US dollars could be avoided until 2050 as compared with a scenario in which there is no emissions trading. In order to lower expenses to this extent, Europe, the USA, Japan and Russia need to reduce their emissions by 3% per year from 2012 onwards as compared with an estimated emission curve according to a 'business as usual' scenario, and moreover, simultaneously China needs to be granted emissions rights after 2012. On the one hand, this would help industrialized countries like the USA to effectively reduce emission reductions costs. On the other hand, China could benefit to a large extent from selling emission rights. Moreover, additional incentives to meet climate protection targets could be created through specific cooperation when investing in new technologies.

How to proceed after Kyoto?

Greenhouse gas emissions and thus greenhouse gas concentrations have constantly increased over the past centuries.[1] The Intergovernmental Panel of Climate Change (IPCC) and the German Advisory Council on Global Change (WBGU) assume that a rise in the global carbon dioxide concentration to over 450 ppm (parts per million) – which would correspond to a tem-

perature increase by more than 2° C until 2100 – would constitute a harmful human impact on the climate.

Current carbon dioxide concentrations already reach approx. 400 ppm.[2] The main emitters of greenhouse gases are industrialized countries with a high per capita energy consumption, e.g. the USA, the EU countries and Japan. Moreover, China has become the 2nd largest emitter of CO_2 world-wide due to its energy-intensive growth. With the entry into force of the Kyoto Protocol, most industrialized countries have committed themselves to a reduction of their greenhouse gas emissions over the period 2008 to 2012.

However, efforts for an effective and internationally agreed climate protection have been sluggish, and it appears doubtful whether binding emission targets will be actually set for the time after the expiry of the Kyoto Protocol's first commitment period in 2012. While Germany and the European Union insist on binding commitments and have already implemented numerous climate protection measures themselves, other countries like the USA and China have refused to meet these demands.[3] This contrasts the urgent need for a participation of the USA in international climate protection which could help persuade countries like China and India to take action as well.

Nations with high emissions and often high abatement costs will in the medium or long run only join a climate protection agreement if cooperation in international climate protection yields a low-cost option to achieve emission targets. In this respect, various incentives could be used. Countries could be persuaded to commit to climate protection goals using *Side Payments,* i.e. cash payments e.g. from climate protection funds[4] specifically set up for that purpose. There could be financial support for concrete climate protection measures. Moreover, forerunner states like the European countries could put pressure on hesitating nations to sign a climate protection agreement by imposing restrictions on trade, in particularly climate-damaging energy sources (e.g. for coal from the USA). However, quantitative investigations have shown that this would have negative economic effects for the countries suffering from trade restrictions as well as for those countries imposing them.[5]

It seems more promising to introduce at the international level those emission reduction measures which cause minimal economic costs. Industrialized countries' abatement costs can be significantly reduced through emissions trading compared to other climate protection instruments. This also applies to other countries that would like to contribute to an international climate protection. Moreover, countries could cooperate on technological innovation in order to improve energy efficiency and to bring about additional reductions in abatement costs. This could create a competitive advantage for the participating countries.[6]

Thus, the success of climate protection policies after 2012 depends on three factors: concrete global emission reduction targets, cooperation and cost efficiency.

Cost reduction through emissions trading – three scenarios

The trade in emission rights already included in the Kyoto Protocol significantly reduces emission mitigation costs.[7] This is primarily due to the fact that Russia's emissions, following the economic slump after 1990, lie much below the 1990 level. Thus, Russia could sell emissions rights in the commitment period.[8] For countries with relatively high abatement costs, e.g. the EU countries and Japan, it can be less costly to buy emission rights instead of implementing emission reduction measures in their countries.

For further climate protection after Kyoto, i.e. after 2012, it will be decisive that additional emissions reduc-

[1] Cf. Hans-Joachim Ziesing: 'Worldwide Climate Protection Policy – Still No Visible Success.' In: *DIW Economic Bulletin,* vol. 41, no. 10, October 2004; Hans-Joachim Ziesing and Franz Wittke: 'Primärenergieverbrauch in Deutschland von hohen Energiepreissteigerungen und konjunktureller Belebung geprägt'. In: *Wochenbericht des DIW Berlin,* no. 7/2005; Hans-Joachim Ziesing: 'Carbon Dioxide Emissions in Germany – Stagnating in 2004.' In: *DIW Berlin Weekly Report,* no. 9/2005.

[2] Intergovernmental Panel of Climate Change (IPCC): 'Climate Change 2001. Third Assessment Report.' Synthesis Report: Cambridge 2001; Claudia Kemfert: 'Global Protection of Climate – Immediate Action Will Avert High Costs.' In: *DIW Berlin Weekly Report,* no. 12/2005.

[3] However, it should be noted that a number of US Federal States have already implemented ambitious climate protection goals. In China an energy efficiency increase can be observed.

[4] Carl Christian von Weizsäcker suggested that emission rights of 10 euros per tonne of carbon dioxide be purchased and deposited into a climate protection fund; cf. Carl Christian von Weizsäcker: 'Was kommt nach 'Kyoto'?' In: *Energiewirtschaftliche Tagesfragen,* no. 12, 2004, p. 782-786.

[5] Cf. Claudia Kemfert: 'International Climate Coalitions and Trade – Assessment of Cooperation Incentives by Issue Linkage.' In: *Energy Policy,* no. 4, p. 455-465; Susanne Dröge and Claudia Kemfert: 'Trade Policy to Control Climate Change: Does the Stick Beat the Carrot?' In: *DIW Berlin Quarterly Journal of Economic Research,* vol. 74, no. 2, 2005, p. 235-248.

[6] Ibidem

[7] Claudia Kemfert: 'Global Climate Protection ...' op. cit.; Claudia Kemfert: 'The Economic Costs of Climatic Change.' In: *DIW Berlin Weekly Report,* no. 2/2005; Christian van Hirschhausen, Franziska Holz and Claudia Kemfert: 'Russian Energy and Climate Policy Remains Inconsistent – Challenges for the EU'. In: *DIW Berlin Weekly Report,* no. 11/2005.

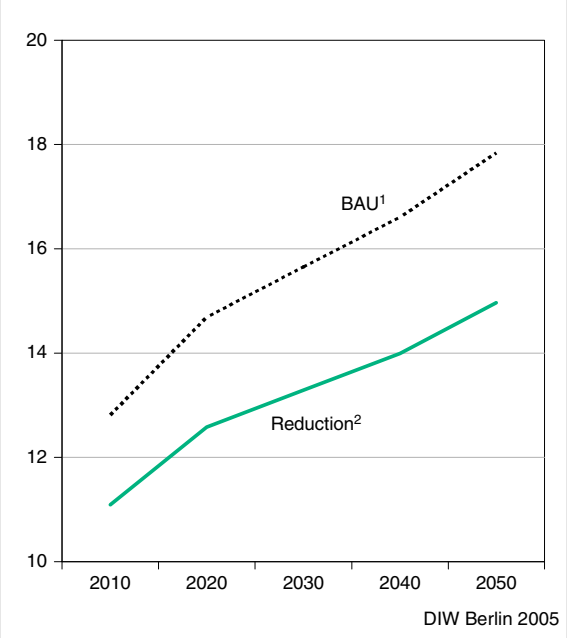
[8] This leads to the so-called 'Hot Air' problem, i.e. Russia can sell excess emissions rights and achieve significant revenue.

tions can be achieved at the lowest possible cost. 'Kyoto Plus' must include three important features:

1. Binding emission reduction targets for all industrialized countries
2. Cost efficiency through an international emissions trading that includes fast-growing economies
3. Cooperation in technological research

Three simulated scenarios are described below. The first one is based on the assumption that after 2012 only the industrialized countries Europe, Japan, Russia and also the USA will commit themselves to emission reductions of 3% per year as compared with the estimated emission curve in the 'business as usual' scenario (cf. table) until 2050 (scenario I). This would not be enough to avert climate change, yet would mean much higher emission reductions than in the years after expiry of the Kyoto Protocol, and would be a politically achievable goal, especially for the USA. All the more so since the USA had already announced in 2002 that it is striving to substantially increase energy efficiency and to uncouple economic growth from energy consumption.[9] This scenario would yield a total reduction of 10 gigatonnes of carbon dioxide (cf. figure) in the industrialized countries until 2050. Economic costs are estimated using the WIAGEM global simulation model.[10] It is also assumed that Russia will grow strongly and will demand emissions certificates after 2012. If industrial countries were to reach the emission reductions targets by 2050, this would entail total costs of approx. 1 billion US dollar. The emissions certificate price would reach US $ 51 per tonne of carbon dioxide.

Figure
Emissions Curve
In gigatonnes of carbon dioxide



1 Business as usual. — 2 By 3% annually as compared to BAU.
Sources: Simulation with WIAGEM model; DIW Berlin calculations.

Table
Emissions Reduction Costs for Industrialized Countries, 2012 to 2050
In billion US dollars

	Emissions trading as carried out by		
	only industrialized countries	industrialized countries and China	industrialized countries and all developing countries
	(Scenario I)	(Scenario II)	(Scenario III)
Total	995.55	736.71	497.77
Prevented costs		258.84	497.77
of which: Europe		103.54	199.11
Memo item: Certificate price in US dollar/t CO_2	51	37	25

Sources: Simulation with WIAGEM model; DIW Berlin calculations.

In the second scenario it is assumed that China will be granted emission rights amounting to the estimated emissions from 2020 onwards (scenario II). It is further assumed that China can reduce energy intensity by 1% per year through technological improvements and efficiency increases and, thus, can sell emission rights. In a third scenario, it is assumed that all other developing countries, such as India, South America and Africa, will be granted emission rights according to the estimated development of their emissions. Then, these countries can also trade emission rights (scenario III). This is also based on estimated energy efficiency increases of 1% per year.

The costs of the industrialized countries are calculated as difference between the potential growth paths of the gross national product (GNP). In addition, emissions certificate prices are compared.

A climate protection policy with trade in emission rights among the industrialized countries would entail costs amounting to approx. 1 billion US dollars until 2050 (this corresponds to 0.31% of the GNP of industrialized countries).[11]

[9] In 2002, the USA announced a reduction of carbon intensity (carbon emissions per unit of GNP) by 18%, which represents a reduction of 1.96% per year (cf. www.whitehouse.gov/news/releases/2002/02/climatechange.html).

[10] Claudia Kemfert: 'The Economic Costs of Climate Change,' op. cit.; Claudia Kemfert: 'Global Climate Protection', op. cit.

If China joins the emissions trading, industrialized countries could be able to avoid costs amounting to 259 billion US dollars. Furthermore, if other developing countries participate, costs amounting to approx. 500 billion US dollars could be saved. The emissions certificate price would fall from US $ 51/t CO_2 to US $ 37 or even US $ 25/t CO_2. An additional effect would be that developing countries could realize significant revenue through the sale of emissions rights, which would entail additional economic growth by 0.1 percent.

Cost reduction through cooperation and technical innovations

Avoiding climate change is only possible if the greenhouse gas emissions remain at today's levels. The IPCC assumes that the necessary technologies to achieve this goal already exist, but that they need to be used in a more purposeful manner.[12] The WBGU argues in a similar way and emphasizes that a significant share of renewable energies must be used in the future.[13]

Currently, there are many technological options for emission reduction, as also listed by Princeton scientists.[14] Efficiency improvements in energy production as well as in transport and in housing play a major role. Moreover, the authors consider to replace coal-fired power plants with gas, wind, nuclear and solar power plants and additionally to use Capture Carbon and Sequestration (CCS).[15] In addition, biomass use for power generation could be increased and the absorption of carbon from the atmosphere could be raised through better forest management.

However, it should be noted that it is crucial for both, the use of existing technologies and the development of new technologies to set specific emission targets as early as possible. If the necessary climate protection goals are set too late, this may entail significant misdirected investments which, as 'stranded investments', may lead to economic losses. Replacement investments amounting to 60 billion euros are due over the next two decades regarding energy generation in Germany; in Europe, they could amount to 350 billion euros. Large misdirected investments must be avoided in the course of this replacement investment cycle.

If, for instance, the emissions trading price increases to over 30 euros per tonne of carbon dioxide, the power generation with CO_2 capture and sequestration could be more profitable in the long term as compared to traditional fossil energy production. A rising shortage of conventional oil and gas reserves could lead to significant price increases for both raw materials over the next two decades, which would allow low emissions technologies to rapidly become cost effective.

In addition, specific technological development cooperations could create incentives to join a climate protection agreement. This would be especially important for fast-growing economies like China and India.

Summary

A long-term effective climate protection policy must prescribe binding climate goals and ensure cost efficiency. The USA and China must be involved in a 'Kyoto Plus' Agreement after 2012. However, the USA will only join an agreement if emission reductions are cost effective and if fast-growing economies like China also cooperate. Provided that the EU countries, the USA and Japan agree upon an annual emission reduction of 3% until 2050 and that China is granted emissions rights amounting to its estimated future 'business as usual' emissions, the emission reduction cost can be reduced up to 500 billion US dollars.

Thus, cost efficiency for industrialized countries could be substantially improved through China's involvement. Additional incentives to participate in a 'Kyoto Plus' Agreement could result from technological cooperation.

In the long run, the objective is certainly to achieve higher emissions reduction targets. In the medium-term, however, an effective global climate protection could definitely be achieved by involving countries that are concerned about their economic power (USA) through international trade in emission rights, thus creating an incentive for fast-growing economies like China to participate in an international climate protection agreement.

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[11] Measured in real values of year 2000.

[12] Cf. IPCC: Mitigation. *A Report of Working Group III of the Intergovernmental Panel on Climate Change*. Accra, Ghana, February 28 to March 3, 2001.

[13] Cf. WBGU: 'World in Transition – Towards Sustainable Energy Use'. Berlin 2003, p. 94-98

[14] Cf. Steve Pacala and Robert Scolow: 'Stabilization Wedges: Solving the Climate Problem for the next 50 Years with Current Technologies.' In: *Science,* vol. 305, S. 968-972.

[15] Cf. Claudia Kemfert and Katja Schumacher: 'Climate Protection in the German Electricity Market: Opportunities for Coal Technologies Through CO_2 Capture and Storage?' In: *DIW Weekly Report,* no. 16/2005.

Supplement: Economic Indicators
Weekly Report No. 23/2005
(data as of 16 August 2005)

Germany – Selected Seasonally Adjusted Economic Indicators[1]

		Unemployment		Vacancies		Orders in manufacturing (volume)[2]													
						Manufacturing						Intermediate goods industry		Capital goods industry		Durable consumer goods industry		Non-durable consumer goods industry (incl. semi-durable goods industry)	
						Total		Domestic		Abroad									
		in 000s				2000 = 100													
		month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter
2003	J	4 316		391		98.1		93.3		104.2		97.6		99.4		89.0		98.5	
	F	4 363	4 333	379	385	98.4	97.1	94.8	92.9	103.0	102.3	96.8	96.5	100.4	98.3	88.0	87.6	100.0	97.6
	M	4 388		371		94.6		90.7		99.7		95.0		95.3		85.7		94.4	
	A	4 405		365		96.9		92.7		102.1		96.1		98.5		86.8		96.6	
	M	4 399	4 397	353	359	93.1	95.8	91.7	92.4	94.8	99.9	93.6	95.2	93.1	97.0	83.8	84.6	95.6	96.7
	J	4 385		345		97.3		92.9		102.7		96.0		99.5		83.1		97.8	
	J	4 393		346		97.3		92.9		102.7		97.5		98.0		88.2		96.5	
	A	4 400	4 396	341	343	97.3	97.8	92.2	93.1	103.7	103.6	97.1	97.8	98.5	98.9	85.6	87.3	97.7	96.8
	S	4 402		337		98.7		94.3		104.3		98.6		100.2		88.1		96.0	
	O	4 403		333		99.7		94.8		105.9		100.2		100.5		89.2		98.5	
	N	4 399	4 398	330	331	100.2	100.1	95.7	94.7	105.9	106.7	100.9	101.0	101.6	100.8	87.4	88.3	95.8	97.5
	D	4 379		324		100.2		93.7		108.4		101.8		100.3		88.4		98.3	
2004	J	4 298		313		99.7		94.9		105.7		100.6		100.7		87.7		95.1	
	F	4 276	4 301	301	306	100.7	101.0	95.3	95.8	107.4	107.4	102.4	102.1	101.5	102.1	87.6	87.9	94.4	95.4
	M	4 280		286		102.6		97.3		109.1		103.4		104.2		88.3		96.7	
	A	4 319		276		103.5		97.2		111.4		104.6		104.9		87.8		98.7	
	M	4 337	4 327	279	279	106.8	104.1	98.5	97.1	117.2	112.8	106.8	105.0	109.2	105.6	90.5	88.7	100.0	98.4
	J	4 370		279		101.9		95.6		109.9		103.6		102.7		88.0		96.6	
	J	4 413		276		103.2		96.2		112.0		103.1		105.5		87.0		98.6	
	A	4 427	4 417	274	276	103.4	103.3	97.0	96.2	111.3	112.2	104.4	103.6	105.0	105.4	87.5	86.5	97.2	97.8
	S	4 451		276		103.2		95.2		113.2		103.2		105.7		85.0		97.7	
	O	4 466		280		102.8		95.6		111.9		102.0		106.2		83.8		97.0	
	N	4 492	4 485	282	282	102.1	103.6	94.5	96.2	111.5	112.9	101.6	101.5	104.2	107.8	85.5	84.4	100.2	98.6
	D	4 547		290		105.8		98.4		115.2		100.8		113.0		84.0		98.6	
2005	J	4 731		305		104.9		96.2		115.8		103.6		108.0		85.6		103.1	
	F	4 827	4 756	327	318	103.7	104.6	94.4	95.5	115.3	115.9	101.2	102.3	107.3	108.2	85.9	85.9	103.6	103.6
	M	4 875		356		105.1		95.9		116.7		102.1		109.4		86.2		104.0	
	A	4 835		382		103.3		95.4		113.1		100.8		106.8		87.8		101.7	
	M	4 847	4 848	396	387	102.9	104.7	94.8	96.4	113.1	115.1	101.6	102.3	105.8	108.6	84.6	87.3	102.8	103.0
	J	4 850		409		108.0		99.1		119.2		104.3		113.3		89.6		104.7	
	J	4 856		426															
	A																		
	S																		
	O																		
	N																		
	D																		

1 Seasonally adjusted by the Berlin Method (BV4). With this method, the addition of new data can change previous seasonal adjustment patterns even if the original, unadjusted, figures remained unchanged. Quarterly figures are calculated from seasonally adjusted monthly figures. — 2 Also adjusted for working days.

Sources: Federal Labour Office; Federal Statistical Office; DIW Berlin calculations.

Germany – Selected Seasonally Adjusted Economic Indicators[1] (continued)

		Employment in mining and manufacturing		Manufacturing output[2]										Retail trade turnover		Foreign trade (Special trade)[2]			
				Manufacturing		Capital goods industry		Durable consumer goods industry		Non-durable consumer goods industry (incl. semi-durable goods industry)		Construction industries				Exports		Imports	
		in 000s		2000 = 100										2003 = 100		Euro billion			
		month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter	month	quarter
2003	J	6 190		99.6		102.4		88.1		97.5		85.6		100.6		55.5		45.7	
	F	6 181	6 177	100.1	99.2	104.1	102.3	89.1	87.7	97.5	97.0	81.1	83.8	100.5	99.9	55.5	165.1	44.8	135.6
	M	6 172		98.0		100.4		85.8		96.1		84.8		98.5		54.0		45.1	
	A	6 161		99.8		101.7		87.6		98.9		86.8		100.4		54.3		44.5	
	M	6 152	6 157	97.7	98.5	100.2	100.2	85.6	85.6	95.8	97.6	84.9	85.7	102.0	100.4	54.1	163.3	44.1	133.2
	J	6 141		97.9		98.7		83.8		97.9		85.5		98.7		54.9		44.6	
	J	6 130		99.6		102.1		88.6		97.8		86.5		99.7		55.7		44.0	
	A	6 116	6 123	98.2	98.8	99.8	100.9	85.5	87.0	97.4	97.2	83.6	84.8	99.0	99.8	55.7	168.2	44.2	132.1
	S	6 106		98.5		100.7		86.8		96.4		84.4		100.6		56.8		43.9	
	O	6 095		100.3		102.3		88.1		97.8		84.4		101.1		55.7		44.3	
	N	6 087	6 091	101.2	101.1	104.6	104.0	88.1	88.4	97.1	97.7	83.8	84.3	98.7	100.1	56.9	171.0	45.7	135.5
	D	6 079		101.8		105.1		88.9		98.3		84.7		100.6		58.3		45.5	
2004	J	6 048		100.7		103.0		88.0		97.5		81.4		100.4		58.1		45.1	
	F	6 041	6 049	101.2	101.3	103.1	103.8	87.5	88.4	97.2	97.2	86.0	83.7	100.2	100.8	58.5	176.1	46.2	136.9
	M	6 035		102.1		105.3		89.6		97.1		83.6		101.8		59.4		45.6	
	A	6 031		102.5		105.4		88.8		97.7		80.7		101.0		61.3		47.0	
	M	6 023	6 027	105.4	103.7	109.1	107.2	92.5	90.1	99.7	98.3	82.5	81.2	97.9	100.4	62.7	184.0	48.4	142.0
	J	6 019		103.2		107.2		89.2		97.4		80.3		102.2		60.0		46.7	
	J	6 011		102.8		105.8		87.3		97.9		78.8		101.1		60.9		48.9	
	A	6 010	6 011	104.1	103.7	107.9	107.3	88.4	87.6	98.2	98.3	80.7	79.5	100.6	100.8	60.6	181.8	48.3	146.4
	S	6 007		104.3		108.3		87.0		98.9		78.9		100.6		60.2		49.2	
	O	6 002		103.5		107.9		85.8		98.0		77.7		99.3		62.7		49.4	
	N	5 992	5 997	102.3	102.5	104.3	105.3	85.2	85.4	98.7	98.1	77.4	77.5	102.5	101.2	61.9	185.1	49.0	146.6
	D	5 986		101.7		103.7		85.2		97.7		77.3		101.8		60.5		48.2	
2005	J	5 970		105.3		107.9		88.2		100.5		80.1		100.7		63.2		49.6	
	F	5 959	5 965	104.3	104.9	107.2	108.0	88.4	88.1	100.8	100.9	72.3	73.8	101.6	101.4	62.5	189.0	48.7	147.8
	M	5 949		105.1		108.8		87.8		101.4		68.9		101.8		63.4		49.6	
	A	5 941		105.3		109.7		89.2		99.6		74.8		101.2		62.0		49.8	
	M	5 936		103.3	105.0	105.7	108.9	84.6	88.6	100.1	100.1	72.4	74.2	102.3	102.3	62.5	188.9	50.8	150.5
	J			106.5		111.1		92.2		100.5		75.4		103.4		64.3		49.9	
	J																		
	A																		
	S																		
	O																		
	N																		
	D																		

1 Seasonally adjusted by the Berlin Method (BV4). With this method, the addition of new data can change previous seasonal adjustment patterns even if the original, unadjusted, figures remained unchanged. Quarterly figures are calculated from seasonally adjusted monthly figures. — 2 Also adjusted for working days.

Sources: Federal Statistical Office; DIW Berlin calculations.