JET-SET

Joint Emissions Trading as a Socio-Ecological Transformation

Linking Emissions Trading Schemes:

Institutional, Economic and Environmental Effects of Policy Scenarios

Ralf Schüle*, Niels Anger, Christiane Beuermann, Marcel Braun, Bernd Brouns, Renate Duckat, Janina Onigkeit and Wolfgang Sterk

* Corresponding author. Wuppertal Institute for Climate, Environment, Energy
Döppersberg 19, D-42103 Wuppertal, Germany, Email: ralf.schuele@wupperinst.org

Working Paper III/06

JET-SET is a joint research project within the research programme "Social Ecological Research" of the German Federal Ministry of Education and Research (BMBF)

FUNDED BY Federal Ministry of Education and Research

SÖF Sozial-ökologische Forschung

JET-SET

Joint Emissions Trading as a Socio-Ecological Transformation

Science Centre North Rhine-Westphalia – Institute of Work and Technology
Institute for Culture Studies
Wuppertal Institute for Climate, Environment and Energy

Dr. Ralf Schüle (*Coordination*)	ralf.schuele@wupperinst.org
Dipl. Vw. Christiane Beuermann	christiane.beuermann@wupperinst.org
Dipl. Umw. Wiss. Bernd Brouns	bernd.brouns@wupperinst.org
Dipl. Soz. Tilman Santarius	tilman.santarius@wupperinst.org
Wolfgang Sterk, M.A.	wolfgang.sterk@wupperinst.org
Dipl. Geogr. Renate Duckat	renate.duckat@wupperinst.org
Marcel Braun, M.A.	marcel.braun@wupperinst.org
Dr. Hermann E. Ott	hermann.ott@wupperinst.org

CESR Center for Environmental Systems Research

Prof. Dr. Joseph Alcamo	alcamo@usf.uni-kassel.de
Dr. Janina Onigkeit	onigkeit@usf.uni-kassel.de

ZEW Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

Dipl. Vw. Niels Anger	anger@zew.de
Prof. Dr. Christoph Böhringer	boehringer@zew.de
Dr. Ulf Moslener	moslener@zew.de
Dipl. Wi.-Ing. Marcus Stronzik	stronzik@zew.de
Dipl. Wi.-Ing. Marion Hitzeroth	hitzeroth@zew.de

ISOE

Dr. Irmgard Schultz	schultz@isoe.de
Dr. Immanuel Stiess	stiess@isoe.de

ifeu

Dipl. Ing. Markus Duscha	duscha@ifeu.de
Dipl.-Ing. Hans Hertle	hertle@ifeu.de

Wuppertal, September 2006

Contents

The Research Project "Joint Emissions Trading Systems as a Socio-Ecological Transformation (JET-SET)"

Background

The signing of the Kyoto Protocol in 1997 marks an important milestone for the development and implementation of climate policy within the European Union (EU) and Germany: The implementation of so-called flexible instruments – here in particular the trading of emission certificates between industrialised countries – has since come to play a key role. The development of domestic emissions trading schemes (ETS) adds a new market-based instrument to environmental policy in the EU, which has traditionally been more oriented towards regulatory instruments. Implementing this instrument at the national level entails new societal opportunities as well as risks. Even though there is already a number of studies available from economics and political science, there is still a significant need for information on the ecological, economic, institutional and social impacts of emissions trading. Moreover, there is a strong need for further research on the further development of the EU ETS, both for the first commitment period of the Kyoto Protocol from 2008 to 2012 as well as beyond.

The aim of the **JET-SET** (**J**oint **E**mission **T**rading as a **S**ocio-**E**cological **T**ransformation) project, which is funded by the German Federal Ministry of Education and Research, is to conduct an integrated analysis and assessment of the impacts of emissions trading in the EU and in Germany. The project is coordinated by the Wuppertal Institute and designed as a multi-disciplinary research process.

Objectives of the Research Project

The project's basic **hypothesis** is that the introduction of the EU ETS will lead to far-reaching socio-ecological transformation and learning processes which will, among others,

- change the institutional setting of climate policy at the EU and national level,
- significantly influence the choices and market behaviour of companies,
- affect the public discourse about – and the public perception of – (inter)national climate policy, and
- affect the relationship between society and nature.

In this respect the introduction of an EU emissions trading scheme can be perceived as a transformation process which comprises both social and ecological dimensions and their interrelation.

The **aims** of the project are:

- monitoring the introduction of emissions trading in the EU and in Germany,
- integrated assessment of the economic, ecological and social implications of the EU ETS,
- the elaboration of policy recommendations with respect to the future design of the trading scheme, and
- the conceptual and theoretical embedding of the research results into the inter-disciplinary sustainability research.

Design of the Research Project

The **structure of the research project** reflects *analytical* and *practical-political* elements of socio-economic transformations induced by the introduction of the EU ETS:

In the ***first project phase***, the project partners focused on the currently emerging transformation processes triggered by the EU ETS from an analytical perspective. In line with the aims of the project, four so-called "**Base Projects**" (BPs) dealt with:

- the modifications of institutions within society and politics brought about by the progress of the EU ETS (BP1),
- the modification of business strategies (BP2),
- the changing discourses and public perception of climate policy (BP3), and
- land-use-changes, based on the example of energy crops (BP4).

Furthermore, gender aspects of international climate policy have been analysed. At the end of the first phase, an integrated research concept was developed that serves as the basis for the second project phase.

The ***second project phase*** addresses the potentials and risks related to linking the EU ETS with other emerging domestic trading schemes. Four so called "**Cross-Section Projects**" address the following aspects:

(1) Which countries are currently planning to introduce national greenhouse gas emissions trading schemes and when will these schemes be established?

(2) What are the economic effects (abatement costs, certificate price) of different alternative scenarios („storylines") of linking the EU ETS with other domestic schemes?

(3) What will be the contribution of linking to achieving more ambitious targets for reducing greenhouse gas emissions for the period after 2012?

(4) What are institutional and political preconditions for linking?

The project addresses these questions by an integrated assessment of different alternative policy scenarios of linking domestic emission trading systems (ETS) in four Cross-Section Projects (CSPs):

- Policy scenarios of linking (CSP1)
- Impacts of linking domestic ETS on the distribution of per capita emissions (CSP2)
- Economic and environmental effects (CSP3)
- Implications of design differences (CSP4)

Role of this Paper within the Research Project

This paper has been developed within CSP1. The objective of the present working paper is to outline the conceptual research framework of the second project phase. Additionally, it describes the methodology with which future images of linking processes are developed and assessed.

1 Introduction

Backed by the entry into force of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) on 16 February 2005, many countries and regions have started to integrate emissions trading into their spectrum of national climate policy instruments. The EU Emissions Trading Scheme (EU ETS) has been one of the front runners but is now being followed by many comparable initiatives in both ratifier (e.g. Canada and Japan) and non-ratifier countries (e.g. states of the U.S. and Australia) of the Kyoto Protocol. The emergence of national and sub-national emissions trading schemes raises the issue of linking these schemes. What economic and environmental effects can be expected? What are crucial institutional and political preconditions for linking? In terms of economic efficiency and global equity, will the effects of connected domestic markets at the company level be similar to the ones that have been analysed for trading at the government level? What will be the contribution of linking processes to achieving more ambitious targets for reducing greenhouse gas emissions?

The JET-SET project[1] addresses these questions by integratively assessing different possible policy scenarios about future linking processes. It aims at formulating policy recommendations for the national and EU level. The objective of the present working paper is to outline the conceptual research framework of the project. Additionally, it describes the methodology with which future images of linking processes are developed and assessed. Three sections can be distinguished: The introduction (**Section 1**) is followed by a context section (**Section 2**) pointing briefly to the discussions about the development and linking of domestic schemes as well as to their relation to economic efficiency and post-2012 reduction targets. **Section 3** describes the objectives, research questions and the methodology of the project. In particular, the development of a scenario approach is described.

The anticipated effects of linking ETS will be subsumed into the following hypotheses:

- In economic terms, generally the linking of domestic schemes should reduce the overall reduction costs. However, the level of cost reduction crucially depends on the cost structures and technological pre-conditions of participating countries/regions as well as on the specific design of the market (i.e. on allowance allocation mode).
- In institutional terms, the linking of the differently designed domestic schemes is possible but certain differences in design may require adjustments to be made. Additionally, from the perspective of the future development of an international climate regime, the approach of linking domestic schemes developed for and implemented at the entity level serves to bolster the Kyoto regime, especially with a view to its extension beyond its first commitment period.
- With respect to global equity, linking the EU ETS with other ETS and JI/CDM might hinder a fundamental restructuring of the global energy system.

[1] http://www.wupperinst.org/Sites/Projects/rg2/3214.html

2 Research Context

Relating to discussions about the linking of domestic emissions trading schemes, the discussion on linking emissions trading schemes touches three relevant strands of literature and discussion:

(1) ***Firstly,*** besides the EU, several industrialised countries or regions at the sub-national level have already started political discussions and initiatives on the establishment of domestic emissions trading systems. A wide spectrum of designs and options will be, or have already been, established, reflecting country-specific interest structures, structures of energy supply and emissions as well as country-specific paths of climate policy. Drawing on an already established system of CO_2 taxation, within **Europe** the emissions trading schemes in Norway and Switzerland will be very similar to the EU ETS. Norway, for example, has already established a domestic scheme in 2005. Corresponding to the EU ETS in sectors, gases as well as compliance and trading periods, the scheme offers a special exclusion option for companies entering into voluntary commitments.

Besides the European initiatives also other **ratifier** of the Kyoto Protocol such as Canada or Japan are trying to establish domestic emissions trading systems. The former Government of Canada announced the establishment of a domestic emissions trading scheme in its 2002 Climate Change Plan. The scheme to be launched in 2008 will cover large final emitters (LFE) in the thermal electricity sector, the oil and gas sector as well as the mining and manufacturing sector. In difference to the *cap-and-trade* approach chosen in the EU ETS, however, the scheme in Canada will be a mandatory *credit-and-baseline* system with relative targets at the entity level. Based on the experience gained in several voluntary pilots, in Japan the Ministry of the Environment decided to launch a small voluntary emissions trading scheme in 2006 combining emissions trading with subsidies.

As a **non-ratifier** of the Protocol, the United States have already gained experience with a number of voluntary and mandatory non-GHG emissions trading systems. All initiatives to establish a mandatory cap-and-trade ETS for GHGs at the federal level have so far failed.[2] At the state level, however, initiatives have been more successful, such as the schemes in *Massachusetts* (since 2002) or *New Hampshire*. Having already created a registry for GHG emissions, also California is taking steps towards an ETS. In 2003, nine north- and middle-eastern states of the U.S. set out to create the Regional Greenhouse Gas Initiative (RGGI), a mandatory multi-state *cap-and-trade* programme with absolute targets. In August 2005 the RGGI Staff Working Group proposed design options for a future emissions trading regime. In Australia, also a non-ratifier of the Protocol, the main initiatives have also been at the sub-national level. New South Wales (NSW), for example, already established an emissions trading scheme in 2003, called the ”NSW Greenhouse Gas Abatement Scheme”, with 31 participants, which is based on a former emission-benchmarking programme.

[2] Potentially covering the industry and energy sector as well as the commercial and transportation sector, the most prominent attempt has been the McCain-Lieberman Climate Stewardship Act, which was rejected in the Senate in 2003 and again in 2005.

Even the brief overview shows a broad spectrum of approaches and initiatives: Mandatory schemes (EU and Canada) will stand vis-à-vis voluntary systems (Japan), cap-and-trade schemes (EU) will face credit-and-baseline schemes (Canada) and "pure" emissions trading systems will be confronted with combinations of emissions trading with tax systems (Switzerland) or subsidies (Japan). The question arises now how these different approaches and schemes can be institutionally linked, which economic and environmental effects these linkages would entail and what adjustments might need to be made to allow for linking?

From a more general perspective, a few authors have addressed the institutional and systemic requirements of linking different types of emissions trading schemes. In detail, the issues that will need to be considered in linking processes are (see Meadows 2004, Baron/Bygrave 2002, Blyth/Bosi 2004):

Table 1: Issues to be considered for linking

(1) Coverage of the Scheme ○ **Differences in gases covered** ○ **Differences in sector coverage** ○ **Direct versus indirect emissions** ○ **Opt-in and opt-out provisions**
(2) Definition and Recognition of Trading Units
(3) Absolute versus Relative Targets
(4) Stringency of Targets
(5) Allocation Methodology
(6) Compliance Period, Allowance Validity and Banking
(7) Monitoring, Reporting, Verification and Accounting
(8) Compliance Framework and Penalties

Against the background of the emerging schemes, the question arises which design issues have especially been taken into consideration?

(2) ***Secondly***, there has been a large body of model-based studies assessing the economic effects of different structures and participants of emissions markets. Predominantly, economic assessments have been carried out with numerical simulation models such as computable General Equilibrium Models (GEMs) or Partial Equilibrium Models (PEMs). By predominantly basing upon GEM-frameworks, there are a number of model simulations available that analyse the impacts of emissions trading under the Kyoto Protocol and its (probable) successors. So far, however, all these assessments have focused on *governmental trade* (Kyoto Trade) and not on trade at the *company* or *entity level*. In this context, analyses of different clusters of industrialised countries or countries in transition (e.g. Buchner/Carraro 2004) are completed by assessments focusing on the relationship between industrialised and developing countries in globalised markets (Kallbeken/Westkog 2003) or on the dimension of international equity (Leimbach 2003). The possible emergence of linked emissions trading schemes at the company or entity level, however, challenges economic analyses: What will be the economic effects (in terms of compliance costs) and potentials of an enlarged market at the entity level? Will the effects of a linked emissions market at the entity level be comparable to results of analyses of Kyoto trade?

(3) ***Thirdly***, the question of linking domestic schemes is related to the emerging discussion about an international future climate regime in the post-2012 period and its institutional structure. So far, the discussions about the future design of emissions trading schemes have been decoupled from post-2012 debates on future mitigation and the institutional design of the international climate regime in the future. Linking these debates leads to questions such as: To what extent is a strategy of voluntary co-operation such as the linking of domestic emissions trading schemes supportive for the further development of the international climate regime? Are such "parallel" international processes "just" ways of implementing Kyoto type commitments and therefore complementary to the current institutional design of the climate regime? Or do they represent independent processes of international policy co-ordination that might even undermine the further development of the Kyoto regime?

3 Research Questions, Project Design and Methodology

3.1 Research Questions and Project Design

Against this background, the project addresses the following research questions:

(1) Which countries are currently planning to establish a domestic emissions trading scheme? What kind of types and approaches are currently discussed? What will be the differences of the schemes?

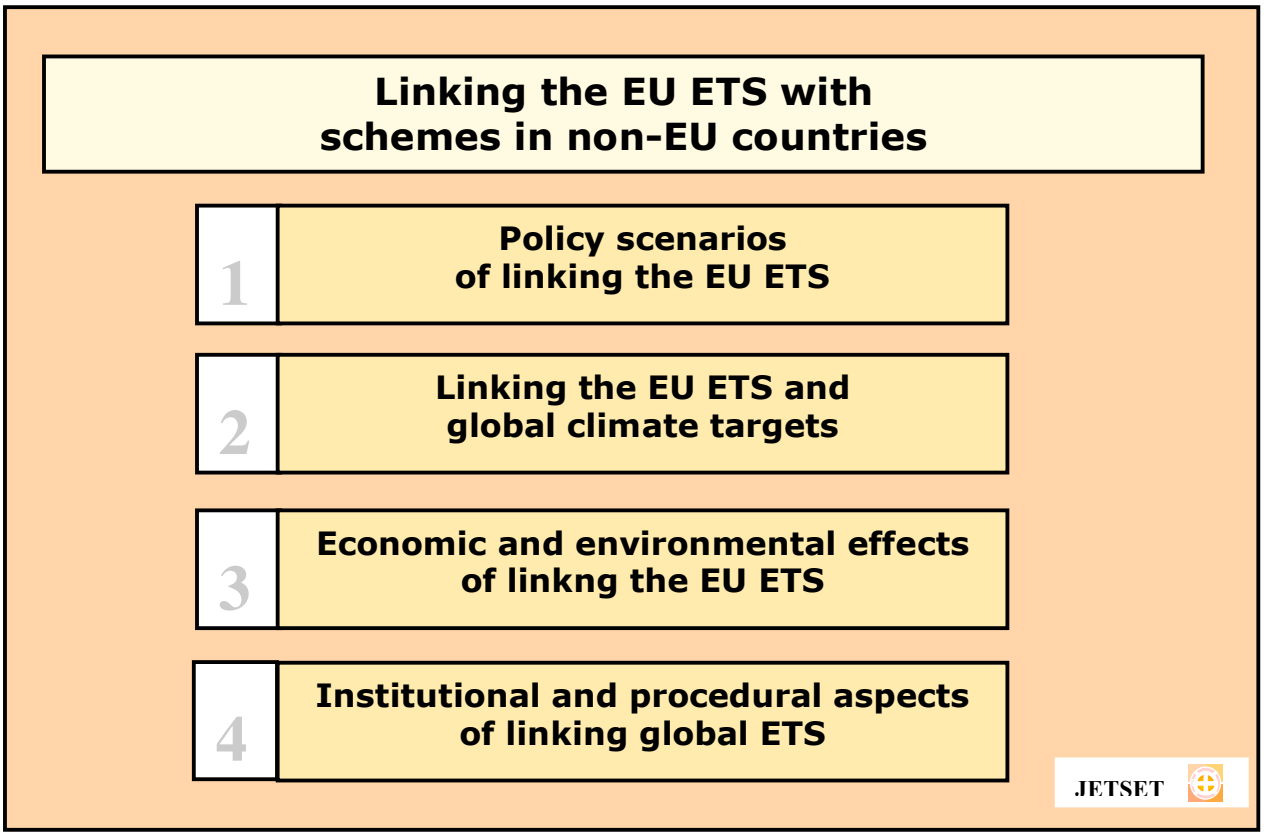
(2) What barriers might the different designs of the emerging domestic ETS pose to linking processes and what are possible ways to overcome them?

(3) Which economic impacts (costs, allowance prices, distributional effects) results from different scenarios of linking domestic schemes?

(4) In which sense do different alternatives of the linking process affect the level of per capita emissions in the EU?

(5) How is a "bottom-up linking" of domestic schemes related to the further development of the international climate regime itself?

Figure 1: Sub-Projects of JET-SET



The project is divided into four different sub-projects:

- The development of the policy scenarios provides the basis for the assessments made by the research team (see subsequent sections).

- By using a partial equilibrium model of global emisisons markets, an economic analysis is carried out by Anger et al. (2006).

- Calculating the effects of different linking scenarios on per capita emissions in the EU, an analysis of equity dimensions is done by Onigkeit et al. (2006).

- The institutional dimensions of linking processes are addressed in Sterk et al. (2006) and Schüle et al. (2006). While the former investigates the emerging schemes and their linkages more from the technical point of view, the latter discusses the relevance of linking processes of the futher development of an international climate regime for the post-2012 period.

3.2 Methodology

3.2.1 Developing Basic Policy Scenarios

The technique chosen for the assessment of the effects of linking national and sub-national emissions trading schemes is the scenario technique. Given the large differences in designing and implementing domestic schemes, a number of alternative *policy* scenarios of linking processes will be defined and then be assessed in economic, environmental and institutional terms. These policy scenarios are specified by so-called *storylines*, which define the basic variables of the scenarios. The basic variables here are,

- the participating countries,
- the institutional status with regard to the climate regime (*ratifier and non-ratifier*),
- the time-horizon by when domestic schemes will be developed and will (probably) be linked to an emerging multi-national emissions trading scheme (2010 and 2020).

In this sense, the development of policy scenarios of linking follows along a political rationale. For the purpose of our research, *three basic scenarios* of linking emissions trading schemes are distinguished with regard to the participating countries/regions and their legal status regarding the Kyoto Protocol (EU, Kyoto ratifiers, current Annex B countries, developing countries) and the temporal dimension:

(1) **Baseline EU-Scenario:** The EU-27-ETS will be linked with the Norwegian system from the year 2006 on. In this scenario, no further linkings will happen in the future

(2) **Kyoto Ratifier-Scenario**: All Annex B ratifier countries, which can realistically be expected to develop domestic ETS, are linked. It thus covers the linked markets of the following participants: the EU-27-ETS, the Norwegian system, as well as systems in Japan, Canada, New Zealand and Switzerland. Additionally, due to assumed technical problems to establish an ETS by 2010, the market is expected to include Russia and the Ukraine only from 2020 on. In this scenario, non-ratifiers of the Kyoto Protocol are excluded on purpose.

(3) **Current Annex B-Scenario**: Envisaged is the rapid introduction of domestic ETSs in all Annex B ratifier countries as well as the eventual accession of the non-ratifier countries. As in the *Kyoto Ratifier Scenario*, in this scenario the emissions trading market thus includes the EU-27-ETS, Norway, Japan, Canada, New Zealand and Switzerland. In difference to the *Kyoto Ratifier Scenario*, however, Russia and the Ukraine are assumed to participate already in the year 2010. Additionally, the U.S. and Australia will join the market in the year 2020.

Table 2 shows the scenarios as regards the assumed participants and the temporal perspective of the emerging linked ET markets:

Table 2: Overview of policy scenarios as defined by country/region and time

Scenario \ Time	2010	2020
ETS EUROPE	EU-27	EU-27
ETS KYOTO	EU-27 Japan Canada	EU-27 Japan Canada Former Soviet Union
ETS ANNEX B	EU-27 Japan Canada Former Soviet Union	EU-27 Japan Canada Former Soviet Union Australia New Zealand USA
CDM host countries	Brazil Mexico India China South Korea	Brazil Mexico India China South Korea

In all scenarios, the CDM countries Brazil, Mexico, India, China and South Korea are included.

3.2.2 Differentiating Policy Scenarios

In order to assess these scenarios along their economic efficiency, their level of emission abatement, their compatibility in design, their level of ecological equity, their distributional effects and along their innovative impulse, further dimensions have to be considered, as the **instrument dimension** and the **target dimension**.

- Relating to the former, the CDM is considered in all three policy scenarios. However, an 8%-limitation of purchases from project-based mechanisms (specifically CDM) is assumed for the EU ETS as CDM-countries Brazil, Mexico, India China and South Korea are analysed. As a second option, unlimited purchases have been assumed.

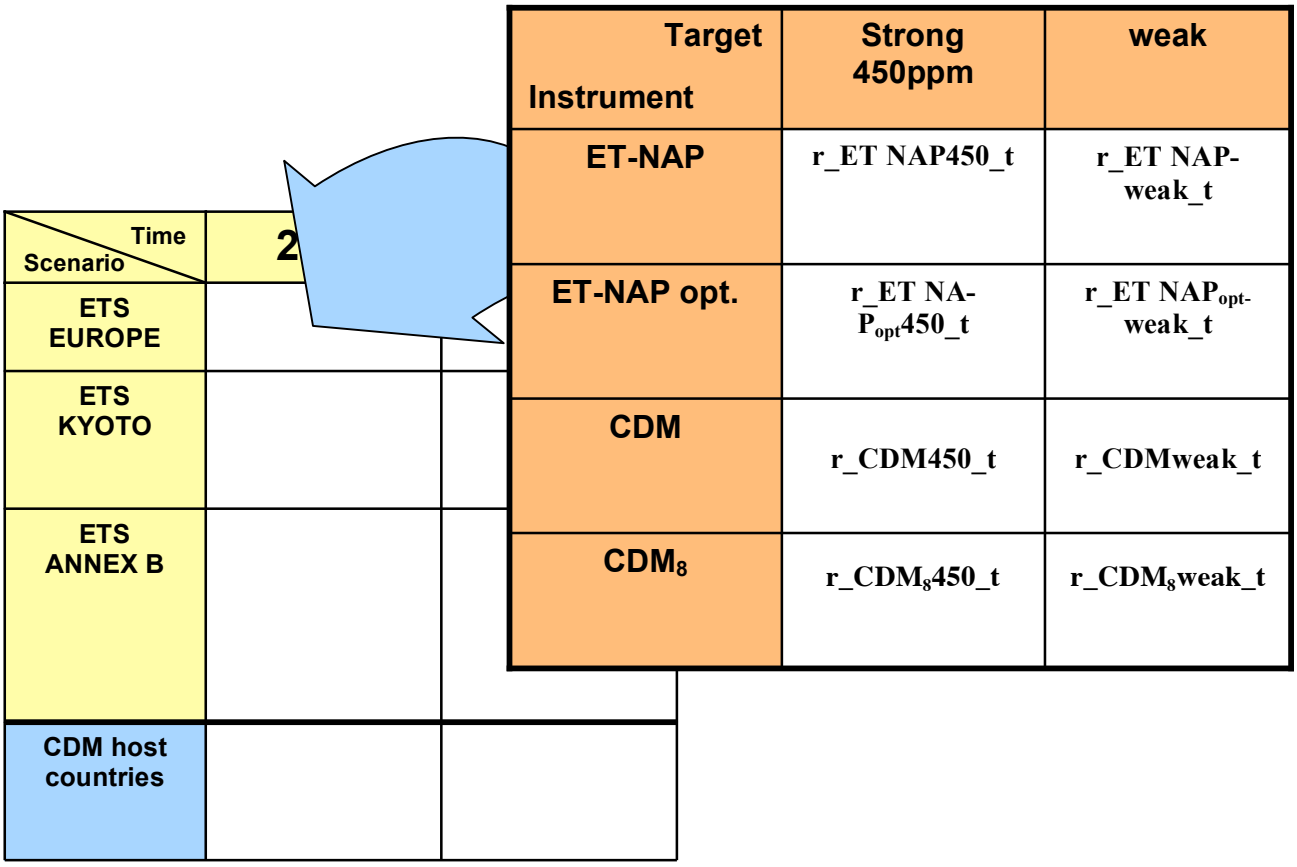
- Relating to the latter, assumptions have to be made with regard to the future reduction targets of single countries. In this sense, we defined weak and strong future targets.

Based on "political willingness" assumptions future emissions targets for (groups of) industrialised countries were calculated for 2010, 2020 and 2030. The applied approach resulted in a broad range of targets continuing, to a certain extent, the differentiation set up by the Kyoto Protocol and the EU burden sharing agreement and considering the special case of non-ratifier countries. Due to rather conservative and "pessimistic" assumptions on "political willingness" the resulting targets are quite moderate even if compared to "political willingness scenarios" in other assessments.

Strong future mitigation targets: Aiming at a maximum temperature increase of 2° Celsius compared to pre-industrial levels as agreed upon by the European Union would most probably require atmospheric greenhouse gas concentrations to stabilise well below 550 ppmv CO_2e. Thus, based on the IPCC-B2 scenario (IMAGE data) stabilisation of CO_2 concentration at 450 ppmv was assumed as a basis for the calculation of "strong targets" that might be in line with the objective of the Climate Convention.

All dimensions of the policy scenarios are mapped out in the following figure 2:

Figure 2: dimensions of policy scenarios[3]



Consequently, table 2 results in a matrix of **48 different policy scenarios** as defined by the above four dimensions.

[3] With: r (region) = EU-ETS, Kyoto Ratifiers, Current Annex B;
t (time) = 2010, 2020.

3.2.3 Assessment of Policy Scenarios and Analytical Procedure

Assessment Criteria

The criteria by which the policy scenarios will be assessed are:

- economic efficiency in terms of a change in marginal abatement cost,
- level of emission abatement,
- compatibility in design,
- distributional effects, and
- ecological equity.

Additionally, the analysis will be conducted with regard to countries to be potentially linked to the EU-ETS and with regard to selected criteria such as mode of allocation, stringency of targets, ratification and role of the CDM.

Levels of Integration

In order to carry out this multi-dimensional analysis, the research team applied three different analytical procedures:

(1) At the level of the basic *policy scenarios*, the research team jointly discussed probable paths and participants of the entity level market emerging by the linking efforts. What should be the rationale of scenario development (potentials or political regimes)? Which country will join the linked market at which point in time? What will be the relationship between project-based mechanisms and the linked ETS. In this context, especially the development of a common understanding about the role of Russia and the Ukraine (as economies in transition, ratifiers of the Kyoto Protocol) and the inclusion of the U.S. and Australia (non-ratifiers) was crucial.

(2) The policy scenarios provided the basis for the model calculations especially within the second and the third sub-project (CSP 2 and 3). Further assumptions were made as regards the reference scenario (IPPC B2-scenario as realised by the IMAGE 2.2 model) and the level of targets (weak or strong, see above).

In doing so, the project team collected, modified and distributed the following data on countries participating in the scenarios as input in either the policy scenarios or in order to calibrate the economic model applied:

- greenhouse gas emissions,
- climate policy strategy,
- emissions trading,
- abatement costs,
- abatement technologies, and
- energy intensive sectors.

(3) The project team discussed the outputs of the single projects and jointly validated the findings through a consultation process with stakeholders, experts and policy makers. The consultation process consisted of three different steps: As a first step, the policy scenarios have been validated by external experts. As a second step, an expert workshop has been carried out in November 2005 in order to discuss the preliminary research findings. An additional workshop has been organised in the form of a side event of the 11th Conference of the Parties to the UNFCCC in Montreal, Canada. Thirdly, the policy recommendations derived from the project have been discussed and evaluated by policy makers and stakeholders on a project conference in Brussels in May 2006.

4 References

ACT (Australian Capital Territory) (2004): Electricity (Greenhouse Gas Emissions) Act 2004, Republication No 1, ACT Parliamentary Counsel, 7 September 2004, www.legislation.act.gov.au/a/2004-71/default.asp.

Anger, Niels, Bernd Brouns and Janina Onigkeit (2006): Linking the EU Emissions Trading Scheme under Alternative Climate Policy Stringencies: An Economic Impact Assessment, Wuppertal Institute for Climate, Environment and Energy, JET-SET Working Paper II/06, July 2006.

Anger, Niels and Christoph Böhringer (2006): Emission Trading Beyond Europe: Linking Schemes in a Post-Kyoto World, Centre for European Economic Research, Discussion Paper No. 06-058, ftp://ftp.zew.de/pub/zew-docs/dp/dp06058.pdf.

Baron, Richard and Stephen Bygrave (2002): Towards International Emissions Trading: Design implications for linkages, OECD and IEA Information Paper, Paris.

Böhringer, Christoph (2001): Climate Politics from Kyoto to Bonn: From Little to Nothing?!?, ZEW Discussion Paper No. 01-49, Mannheim, ftp://ftp.zew.de/pub/zew-docs/dp/dp0149.pdf.

Böhringer, Christoph and Andreas Löschel (2005): Climate Policy Beyond Kyoto: Quo Vadis? A Computable General Equlibrium Analysis Based on Expert Judgements. In: *KYKLOS* 58 (4), p. 467-493.

Böhringer, Christoph and Carsten Vogt (2002): Dismantling of a Breakthrough: The Kyoto Protocol – Just Symbolic Policy!, ZEW Discussion Paper No. 02-25, Mannheim, ftp://ftp.zew.de/pub/zew-docs/dp/dp0225.pdf.

Böhringer, Christoph and Carsten Vogt (2002): Rio – 10 Years After: A Critical Appraisal of climate Policy. ZEW Discussion Paper No. 02-09, Mannheim, ftp://ftp.zew.de/pub/zew-docs/dp/dp0209.pdf.

Böhringer, Christoph, Tim Hoffmann, Andreas Lange, Andreas Löschel and Ulf Moslener (2005): Assessing Emission Allocation in Europe: An Interactive Simulation Approach. In: *The Energy Journal* 26 (4), p. 1-22.

Brouns, Bernd and Hermann E. Ott (2004): Taking the Lead Post-2012 Climate Targets for the North. Towards Adequate and Equitable Future Climate Commitments for Industrialised Countries, Wuppertal Paper No. 155, www.wupperinst.org/Publikationen/WP/WP155.pdf.

Buchner, Barbara and Carlo Carraro (2004): Emissions trading regimes incentives to participate in international climate agreements. In: *European Environment* 14, 2004, p. 276-289.

BUWAL (2004): Emissions Trading in Switzerland. Input IEA/IETA/EPRI-Workshop 4./5.10.04, Paris: IEA, www.iea.org/textbase/work/2004/ghg/country_reports/switzerland.pdf.

CAN (Climate Action Network) (2002): Preventing dangerous climate change. CAN Position Paper, www.climnet.org/pubs/CAN-adequacy30102002.pdf.

Den Elzen, Michel G. J. (2005): Differentiation of countries' post-2012 mitigation commitments under the "South-North Dialogue" Proposal using the FAIR 2.1 world model, MNP report 728001032/2005, Bilthoven: Netherlands Environmental Assessment Agency. (forthcoming)

Den Elzen, Michel G. J. and Malte Meinshausen (2005): Meeting the EU 2°C climate target: global and regional emission implications. Report No. 728001031/2005, Bilthoven: Netherlands Environmental Assessment Agency, www.rivm.nl/bibliotheek/rapporten/728001031.pdf.

EC – Commission of the European Communities (2005a): Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Winning the Battle Against Global Climate Change, COM (2005) 35

final, 9.2.2005, Brussels: European Commission. http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/com/2005/com2005_0035en01.pdf.

EC – Commission of the European Communities (2005b): Commission Staff Working Paper. Winning the Battle Against Global Climate Change, Background Paper, 9.2.2005, Brussels: European Commission, http://europa.eu.int/comm/environment/climat/pdf/staff_work_paper_sec_2005_180_3.pdf.

EU – Council of the European Union (2005a): European Council Brussels, 22 and 23 March 2005, Presidency Conclusions, 7619/05, Brussels: European Union, http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/84335.pdf.

EU – Council of the European Union (2005b): 2647th Council meeting, Environment, Brussels, 10 March 2005, 6693/05, Brussels: European Union, http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/envir/84322.pdf.

France (2004): Plan Climat 2004. Face au changement climatique. Agissons ensemble, Paris: Ministère de l'Écologie et du Développement Durable.

Germany (2004): Fortschrittsbericht 2004. Perspektiven für Deutschland. Unsere Strategie für eine nachhaltige Entwicklung, Berlin: Bundesregierung, www.bundesregierung.de/Anlage740735/pdf_datei.pdf.

Hare, William (2003): Assessment of Knowledge on Impacts of Climate Change – Contribution to the Specification of Art. 2 of the UNFCCC: Impacts on Ecosystems, Food Production, Water and Socio-economic System, Expertise for the WBGU Special Report 'Climate Protection Strategies for the 21st Century: Kyoto and Beyond', Berlin: WBGU, www.wbgu.de/wbgu_sn2003_ex01.pdf.

Hare, Bill and Malte Meinshausen (2004): How much warming are we committed to and how much can be avoided? PIK Report No. 93, Potsdam: Potsdam Institute for Climate Impact Research, www.pik-potsdam.de/pik_web/publications/pik_reports/reports/pr.93/pr93.pdf.

Höhne, Niklas and Simone Ullrich (2005): Emission allowances under the proposal of the "South north dialogue – equity in the greenhouse", Research-report DM 70096, Cologne: Ecofys, www.ecofys.com/com/publications/documents/EcofysSouthNorthQuantification.pdf.

Höhne, Niklas, Dian Phylipsen, Simone Ullrich and Kornelis Blok (2005): Options for the second commitment period of the Kyoto Protocol, Climate Change 02/05, Berlin: Umweltbundesamt.

IETWG (Inter-jurisdictional Emission Trading Working Group) (2004): A National Emission Trading Scheme, A Report to First Ministers from the Inter-jurisdictional Emission Trading Working Group, 6. December 2004, www.cabinet.nsw.gov.au/greenhouse/report.pdf.

Kallbekken, Steffen and Hege Westskog (2003): Should developing countries take on binding commitments in a climate agreement? A cost-benefit analysis. CICERO (Center for International Climate and Environmental Research) Working Paper 2003: 09.

Leimbach, Marian (2003): Equity and Carbon Emissions Trading: A Model Analysis. In: *Energy Policy* 31, p. 1033-1044.

Netherlands (2004): Where there's a will there's a world. Working on sustainability. 4th National Environmental Policy Plan – Summary, The Hague: Ministry of Housing, Spatial Planning and the Environment, http://www2.vrom.nl/Docs/internationaal/NMP4wwwengels.pdf.

NSW (NSW Government) (2002): Electricity Supply Amendment (GHG Emission Reduction) Act 2002, No 122, 2002, www.greenhousegas.nsw.gov.au/legislative_framework.htm#.

Onigkeit, Janina et al. (2006): Fairness Aspects of Linking the European Emissions Trading System under a Long-Term Stabilisation Scenario, unpublished manuscript.

Ott, Hermann E., Harald Winkler, Bernd Brouns, Sivan Kartha, M.J. Mace, Saleemul Huq, Yasuko Kameyama, Agus P. Sari, Jiahua Pan, Youba Sokona, Preety M. Bhandari, Andrzej Kassenberg, Emilio Lèbre La Rovere and Atiq A. Rahman (2004): South-North Dialogue on Equity in the

Greenhouse. A proposal for an adequate and equitable global climate agreement, Eschborn: GTZ, www.wupperinst.org/download/1085_proposal.pdf.

Prestrud, Pål, Asbjørn Torvanger and Jonas Vevatne (2005): Opinion: Emissions trading and Norwegian climate policy. In: *Cicerone* 2005 (1), p. 10-11, www.cicero.uio.no/fulltext.asp?id=3492&lang=en.

Schüle, Ralf, Wolfgang Sterk, Marcel Braun and Niels Anger (2006): Linked Emissions Trading Schemes and the International Climate Regime. Bottom-up Support of Top-down Processes, JET-SET Working Paper. (forthcoming)

Sterk, Wolfgang, Marcel Braun, Constanze Haug, Katarina Korytarova and Anja Scholten (2006): Ready to Link Up? Implications of Design Differences for Linking Domestic Emissions Trading Schemes, Wuppertal Institute for Climate, Environment and Energy, JET-SET Working Paper I/06, July 2006, www.wupperinst.org/download/3214/ready-to-link-up.pdf.

WBGU (German Advisory Council on Global Change) (2003a): Climate Protection Strategies for the 21st Century. Kyoto and Beyond, Berlin: WBGU, www.wbgu.de/wbgu_sn2003.pdf.

WBGU (German Advisory Council on Global Change) (2003b): World in Transition: Turning Energy Systems Towards Sustainability, Berlin: WBGU, www.wbgu.de/wbgu_jg2003.pdf.

5 Appendix

5.1 Political Targets

Analytical Basis of Future "Political" Emission Targets of SIMAC Countries/Regions

The "political" targets of SIMAC countries/regions were calculated based on:

- historical emission data as reported to the UNFCCC (1990; base year/period);
- "Kyoto targets" as included in Annex B to the Kyoto Protocol and the EU burden sharing agreement;
- assumptions on future "political willingness" indicated by already adopted mid- and long-term emission targets within the European Union.

Calculating emission targets for 2010

The emission targets assigned to SIMAC countries/regions for 2010 are listed in Table 3. The underlying assumptions are as follows:

- All industrialised countries that have ratified the Kyoto Protocol comply with their quantified emission limitation and reduction commitments as outlined in Annex B to the Protocol and in the EU burden sharing agreement, respectively.
- The target for the United States – as a non-ratifier – is calculated on the basis of its national intensity target to reduce greenhouse gas intensity by 18 percent by 2012 (White House 2002) assuming GDP growth figures of the IPCC Image B2 scenario.
- For Australia (included in SIMAC region "Pacific OECD without Japan"), the other industrialised country that has not yet ratified the Kyoto Protocol, compliance with its Annex B Kyoto target is assumed as the Australian government repeatedly emphasised that they aim at fulfilling their Kyoto limitation commitment despite non-ratification of the Protocol (Australia 2002).
- Up to now, developing (non-Annex I) countries do not have any quantified mitigation commitments under the Kyoto Protocol. Therefore, a "business-as-usual" emission path according to the IPCC Image B2 scenario (IMAGE 2.2) is assumed.

Table 3: Emission targets of SIMAC countries/regions compared to Kyoto baseline (in %)

Country / Region	2010	2020	2030
Austria	-13	-19,7	-33,9
Belgium	-7,5	-14,7	-29,7
Denmark	-21	-27,1	-40,0
Spain	15	6,1	-12,6
Finland	0	-7,7	-24,0
France	0	-7,7	-24,0
United Kingdom	-12,5	-19,3	-33,5
Greece	25	15,3	-5,0
Ireland	13	4,3	-14,1
Italy	-6,5	-13,7	-29,0
Netherlands	-6	-13,3	-28,6
Portugal	27	17,2	-3,5
Germany	-21	-27,1	-40,0
Sweden	4	-4,0	-21,0
Central Europe[1]	-7	-14,2	-29,3
United States	27,3	23,8	8,2
Canada	-6	-8,6	-20,1
Japan	-6	-8,6	-20,1
Pacific OECD without Japan[2]	7	4,1	-9,1
Former Soviet Union[3]	0	-2,7	-15,0
Brazil	BAU	BAU	BAU
China	BAU	BAU	BAU
South Korea	BAU	BAU	BAU
Mexico	BAU	BAU	BAU
India	BAU	BAU	BAU

Source: Own calculation based on data from UNFCCC (2004).

1: Calculations included Eastern European EU-25 member states as well as applicant countries (apart from Croatia due to a lack of data).
2: Calculations only considered Australia and New Zealand that represent almost all emissions from this group (> 97 % in 2000).
3: Calculations only considered the Russian Federation and Ukraine.

Calculating emission targets for 2020/30

To define reduction targets for 2020 and 2030 the SIMAC countries/regions were differentiated into three groups: EU-27 member states (incl. applicant countries[4]), other industrialised countries and developing countries. The differentiation between EU and non-EU industrialised countries is based on assumption of their "political willingness": on the one hand, the European Union which repeatedly announced its willingness to demonstrate leadership in

4 Turkey was not considered as it is not included in the SIMAC model.

climate mitigation policy and, on the other hand, countries like the U.S., Australia and Japan that act rather "cautious" in debates on post-2012 reduction targets. Finally, developing (non-Annex I) countries formed a separate group in the Climate Convention and the Kyoto Protocol and are assumed to be treated differently in the mid-term future. Within these groups the same approach for calculating emission targets was used.

EU-27 member countries

At its spring session in March 2005, the Council of the European Union concluded that "reduction targets for the group of developed countries in the order of 15-30% by 2020, compared to the baseline envisaged in the Kyoto Protocol (…) should be considered" (EU 2005a: 16). Bearing this decision in mind it is reasonable to assume that the European Union will aim at a reduction of 15 percent by the year 2020 compared to its Kyoto baseline emissions. It is further assumed that all EU member states have to contribute the same (relative) proportion towards achieving this mid-term goal. However, as a matter of fairness the base year was changed to 2010 thereby taking into account the different treatment of countries within the EU burden sharing agreement (and the Kyoto targets for non-EU-15 countries). Each EU-27 country is assumed to reduce its 2010 emissions by 7.7 percent so that the European Union as a whole would achieve its -15 percent target (compared to the Kyoto baseline). This approach maintains to a certain extent the 2010 differentiation of targets resulting in 2020 emission targets that range from reduction in the order of 27 percent (Denmark, Germany) to increases of about 15-17 percent (Greece, Portugal) compared to Kyoto baseline levels (*see Table 2*).

For emission targets in 2030 the same approach is used. The EU as a whole is assumed to aim at reducing its emissions by 30 percent in 2030 (compared to the Kyoto baseline) which is in line with the lower end of the EU Environment Council recommendations that "reduction pathways by the group of developed countries in the order of (…) 60-80 % by 2050 compared to the baseline envisaged in the Kyoto Protocol should be considered" (EU 2005b: 13). To comply with this goal each EU member country would have to reduce its 2020 emission level by 17.6 percent. Comparing the resulting emission allowances with the Kyoto baseline emissions reveals that all countries would need to reduce their base year emissions. However, the range of reduction targets still covers figures from 40 (Denmark, Germany) to 3-5 percent (Greece, Portugal) (*see Table 2*).

Non-EU industrialised countries

For industrialised countries that are not a member of the EU (or an applicant country) a similar approach is being used with reduction targets being less ambitious. This means that countries within this group are assumed to reduce their emissions by the same percentage compared to 2010 and 2020 emission levels, respectively. The rate of reduction is derived from the respective EU figures minus 5 percentage points, i.e. by 2020, emission targets are 2.7 percentage below 2010 levels and by 2030, emission targets are 12.6 percent below 2020 levels.

Applying this approach results in slightly less ambitious targets than those of economically comparable EU countries but they are still within the broad range of EU targets. This is valid for all non-EU industrialised countries apart from the U.S.. Due to its high emission growth rates between 1990 and 2010 even the U.S. target for 2030 is assumed to be slightly above the Kyoto baseline.

Developing countries

As in the first commitment period, developing countries are not assumed to take on any quantitative mitigation commitment by 2020 and 2030 but to follow a "business-as-usual" emission path according to the IPCC Image B2 scenario.

Conclusion

Based on these "political willingness" assumptions future emission targets of SIMAC countries/regions cover a broad range (*see Table 1*) thereby continuing the Kyoto path – apart from the U.S. targets which reflect their status as a non-ratifying country and the corresponding inaction in implementing mitigation policies and measures. It needs to be emphasised that these targets are not in line with mitigation efforts most probably required to meet the objective of the Climate Convention to "prevent dangerous anthropogenic interference with the climate system" (den Elzen/Meinshausen 2005). Moreover, the calculated emission targets are quite moderate even if compared to "political willingness scenarios" in other assessments (e.g. den Elzen 2005; Höhne/Ullrich 2005) due to rather conservative and "pessimistic" assumptions.

5.2 Overview of Sub-Project and Modules