DOI: 10.1007/s10272-007-0211-1

The Climate Policy of the European Union

There is now almost universal agreement that climate change, with potentially disastrous consequences, is happening and that it is contributed to by human activities. This Forum is dedicated to the discussion of various aspects of the European Union's climate policy, e.g. the EU's future role in the global effort to combat global warming, the efficiency of its climate strategy, the design of a new rule for sharing the corresponding burdens fairly among member states, and the interrelationships between the Union's climate policies, on the one hand, and its energy and transport policies, on the other.

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Setting Efficient EU Climate Policy Targets: Mission Possible?

The EU claims to be a front runner in climate policies and considers itself a leader in international climate negotiations. It reconfirmed this perception at the EU summit this spring by substantiating its climate policy objectives. Both the goals and the instruments of EU climate policy are controversial among economists. Subsequent to some basic information on the EU objectives and global warming, the following article discusses how far the allegation holds that EU climate protection policy targets lack economic efficiency.

EU Climate Protection Targets

Fundamentally the EU stands by the 2°C objective, i.e. the mean global surface temperature increase is not to exceed 2°C compared to pre-industrial levels. This corresponds to the "climate window" that was first developed by the German Advisory Council on Global Change (WBGU) in 1995.[1] This guardrail of 2°C requires drastic emission reductions in the course of this century. For example, when assuming a medium level BAU (business as usual) emission scenario, cumulated global CO_2 emissions have to be reduced by two thirds by 2100.[2] These targets are not easily transposed in political terms. Therefore they ought to be broken down to the level of the EU. Further, decisions have to be made regarding the time path of emission reductions.

Within the Kyoto Protocol of the UN Framework Convention on Climate Change (UNFCCC) the EU committed itself to a reduction of greenhouse gas (GHG) emissions by 8% by 2012 compared to 1990. In March 2007 the EU Council updated its targets. The Council largely adhered to the preceding proposals of the EU Commission and announced the following targets, each to be reached by the year 2020.

- The EU will lower GHG emissions by 30% compared to 1990, "provided that other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries to contributing adequately …".[3]

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[1] WBGU: World in Transition: Ways Towards Global Environmental Solutions. 1995 Report, Berlin 1996; WBGU: Targets for Climate Protection, A Statement for the Third Conference of the Parties to the Framework Convention on Climate Change in Kyoto, Bremerhaven 1997.

[2] WBGU: The Future Oceans – Warming Up, Rising High, Turning Sour, Special Report, Berlin 2006.

[3] Council of the EU: Presidency Conclusions 7224//07.

- If the other countries will not make corresponding concessions in international climate negotiations, the EU will go it alone and will reduce its GHG emissions by at least 20% by 2020.
- The share of renewable energy in primary energy use is to be increased to at least 20%.
- Energy use is to be lowered through increasing energy efficiency (use of input energy to provide the same level of energy service) by 20% compared to BAU projections.

In addition, the EU traditionally breaks down its climate and energy targets to sector specific targets. One example is the EU summit's announcement of an increase in the biofuel target from a share of 5.75% in petrol and diesel supply by 2010 to 10% by 2020. Another indicative target is an increase in the share of renewable energies in electricity production to 21% in 2010. The EU Action Plan for Energy Efficiency that supplements the Directive on Energy End-Use Efficiency and Energy Services, provides further sector-specific targets.[4]

Avoiding a Dangerous Climate Change

Nowadays it is neither seriously questioned that the global and regional climate is noticeably changing, nor that climate change is caused by human activities. The fourth assessment report of the International Panel on Climate Change (IPCC) confirms previous findings that without effective climate protection measures humankind will experience a dangerous climate change.[5] The globally averaged surface temperatures have already increased by more than 0.7°C during the past 100 years. If business as usual continues, a global warming of 3-4° by the end of the century is very likely, and even a 6°C increase is possible. Rising temperatures are accompanied by changing patterns of precipitation causing droughts, severe water scarcity and flooding in regions already stressed. Furthermore, given the trend in temperature increase, a future sea level rise of on average 60 cm by 2100 is likely. Even if global warming were limited to 3°C, we would have to assume that thermal expansion of the oceans and the melting of glaciers and ice sheets would lead to oceans' rising between 2.5 and 5 m by 2300.[6] The negative impacts of such developments for humans, the environment and the economy would be severe and could trigger the destabilisation of already fragile countries and of entire regions.

The regional change of temperature, the rise in sea-level and the increase in extreme weather events (e. g. hurricanes, floods, droughts and heat waves) will differ from region to region. Equally, the impacts on the environment and societies will differ regionally, depending on the ecological and socio-economic adaptive capabilities and capacities in each country and region. Even though the reliability of climate change projections decrease the more regionally differentiated they become, it is certain that no region will be spared severe negative impacts if GHG emissions are not significantly reduced during the next 90 years. Within the EU the consequences will vary from significant effects on forestry, agriculture, tourism and insurance to severe impacts on coastal areas. Other impacts will be biodiversity losses as well as health risks due to vector-, food- or water-borne diseases and heat-related morbidity.[7] If climate change stays moderate (beneath 2°C) it is expected that within the EU there will be both negative and positive impacts. If climate change is much stronger, all EU countries will experience severe net welfare losses.

Today it is broad consensus among climate change researchers, be they from the natural or the social sciences, that it definitely pays to lower global GHG emissions drastically. Therefore the global long-term objective of the EU is, in principle, unchallenged. But when it comes to the more specific question, what increase in global mean temperature is still tolerable (2° or up to 3°C) there is uncertainty, conflicting interests and disagreement. In the light of climate sensitivity[8] uncertainty it is not possible to deduce a clear-cut GHG concentration level for each temperature target.

The WBGU, for example, recommends not exceeding an atmospheric concentration of 450 ppm (parts per million) of CO_2-equivalents in order to comply with the 2°C target.[9] In 2004 the EU concluded that a stabilisation of concentration well below 550 ppm may be needed.[10]

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[4] EU COM(2006)545, Directive 2006/32/EC of the European Parliament and the Council.

[5] IPCC: Fourth Assessment Report (AR4) of the IPCC on Climate Change, Part I – The Physical Science Basis, 2007.

[6] WBGU: World in Transition … , op. cit.

[7] Commission of the EC: Accompanying Document to the Communication: Limiting Global Climate Change to 2 degrees Celsius. The way ahead for 2020 and beyond. Impact Assessment, Brussels, 10 January 2007.

[8] Global temperature rise if the CO_2 concentration in the atmosphere doubles from pre-industrial level.

[9] WBGU: New impetus for climate policy: making the most of Germany's dual presidency, Policy paper No. 5, Berlin 2007 (CO_2eq. in this case only includes long-lived species).

[10] European Environment Agency (EEA): Climate change and a European low carbon energy system, EEA Report No. 1/2005, Copenhagen 2005.

Neither the 2°C, nor the 450 ppm is uncontroversial. Quite a few economic studies consider 2-3°C or up to 550 ppm (note that many even refer to 550 ppm CO_2, which comes to more than 550 ppm CO_2eq) to be tolerable or at best feasible. Today's concentration has already climbed from a pre-industrial level of approx. 280 ppm to above 420 ppm CO_2eq.

Economically Optimal Timing of Reduction in EU GHG Emissions

The WBGU not only advocates ambitious emission reductions but also recommends rapid action. Since 1990 global GHG emissions have increased by approx. 25%. By 2020, the trend must be reversed. By 2050 GHG emissions have to be at least halved compared to 1990, and by 2100 they should be reduced to a fifth. The results of the IPCC affirm this need for rapid action. So does the Stern Review on The Economics of Climate Change that was commissioned by the UK government.[11] The EU has come to a similar conclusion.[12]

The appropriate targets for the EU depend on a series of assumptions (distribution of emission rights, population growth, emissions of other countries etc.) The WBGU, for instance, pleads for a 30% reduction in EU emissions by 2020 compared to 1990. This is precisely what the EU aims at, but only under the precondition that other large emitter nations join in.

Such calls for early and strong emission reductions have always been highly controversial, among economists too.[13] The controversy over the optimal timing of emission reductions peaked during recent months when Nicholas Stern was severely criticised by prominent economists.[14]

The Stern Review is above all criticised for its methodological deficiencies. The climate-change-induced welfare losses (5%-20% of GDP) are claimed to be overly exaggerated, whereas the cost of climate protection (max. 1% of GDP) is underestimated. It is claimed that Stern's method of discounting future welfare losses is inconsistent, the chosen social rate of time preference astonishingly low, income differences overweighted, and future adaptability to climate change assumed to be unrealistically low. A closer look at the Stern Review indeed leaves several methodological questions open. As one of his fiercest critics states, "It is virtually impossible for mortals outside the group that did the modelling to understand the detailed results of the Review".[15] The methodological criticism becomes politically relevant as most critics question Stern's insistent recommendation to reduce emissions drastically within the next 20-40 years. Critics assume immediate drastic reductions to be economically suboptimal. Instead it would be much more efficient to delay climate protection into the second half of this century, when a higher level of wealth and technology is reached and therefore emissions could be reduced at lower relative prices. On the other hand, proponents of immediate action argue that early action induces learning effects, hence long-term costs will be lower compared to a strategy of postponing emission reductions.[16] Moreover, if action is not taken as soon as possible, emission-intensive technology structures would be locked in and patterns of non-sustainable behaviour would become entrenched. By mid-century these lock-in effects can only be reversed at a very high cost, or at worst not fast enough to prevent a (very) dangerous climate change.

Apart from this, it can be questioned whether policy should be based only on rigorous cost-benefit calculations. Damage caused by the not fully predictable climate change and its not fully foreseeable impacts cannot be expressed accurately in GDP terms. Trying to estimate the social costs of emission mitigation over a time span of 50, 100 or even more years is problematic, apart from anything else, due to our inability to predict the future development of technological inventions and diffusion, prices, human behaviour, preferences and moral concepts. Economies in fact do not move along optimal growth paths. Markets, policies, and finally human beings are, economically speaking, far from "perfect". In my opinion, the well-known columnist Martin Wolf correctly argued that in practice "the problem of climate change should not

[11] N. Stern: Stern Review: The Economics of Climate Change, 2006 Review, Cambridge 2007.

[12] Commission of the EC, op. cit.

[13] W. Cline: Modelling economically efficient abatement of greenhouse gases, in: Y. Kaya, K. Yokobori (eds.): Environment, energy, and the economy: Strategies for sustainability, Tokyo 1997.

[14] Among others W. Nordhaus: The Stern Review on the economics of climate change. Opposite ends of the globe, November 17, 2006 (http://nordhaus.econ.yale.edu/SternReviewD2.pdf); P. Dasgupta: The Stern Review's Economics of Climate Change, in: National Institute of Economic and Social Research, National Institute Economic Review, No. 199, 2007, pp. 4-7; R. O. Mendelsohn: A critique of the Stern Report, in: Regulation, Winter 2006/07, pp. 42-46; D. Leonhardt: Economix. A Battle Over the Costs of Global Warming, in: The New York Times, February 21, 2007.

[15] W. Nordhaus, op. cit.

[16] N. Stern, op. cit.; C. Kemfert: Global Climate Protection: Immediate Action Will Avert High Costs, in: DIW Weekly Report No.12, 2005, pp. 135-141; C. Egenhofer et al.: Revisiting EU Policy Options for Tackling Climate Change, European Centre of Policy Studies, Brussels 2006.

be viewed as just another investment decision",[17] i.e. it cannot be solved by simply applying techniques of investment optimisation. Rather, climate protection has to be regarded as an insurance policy, which at worst is somewhat overpriced.[18] Leaving aside for a moment the reservations associated with long-term cost estimates, let us suppose that discounted costs of early climate protection really amount to the highest present estimations of more than a 6% loss of gross world product by 2050. This implies a reduction of global economic growth by on average less than 0.15% p. a. Therefore, in my opinion, the politically more relevant question is whether today's generations are willing to forgo on average max. 0.15% economic growth per year in order to significantly lower climate risks and to lower mitigation costs for their children and grandchildren. An affirmative answer seems plausible, even if the respondents know that there is a definite probability that the discounted "insurance premiums" could be lowered by delaying emission reductions. For simultaneously there is an increasing risk that a dangerous climate change cannot be prevented. Additionally, it is very likely that the insurance premiums will be much less and at least partially compensated for by positive synergies in other policy areas (e. g. energy supply security, air pollution control, technological development).[19] EU cost projections suggest that if it cuts emissions by 31% by 2020, this amounts to an annualised cost of between 0.06% and 0.19% of EU GDP. The highest costs (0.19%) are estimated if the EU goes it alone and neither do other countries join nor is CDM used to reach the 31% reduction.[20]

Despite the uncertainties associated with attempts to measure the costs of climate protection measures, in my view it is possible to draw the following conclusion from the on average relatively low cost estimates: immediate and ambitious emission reductions are highly justified by the precautionary principle.

Politically Political Timing

The precautionary principle also implies that in the case of climate protection we ought to grasp the chance before it is missed again. In other words, one further risk of delaying emission reductions comes from what one may call the imperfections of political decision making or political lock-ins. We cannot fully predict that tomorrow's EU will take adequate action in 2050, especially if by then costs turn out to have increased due to technological lock-in effects. More positively speaking, in real life politics, it is often willingness that makes the difference. And above all, effective action is a question of opportunities. For the time being the EU window of opportunity stands fairly open: recent surveys indicate that protection from severe climate change is a popular topic. Furthermore, climate protection is a high priority area of Germany's dual presidency (EU and G8). When it comes to energy production there is one outstanding window-of-opportunity: this sector emits approx. one third of the EU's GHG emissions. The transformation into a system of sustainable electricity and heat production is possible in a relatively short time without high additional costs, because in many member countries over two thirds of the power plants have to be substituted within the next 15-20 years anyway.

Optimal Spatial Allocation of Emission Reductions

The EU emission goals are sometimes further criticised for focusing too much on the EU and hence being inefficient and little effective. This criticism rests on two major arguments. Firstly, it is assumed that emission reductions are clearly cheaper in developing countries than in EU countries. Secondly, by pointing out that the EU emits less than 12% of global GHG, it is concluded that the EU can hardly control the size of global emissions. Taking into account that many other countries' emissions are currently increasing, autonomous EU emission reductions will thus be quite ineffective. These objections are based on static thinking, however. In the first place, without clearly visible forerunner achievements, it will be much harder to convince other large emitter countries to join in. The EU is already contributing to chances for climate protection in business and policies elsewhere: European producers enjoy advantages as first-movers in the field of renewable energy and efficiency challenge. This stimulates start-ups and encourages established firms from other countries to catch up and further improve technologies. European regulatory approaches to boost renewable energies are copied in an increasing number of countries. The same applies to the EU emissions trading scheme (ETS) which is meant as a docking station for other regional regimes.[21] Even Chi-

[17] M. Wolf: In spite of sceptics, it is worth reducing climate risks, in: Financial Times, February 6, 2007.

[18] Ibid.; N. Stern, op. cit.; Commission of the EC: Limiting Global Climate Change to 2 degrees Celsius. The way ahead for 2020 and beyond, COM(2007) 2 final, Brussels 2007.

[19] C. Egenhofer et al., op. cit.

[20] Commission of the EC: Accompanying document, op. cit.; J. Bollen et al.: How much does a 30% emission reduction cost? Netherlands Bureau for Economic Policy Analysis, CBP Document 64, The Hague 2004.

[21] C. Egenhofer, N. Fujiwara: Shaping the Global Arena. Preparing the EU Emissions Trading Scheme for the Post-2012 Period, Centre for European Policy Studies, CEPS Task Force Project No. 61, Brussels 2007.

na's growing willingness to combat GHG emissions is in part the outcome of these dynamics.

Furthermore, emission reductions within highly industrialised countries will clearly push technological progress further than only implementing known technologies in developing countries. Finally, even though the EU states that significant domestic emission reductions have to be achieved, this does not mean that EU targets must be met by domestic reductions alone.[22] The flexible mechanisms of the Kyoto Protocol, including the clean development mechanism (CDM), show ways of reaching EU targets more efficiently by realising some of the emission reductions abroad.

To sum up, the theoretical risk cannot be denied that the EU's overall long-term climate objectives and the aspired emission reduction pathway are too ambitious and economically suboptimal. However, the risk is not only bearable but it is extremely likely that in practice the risk will be more than compensated for by further benefits. In short, the overall long-term aspirations of the EU are pointing in the right direction.

National Targets

The EU's limited legislative and enforcement authority restricts its leeway to centrally impose climate protection targets and to implement mitigation measures supranationally, which theoretically might be the economically most efficient strategy. Therefore, in general, targets have to be broken down to the level of EU member states. For example, the EU commitment to reduce GHG emissions by 8% by 2012 compared to 1990, comprises Germany to reduce by 21%, the UK by 12.5% and France by 0%. Although the latest EU 20% (30%) reduction target has not yet been broken down to the national level, the German government has announced its willingness to achieve a 30% (40%) reduction, and the British are currently discussing a reduction of 26% by 2020. The allocation of national commitments is at first a distributional matter, and thus somehow excluded from efficiency evaluation. Nevertheless, differential national targets between EU member states carry the risk of entailing inefficiencies as they can segment the internal market and create rent-seeking opportunities.[23] On the other hand, nationally differentiated targets might increase the feasibility and credibility of the overall emission reduction target, because national targets are more manifest and differentiation makes it easier to reach consensus. One solution to cope with this two-sidedness of differentiated targets is to allow for the trading of these national quotas, e. g. to install intra-EU tradable GHG emission rights. This article will therefore briefly deal with the EU ETS below.

Sector-specific Targets: Risks and Chances

Determining efficient (sub)sector-specific targets is even more difficult than determining overall EU or member GHG emission targets. No matter in which sector GHG emissions are reduced, the direct effect on global warming is more or less the same. Therefore it is argued that in "… order to minimize economic costs, reduction targets must be met by means of economic instruments and by setting norms for the largest-possible groups of emittors [sic!] … Sector-specific reduction targets, however (i.e. targets differentiated by emittor group), are economically inefficient".[24] Combating climate change thus appears to be a perfect example of allowing the market to decide how to reduce emissions. This given, EU-wide (or, better, worldwide) tradable permission units and GHG taxes seem the perfect instruments. Accordingly, sector-specific targets are, at best, necessary to separate emission activities which are suitable for permit trading from those which are not, and hence should be subject to GHG taxes. If targets are broken down to sectors or products, the EU runs the risk of distorting market mechanisms.

On the other hand, sector targets are more tangible than overall objectives, offer precise instructions for engineers and other actors, and therefore are possibly more feasible. On political grounds they may also help to facilitate the campaigning for climate protection measures. Furthermore, they reduce planning unreliability for economic actors and help to reduce administrative coordination requirements. Additionally, they might make motivation and monitoring of achievements easier. As with sectoral targets the responsibilities for success or failure can be more precisely designated to certain industries or governmental departments. Some proponents might even argue that subsectoral targets are superior, not despite but because of the fact that they can be designed to the great advantage of single groups. Thereby specific targets have the potential to win new powerful allies for climate protection. Sector targets sometimes appear more credible than an overall emission reduction

[22] The EU repeatedly stated that at least 50% of reductions ought to be fulfilled domestically. Hence, theoretically up to 50% may be achieved through projects outside of the EU.

[23] C. Egenhofer: Looking for the cure-all? Targets and the EU's New Energy Strategy, in: CEPS Policy Brief, No. 118, January 2007, pp. 1-5.

[24] Organe consultif sur les changements climatique (OcCC), Secondary benefits of greenhouse gas reductions, Synthesis Report, Berne 2000.

target, the attainment of which is left to something as abstract as market forces. Moreover, one has to take into account the EU's limited power to enforce emission reductions. Aspirational sector targets to guide member states' policies or benchmarking for energy related products may simply be seen as a strategy to compensate for this lack of enforceability.[25] Finally, precise sector- and product-specific requirements are often proposed in order to overcome the much bewailed consumers' resistance even to no-regret measures, where individual cost savings and GHG emission reductions would go hand in hand. Prominent examples can be found with regard to electrical equipment, lamps and the insulation of buildings.[26]

To sum up, in spite of the advantages which sector-specific targets may incorporate, they can also lead to such grave efficiency losses that climate protection becomes so costly that the capability or willingness to further curb GHG emissions wanes. Therefore in each case the advantages and disadvantages of sectoral targets need to be weighed against each other. In addition, sector-specific targets must always be seen from a cross-sector perspective. Comparative social cost-benefit analysis of all feasible options should be routinely carried out.[27] But as important as cost-benefit-studies sometimes are for making political decisions, economic modelling for predicting future developments is far from perfect. So is the market, of course. But the same is true for governmental policies.

It is beyond the scope of this article to review the efficiency and effectiveness of the whole range of EU sector-specific targets. Nevertheless, there is both a tendency towards an economically more or less efficient segmentation of overall climate change targets as well as a tendency towards sector-specific targets which are questionable in cost efficiency terms. An example of the latter is the biofuel target, and some of the proposals of the EU Action Plan for Energy Efficiency.[28] An example of the former is the differentiation between CO_2 and other greenhouse gas substances for practical reasons and because of their different atmospheric life spans. Setting a separate target for emissions included in the EU ETS is most obviously another example of necessary differentiation. Finally, the efficiency of overall quotas for renewable energies and the energy efficiency targets are quite ambiguous.

Biofuel Quota

Specific targets for biofuel seem neither effective nor efficient. First of all, it is questionable whether a 10% share of biofuels in all petrol and diesel supply within the EU can be achieved without negative ecological effects and without threatening a reasonably priced food supply.[29] Biomass will most probably have to be imported into the EU without a guarantee that overseas crop production will be environmentally sustainable. Further, depending on land use techniques, transport and processing the net effect of excessive biofuel production use on GHG emissions might be less than usually hoped for. These dangers have been pointed out by more than 200 non-governmental organisations in a letter to several EU institutions, pleading for the abandonment of targets for biofuel use in the EU.[30]

Secondly, turning one hectare of biomass into biofuel is technically inferior to using biomass for biogas that is ultimately used for combined heat and power production when it comes to mitigating CO_2. Most important from the economic perspective is that the mitigation cost of one ton of CO_2 seems to be significantly higher with biofuel in transport than with biogas in combined heat and power production. Also, it has to be taken into account that CO_2 mitigation cost with biogas in many EU countries is higher than for other renewable energy sources, e.g. wind power, or measures to increase energy efficiency and energy saving.[31] Surely a tipping point will be reached where marginal costs speak in favour of biogas. But in my view there is a good case for leaving the decision on the energy mix to the market instead of setting bioenergy or even biofuel quotas.

All in all, there are not many pros for ambitious biofuel quotas except maybe that encouraging biofuel production appeals to some industries (e. g. petrol corporations whose distribution networks serve well to sell biofuel, or the automobile industry), compared to other alternatives. As already mentioned, winning powerful allies in climate protection is helpful, but not at any cost.

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[25] C. Egenhofer, op. cit.

[26] V. Bürger, K. Wiegmann: Energiesparquote und Weiße Zertifikate, Ökoinstitut Arbeitspapier, Freiburg 2007.

[27] C. Egenhofer, N. Fujiwara, op. cit.; C. Egenhofer et al., op. cit.

[28] EU COM(2006)545.

[29] European Environment Agency: How much biofuel can Europe produce without harming the environment? EEA Report No. 7/2006, Luxembourg 2006; U. R. Fritsche et al.: Sustainability standards for bioenergy, WWF Germany, Berlin 2006.

[30] Biofuelwatch: Open letter: We call upon the EU to abandon targets for biofuel use in Europe, 31 January, 2007, http://www.biofuelwatch.org.uk.

[31] C. Egenhofer et al., op. cit.

EU Emissions Trading Scheme (EU ETS)

The ETS is a cornerstone of the EU climate protection strategy, it is the first mandatory regional trading scheme for CO_2. The overall cap is an average of approx. 2.2 billion tons of CO_2 per year during phase I (2005-2007). Only installations of a certain capacity (e.g. combustion installations with a rated thermal input above 20 MW) are included, households or mobile emission sources are currently omitted. Approx. 46% of all EU CO_2 emissions are covered by the ETS. Unfortunately several energy-intensive industrial plants were exempted from the scheme (e.g. aluminium production). GHG other than CO_2 are also not included. But plans are to include further GHG and sectors (e.g. aviation).

It is primarily the EU member states that decide on the total emissions cap for sectors covered by the ETS and the allocation of emissions certificates among them. However, the EU increasingly interferes and coerces members to strictly limit allowances in phase II of the ETS (2008-2012). Free allowances and grandfathering has so far been the most common allocation formula whereas for the second allocation phase the benchmark approach is at the centre. In order to expand their individual caps, firms may use Certified Emission Rights (CER) or Emission Reduction Units (ERU), i.e. emission reduction stemming from the flexible Kyoto mechanisms (CDM and joint implementation).

In principle, emission trading is undoubtedly the most effective and at the same time most efficient mechanism to reach GHG emission targets. In practice, however, there are several limitations regarding its feasibility and its operating efficiency, so in the light of otherwise very high transaction costs emission trading is only applicable to certain emissions and emitters. Clearly, sector targets have to be set to account for the fact that at least a cap for emissions under the ETS has to be set, as well as a target for emissions that cannot be integrated into the EU ETS.

Many of its features reduce the efficiency of the ETS.[32] For example, harmonised allocation rules are considered more efficient than nationally differentiated schemes which can cause distortions in the internal market. Technology-neutral benchmarking or (partial) auctioning are superior to one-off grandfathering of emission rights. Longer compliance periods and time horizons for allocation may also be helpful to lower mitigation costs, as uncertainties for investors and the risk of too early retirement of capital decrease. Finally enhanced use of CER and ERU could further curb cost inefficiencies.

Potentials to Increase the Efficiency of EU Sector Targets

In spite of the need for improvement, the ETS illustrates that the market mechanism, with its flexibility and tradability of (reduction) obligations, has a high potential to compensate for inefficiencies due to nationally and sectorally differentiated targets such as renewable energy targets and targets for energy efficiency.

As mentioned above the EU has set a target for renewable energies of 20% of primary energy use by 2020 and of 21% in electricity production by 2010. The rationale of setting these targets in addition to the EU ETS is at least threefold. Firstly, not all emissions due to primary energy use can be integrated into the ETS (for example, the majority of transport emissions). Secondly, the market's efficiency is often not trusted when it comes to very long-term needs and to innovations that still need basic research. Thirdly, it is claimed, a boost in renewable energies is not only justified by the need to mitigate CO_2 emissions but also by benefits in other policy areas.[33]

Accepting this rationale and thus quotas for renewable energies, quotas still leave room to be implemented in a more efficient way than those preferred by many EU members. For example, quotas could be combined with CDM, or the tradability of quotas between actors from different EU countries could be facilitated.[34] The concept of "green energy certificates" or the "renewable energy certificates system"[35] is one way to achieve tradability. Obstacles to tradable quotas for renewable energy stem e.g. from the different instruments that EU members have implemented to encourage renewable energies.[36] Again, in economic terms, an EU-wide harmonisation of regulatory approaches would provide efficiency gains.

The motivation behind extra targets for energy saving is similar to the rationale behind targets for renewable energies. For instance, the household and transport sectors, which can barely be integrated into the ETS, are responsible for approx. 30% of GHG emissions within the EU. Furthermore, the market, especially the demand side (i.e. end-users), is considered to need

[32] For a comprehensive discussion of the EU ETS see Climate Policy; No. 5, 2005.

[33] C. Egenhofer et al., op. cit.

[34] S. Bode: Promoting Renewables under the CDM. Combining National Quotas in Europe with the CDM, in: Climate Policy, No. 6, 2006, pp. 263-256; C. Egenhofer, op. cit.; WBGU: Towards sustainable energy systems … , op. cit.

[35] www.recs.org.

[36] M. Ringel: Energie und Klimaschutz, Frankfurt/M. 2004.

strong incentives to implement most cost-effective solutions to reduce emissions. In the short to medium term these are clearly energy saving measures such as insulation. Additionally energy saving has some supplementary benefits for air quality and energy security.

Flexibility and tradability that support economic efficiency can be incorporated into the energy efficiency target through "white certificates". The concept is that market actors are obliged to reach certain energy savings. Actors receive certificates for savings achieved which can be used for their own target compliance or can be sold. Ideally it is left to the participants in the market where and how to realise energy savings. For instance, suppliers of heat or electricity can motivate households to increase end-use efficiency in order to comply with their energy efficiency obligation. Since 2004, the EU Commission has supported the "White Certificate Project" which evaluates previous experience with white energy certificates (e.g. in France, Italy and the UK) and promotes the introduction of white certificates.[37] The idea of white certificates is also mentioned in the EU directive on energy efficiency.

So far little experience has been made with either green or white certificates. For the time being studies show that implementing certificates is a rather difficult task but promises noticeable efficiency gains.[38]

Taxes for Climate Protection

In those sectors where neither tradable emission rights nor tradable quotas appear viable (e.g. individual transport, several non-CO_2 GHG emissions), economic efficiency can be achieved through emission taxes. Again, the policies of the EU and the member states on emission related taxes leave much to be desired.[39] Some members have introduced GHG emission taxes, or at least emission based taxes, while others have practically none. Tax rates as well as the tax bases differ significantly between countries and sectors. Plenty of exemptions exist. These differences can hardly be justified by jurisdictional competitiveness as the emission externalities are of an extraterritorial nature. They thus generate efficiency losses.

The EU Commission aims at harmonising emission related taxes (e.g. fuel taxes), but so far with limited success. The resistance of the member states to harmonised and adequate emission taxes partially explains the EU Commission's tendency to occasionally push product specific CO_2 thresholds, even though on efficiency grounds these standards are rarely first, or even second-best, solutions. Another efficiency problem stems from overlapping instruments, i.e. emissions that are taxed and simultaneously covered by the ETS.[40]

In Conclusion

A sophisticated debate on the efficiency of the overall climate protection targets of the EU is in train. Some economists advise against early and drastic emission reductions and instead recommend starting global emission reductions by the middle of the century. On a theoretical basis, arguments for and against this hypothesis can be found. However, it cannot be denied that postponing emission reductions increases the risk that a dangerous climate change can no longer be avoided. Technological and political lock-in effects are one reason, uncertainties about climate sensitivity and climate change impacts is another. Therefore, the EU is well advised to aspire to ambitious emission reduction targets. Anyway, the estimated cost of early action appears to be absolutely acceptable. These estimations admittedly largely build on the assumption that emission cuts are realised in an efficient manner.

In this respect the EU and its member countries still have a long way to go. For example, the EU tends to prefer sector and country specific targets. There are pros and cons to setting specific targets, but all too often they lack efficiency. It can be shown that market oriented approaches have the potential to reduce the economic costs of sector specific as well as national targets. Although the Emissions Trading Scheme needs a lot of improvement, it demonstrates the EU's willingness to implement market-based mechanisms to combat climate change. Furthermore, the EU commission took steps to advocate green and white energy certificates. Also in the case of emission taxes there exist several starting-points for an economically rational policy design. All in all, it is possible to set nationally differentiated as well as sector-specific targets and simultaneously be reasonably efficient. Harmonisation of the national regulatory approaches, flexibility and tradability are keywords here.

Hopefully the reluctance of many EU members and lobbying groups to such EU policy measures will be overridden by the quest for efficiency. This is also essential from an environmental point of view: the less costly climate protection measures are, the more likely it is that long-term targets will not only be set but achieved as well.

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[37] http://www.ewc.polimi.it/.

[38] V. Bürger, K. Wiegmann, op. cit.

[39] N. Fujiwara et al.: The Political Economy of Environmental Taxation in European Countries, CEPS Working Document No. 245, June 2006; COMETR Project: Competitiveness Effects of Environmental Tax Reform, Policy Brief, March 2007.

[40] C. Böhringer et al.: Efficiency Losses from Overlapping Instruments in European Carbon Emissions Regulation, Centre for European Economic Research, Discussion paper No. 06-018, Mannheim 2006.

Sven Bode*

European Burden Sharing Post-2012

In the run-up to the negotiations in Kyoto the EU Council concluded that "… given the serious risk of such an increase [of global average temperature] and particularly the very high rate of change, the Council believes that global average temperatures should not exceed two degrees above pre-industrial level and that therefore concentration levels lower than 550 ppm CO_2 should guide global limitation and reduction efforts."[1] The council's conclusion was recalled in 1997 adding that this " … calls for early action on emission reduction and indicates the need for significant reductions from industrialised countries in the 2000-2020 timeframe."[2] Even though the two target figures of 550 ppm and a two degree Celsius increase seem quite clear, it is difficult to draw concrete long-term emission targets from that. They have to be agreed upon politically, at both the international and the European levels. The Heads of State finally adopted an absolute emission target of minus 20% compared to 1990 levels for the EU.[3] This is an important step towards the ultimate objective of the UNFCCC, to prevent "dangerous" anthropogenic interference with the climate system via the stabilisation of greenhouse gas concentrations in the atmosphere at an acceptable level. The EU thus keeps its role as frontrunner in international climate policy. However, it goes without saying that this minus 20% target is most likely to be distributed unequally among the member states. What will be a fair or acceptable burden sharing rule? The present article discusses this issue.

Implications of the Minus 20% Target

Interestingly, there has been no coordinated discussion on a post-2012 burden sharing agreement within (an enlarged) European community so far. Michaelowa et al.[4] stated that the EU should negotiate a bubble when negotiations at CoP-level on post 2012 commitments started in 2005 with all members at that time. However, no concrete options for the burden sharing agreement are mentioned. Armenteros et al.[5] state that there is no real strategy by the EU on climate policies in the accession countries. Nevertheless there will be an implicit climate policy due to the adoption of the acquis communautaire, which includes a great number of environmental regulations, for example the IPPC directive.

The need for a new burden sharing rule becomes obvious from a comparison of the emission targets under the Kyoto Protocol and the distance from the target of a symmetric "minus 20% for all" (cf. Table 1). Luxembourg would benefit the most as it would be allowed to increase emissions by 8 per cent. Portugal would face the most stringent reduction target. It would be minus 47% compared to its current objective which allows an increase by 27% compared to 1990 levels.

But what could a fair burden sharing look like? The question cannot be answered as there is an unlimited number of views on fairness and equity principles. Table 2 provides an overview of some of the principles referred to in the international climate negotiations.

As it seems justified to refer to any of the abovementioned justice principles during the negotiations of the BSA, it is difficult to predict the outcome. However, an analysis of the last burden sharing may provide some idea.

The First EU Burden Sharing, 2008 to 2012

The guiding principle for European climate policy in the early 1990s was to have an emission target for the EU as a whole and subsequently to differentiate the commitments among member states. The rationale was to allow cohesion countries[6] to increase emissions

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[1] EU Council: Community Strategy On Climate Change – Council Conclusions, CFSP Presidency statement, Luxembourg (25/6/1996) – Press: 188 No: 8518/96.

[2] EU Council: Community Strategy On Climate Change – Council Conclusions, CFSP Presidency statement, Brussels (3/3/1997) – Press: 60 No: 6309/97.

[3] At the same time an increase in the share of renewable energies in the EU was also agreed. Although directly linked to climate policy, this target is not discussed in this paper for capacity reasons. The improvement of energy efficiency is also not considered here, though it is of crucial importance.

[4] Axel Michaelowa, Regina Betz: Implications of EU Enlargement on the EU Greenhouse Gas "Bubble" and Internal Burden Sharing, in: International Environmental Agreements: Politics, Law and Economics, Vol. 1, 2001, pp. 267-279, here p. 278.

[5] Mercedes Fernández Armenteros, Axel Michaelowa: Joint implementation and EU accession countries, in: Global Environmental Change, Vol. 13, 2003, pp. 269-275, here p. 271.

[6] Cohesion countries at that time were Greece, Ireland, Portugal and Spain, which were low-income countries within the EU.

Table 1
Kyoto Targets and Resulting Distance from the Target of "Minus 20% for All"

	Target for Kyoto Period (2008-2012) compared to 1990 levels	Distance (percentage points) from Kyoto target to -20% target
Austria *)	-13.0	-7.0
Belgium *)	-7.5	-12.5
Bulgaria	-8.0	-12.0
Cyprus **)	/	
Czech Rep.	-8.0	-12.0
Denmark *)	-21.0	1.0
Estonia	-8.0	-12.0
Finland *)	0.0	-20.0
France *)	0.0	-20.0
Germany *)	-21.0	1.0
Greece *)	25.0	-45.0
Hungary	-6.0	-14.0
Ireland *)	13.0	-33.0
Italy *)	-6.5	-13.5
Latvia	-8.0	-12.0
Lithuania	-8.0	-12.0
Luxembourg *)	-28.0	8.0
Malta **)	/	
The Netherlands *)	-6.0	-14.0
Poland	-6.0	-14.0
Portugal *)	27.0	-47.0
Romania	-8.0	-12.0
Slovak Rep.	-8.0	-12.0
Slovenia	-8.0	-12.0
Spain *)	15.0	-35.0
Sweden *)	4.0	-24.0
UK *)	-12.5	-7.5

*) 1998 burden sharing agreement

**) no target under the Kyoto Protocol

Table 2
Examples of Justice Principles Discussed in the Context of Climate Change

Author:	Rose[1]	Blanchard et al.[2]	Torvanger et al.[3]
Principle:	Horizontal (initial) Vertical (initial)	Equity of rights, Utilitarian equality	Responsibility Need
	Ability to pay (outcome)	Democratic equality	Capacity
	Sovereignty (outcome)	Causal responsibility	
	Egalitarian (outcome)	Merit	
	Market justice (process)	Proportional equality	
	Consensus (initial)		
	Compensation (process)		
	Rawls' Maxim (process)		
	Environmental equity		

[1] Adam Rose: Equity Considerations of Tradable Carbon Emission Entitlements, in: Unctad: Combating Global Warming – Study on a global system of tradable carbon emission entitlements, Geneva 1992, pp. 55-84. Rose et al. (Adam Rose, Brandt Stevens, Jae Edmonds, Marshall Wise: International equity and differentiation in global warming policy, in: Environmental and Resource Economics, Vol. 12, 1998, pp. 25-51) point out that it is important to distinguish whether a "criterion applies to the process by which a criterion is chosen, the initial allocation of permits, or to be the final outcome of the implementation of the policy instrument ... "

[2] Odile Blanchard, Patrick Criqui, Michel Trommetter, Laurant Viguier: Equity and efficiency in climate change negotiations: A scenario for world emission entitlements by 2030, Cahier de Recherche No. 26, Institut d'economie et de politique de l'energie, Grenoble 2001.

[3] Asbjorn Torvanger, Lasse Ringius: Criteria for Evaluation of Burden-sharing Rules in International Climate Policy, in: International Environmental Agreements: Politics, Law and Economics, Vol. 2, 2002, pp. 221-235. Apart from the three fairness principles, six operational requirements are applied.

while the richer member states in the North would reduce them. In 1991, the Commission proposed a burden sharing with the following three levels: -5% for Denmark, Germany and the Netherlands, +15% for the cohesion countries and stabilisation for the rest. This was, however, rejected by several countries and thus not pursued any further. Only in the run-up to the Kyoto Protocol and the negotiations on binding targets was the discussion on burden sharing revived.[7] A new proposal by the Commission which foresaw a 10% reduction for 2005, however, was not approved. Only when the Dutch presidency commissioned a study by experts from the Netherlands did the negotiations on the burden sharing agreement (BSA) really go ahead.[8]

The "Triptych approach",[9] developed by these experts, distinguishes between three sectors, for each of which a target was defined. Theses targets were, however, not meant to be sector targets but, rather, the basis for the national targets. The underlying idea was to find a compromise between a simple symmetrical approach, which was judged to be politically unacceptable on the one hand, and differentiated but complex and opaque agreements on the other hand.

The first proposal, in early 1997, passed through several negotiations before a final agreement was

[7] To give an example, in March 1997 an agreement was found which foresaw a reduction of 30% for Luxembourg as the strictest target while on the other hand Portugal was allowed to increase emissions by 40%. This in turn led to condemnations by other OECD countries as the EU was calling for equal reduction obligations for other parties (cf. Michael Grubb, Christian Vrolijk, Duncan Brack: The Kyoto Protocol – A Guide and Assessment, London 1999; Joyeeta Gupta, Lasse Ringuis: The EU's Climate Leadership: Reconciling Ambition and Reality, in: International Environmental Agreements: Politics, Law and Economics, Vol. 1, 2001, pp. 281-299). In the end the EU accepted a target of minus 8% and the so-called "bubble" (Art. 4) found its way into the Kyoto Protocol.

[8] Axel Michaelowa, Regina Betz, op. cit., p. 268.

[9] G. J. M. Dian Phylipsen, Jan Wilhem Bode, Kornelius Blok, Bernd Metz: A Triptych sectoral approach to burden differentiation; GHG emissions in the European bubble, in: Energy Policy, Vol. 26, No. 12, 1998, pp. 929-943.

Table 3
Implications of the 1998 Burden Sharing Agreement and Alternatives

Country	Change in % compared to 1990[1]	Change in % compared to baseline[2]	Change of Welfare in % with BSA[3]	Change of GNP in % with BSA[4]	Implicit annual allocation per capita of BSA 1998 (kg/capita)[5]	Change in % compared to 1990 if BSA had been based on equal emissions per capita[6]	Change in % compared to 1990 if BSA had been based on equal burden per Unit GDP[7]	Change in % compared to 1990 if BSA had been based on equal marginal costs[7]
Austria	-13	/	/	/	8.8	3.8	/	/
Belgium	-7.5	/	/	/	13.1	-25.9	1.1	-0.6
Denmark	-21	-43.4	-3.97	-5.72	10.6	-22.1	1.2	0.1
Finland	0	-31.5	-1.90	-2.73	15.5	-32.3	18.2	12.1
France	0	-16.0	-0.67	-1.11	9.9	6.1	-9.7	-8.0
Germany	-21	-17.8	-0.63	-1.17	12.1	-31.3	-26.6	-25.8
Greece	25	/	/	/	12.9	1.4	36.7	26.5
Ireland	13	/	/	/	17.2	-31.1	/	/
Italy	-6.5	-13.0	-1.01	-1.47	8.4	17.0	8.4	9.6
Luxembourg	-28	/	/	/	20.5	-63.1	/	/
Netherlands	-6	-33.1	-4.92	-7.19	13.2	-25.3	5.5	3.4
Portugal	27	/	/	/	7.9	69.4	15.6	9.6
Spain	15	-27.2	-2.83	-4.76	8.4	43.5	3.0	7.3
Sweden	4	-31.0	-3.47	-5.11	8.8	24.0	5.8	9.1
UK	-12.5	-12,7	-0.96	-1.14	10.8	-15.3	-12.0	-10.8
EU	**-8**	**-19.7**	**/**	**/**	**10.5**	**-8**	**-8**	**-8**

[1] 1998 agreement.

[2] Baseline without any climate policy. Source: Laurent L. Viguier, Mustafa H. Babikera, John M. Reill: The costs of the Kyoto Protocol in the European Union, in: Energy Policy, Vol. 31, 2003, pp. 459-481, here p. 474.

[3] Change of welfare without international emission trading, i.e. targets must be met domestically, BSA = 1998 agreement. Source: Laurent L. Viguier et al., op. cit., p. 478.

[4] Change of GNP without international emission trading, i.e. targets must be met domestically, BSA = 1998 agreement. Source: Laurent L. Viguier et al., op. cit.

[5] Population in 1990; emissions from: EEA: Annual European Community greenhouse gas inventory 1990-2001 and inventory report 2003 (final draft), European Environment Agency; own calculations.

[6] Population in 1990; own calculations.

[7] Source: D. Gielen, P. Koutstaal, T. Kram, S. van Rooijen: Post Kyoto effects on the climate policy of the European Union, ECN-C-98-040, Petten 1998.

reached in March of the same year. The final negotiation result included both methane and nitrous oxide.[10] After the Kyoto Protocol had been adopted, the agreement had to be renegotiated due to the inclusion of three more gases and a lower target for the EU.[11] The final agreement can be seen in the second column of Table 3.

Evaluation of the First BSA

As mentioned, the rational behind the Triptych approach was to offer an acceptable compromise. The evaluation of the burden sharing agreement, however, depends on the criteria chosen. Table 3 gives some examples of selected criteria. As one can see, the burden already changes when the factual reduction obligation, i.e. the difference between baseline emissions and the emission target without any additional climate policy, is calculated (second column). The economic effects are shown in the next two columns. Again, effects differ strongly among member states and are not related to the 1998 agreement. For example, while the minus 12.5% target of the UK seems rather strict compared to the minus 6% target of the Netherlands, the model calculations suggest that the economic implications are rather modest for the UK compared to those for the Netherlands. Differences between welfare and GNP changes are *inter alia* due to favourable changes in terms-of-trade patterns.

Also when looking at the marginal abatement costs where the member states were to meet their targets by domestic action only, substantial differences are found.[12] Blok et al.[13] for example report a range of

[10] Ibid., p. 939.

[11] Axel Michaelowa, Regina Betz, op. cit., p. 269.

[12] Note that absolute figures for abatement costs strongly depend on the baseline assumptions. Figures given above are to show the difference among member states only.

[13] Kornelius Blok, David de Jager, Chris Hendriks: Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change – Summary Report for Policy Makers, 2001, http://europa.eu.int/comm/environment/enveco/ [06.11.03].

between €$_{99}$ 1 and €$_{99}$ 100 per t CO_2 eq. Thus, even though some authors have (implicitly) argued that considering economical metrics would be one fair burden sharing rule,[14] there are still problems when trying to determine "the one and only" fair rule.

Given this discussion, non-economical-metric based burden sharing rules may also be considered. Column six shows the implicit allocation per capita of the 1998 agreement while column seven shows what a burden sharing based on equal emissions per capita would have had to look like. Columns eight and nine provide two economic approaches. Note again that the results strongly depend on the assumption regarding GHG emission development.

The above analysis has clearly shown that it is impossible to come up with one fair burden sharing rule for the EU. The future burden sharing will thus most likely not be guided by justice principles but, rather, again be the result of the political bargaining process.

What is at Stake for the Member States?

As shown above, it is impossible to propose the one and only fair burden share rule. However, from a member state's point of view, the question of "what is at stake" with different allocation rules might be of interest. Bode[15] analyses this for another time-horizon, namely a minus 50 per cent reduction for the EU by 2042.[16] The main result should, however, be valid as historical emissions play a crucial role in this game. Bode analyses three burden sharing rules for the EU:

- the sovereignty principle
- equal emissions per capita[17]
- equal emissions per capita over time.

Two of these approaches can be considered to deliver extreme results and are therefore discussed below in more detail.

The Sovereignty Principle

The basic idea of the Sovereignty principle is that "all nations have an equal right to pollute and to be protected from pollution". An operational rule would be to "cut back emissions in a proportional manner across all nations".[18] In the European context this means that all member states would have to reduce emissions by a uniform rate equal to the common target. The rationale behind this approach would be the idea of sovereign states with equal bargaining power negotiating over the allocation. The principle finally results in a protection of rights that have been established by usage or custom.[19] Inequalities regarding the release of GHG emissions would thus be perpetuated.[20] Regardless of any philosophical considerations, the sovereignty rule can be perceived as the simplest form of an allowances allocation,[21] which makes it worth analysing.

Equal Emissions Per Capita Over Time

An allocation based on equal emissions over time has been proposed by the author[22] and was applied on a global level first. However, it is also applicable in the European context. The rationale behind this approach is as follows: with an allocation based on equal emissions per capita, which is also favoured by different Heads of States in the EU, the distribution may be perceived as fair from the point when equal emissions per capita (EEC) are reached. Until this point is reached, however, they may differ considerably (cf. Figure 1a). This is why it is proposed to allocate emissions entitlements in such a way that average emissions per capita

[14] See for example Jens Hauch: Electricity trade and CO_2 emission reductions in the Nordic countries, in: Energy Economics, Vol. 25, 2003, pp. 509-526, here p. 517, who writes that "national emission targets that imply equal marginal costs internationally can be seen as one fair international sharing of reduction costs." One the other hand Dessai et al. (Suraje Dessai, Axel Michaelowa: Burden sharing and cohesion countries in the European climate policy: The Portuguese example, in: Climate Policy, Vol. 1, 2001, pp. 327-341, here p. 333) present a table which is labelled with "Emission change until 2010 under a fair burden sharing rule …" and which provides data on equal burden per unit of GDP and equal marginal cost.

[15] Sven Bode: European Climate Policy: Burden Sharing after 2012, HWWA Discussion Paper No. 265, 2004.

[16] 2042 is chosen as it is 50 years after the Framework Convention on Climate Change was adopted in Rio in 1992.

[17] At this point it is only worthwhile to mention that an allocation of emission rights on the global scale based on equal emissions per capita has been supported by different European (and non-European) policy makers (cf. Meyer: Contraction & Convergence, Dartington 2000, Green Book Ltd.)

[18] Adam Rose, Brandt Stevens, Jae Edmonds, Marshall Wise: International equity and differentiation in global warming policy, in: Environmental and Resource Economics, Vol. 12, 1998, pp. 25-51, here p. 30.

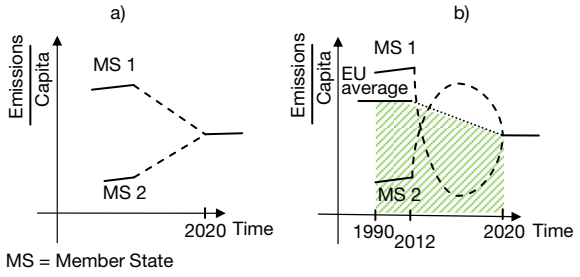
[19] Toke Aidt, Sandra Greiner: Sharing the climate policy burden in the EU, HWWA Discussion Paper No. 176, 2002, p. 13.

[20] Odile Blanchard, Patrick Criqui, Michel Trommetter, Laurant Viguier: Equity and efficiency in climate change negotiations: A scenario for world emission entitlements by 2030, Cahier de Recherche No. 26, Institut d'economie et de politique de l'energie, Grenoble 2001.

[21] For example, Tobias F. N. Schmidt, Henrike Koschel: Climate Change Policy and Burden Sharing in the European Union – Applying alternative equity rules to a CGE-framework, ZEW Discussion Paper No. 98-12, 1998.

[22] Sven Bode: Equal Emissions per Capita over Time – A proposal to Combine Responsibility and Equity of Rights for Post-2012 GHG Emission Entitlement Allocation, in: European Environment, Vol. 14, 2004, pp. 300-316.

Figure 1
Schematic Representation of a) Converging Emissions Per Capita and b) Equal Emissions Over Time



in a period to be specified are also the same prior to the time when equal emissions per capita are reached. Thus, when looking at per capita emissions in the future one cannot only say that the allocation is based on equity of rights in that year and later. One can also look back and see that average emissions per capita in different countries have already been the same for the period considered.

With the total emission budget in the future set and the population prognoses at hand one can calculate the allowed budget of average emissions per capita (hatched area in Figure 1b) for the period considered. The allowed emissions per capita decrease linearly from the value in 2012 until the target year. The allocation of emission entitlements is different. Depending on a member state's cumulative emissions per capita until 2012, the allocation from 2013 onwards may take a form as shown in Figure 1b (dotted lines).[23]

Table 4 summarises some important aspects of the different schemes. Columns two to four show the member states' reduction obligation in 2042 compared to 1990 levels for the three approaches studied above. As can be seen, the individual allocation varies considerably depending on the approach.[24] However, this is only the specific outcome for the final year 2042. From a member state's perspective the resulting cumulative emission entitlements may be of equal importance. This is why the next three columns show the cumulative emission entitlements for each member state for the period between 2013 and 2042, i.e. the period that can still be negotiated. To get an idea of the relative difference among the three approaches, column 8 shows the ratio between the minimum and the maximum allocation. A small figure indicates a high difference. As can be seen the difference is biggest for Estonia and smallest for the UK. Estonia should thus be more concerned about the BSA rules.[25]

Table 4
Implications of Different Allocation Methods for (Future) Member States of the EU[1]

	Change in % in 2042 compared to 1990			Cumulative emission rights 2013-42 (1000 t)[2]			
	Equal per capita	EECT	Sover-eignty	Equal per capita	EECT	Sover-eignty	ratio (min/max)
Austria	-39	-39	-50	1979	2175	1590	.731
Belgium	-56	-56	-50	2533	1806	2988	.604
Bulgaria	-80	-80	-50	1505	1110	3054	.363
Cyprus	33	33	-50	206	283	82	.290
Czech Rep.	-71	-71	-50	2373	1364	3973	.343
Denmark	-50	-50	-50	1382	1147	1329	.830
Estonia	-82	-82	-50	314	74	812	.091
Finland	-61	-61	-50	1268	769	1718	.448
France	-32	-32	-50	15,309	16,895	12,477	.739
Germany	-62	-62	-50	19,502	16,707	23,268	.718
Greece	-40	-40	-50	2589	2314	2711	.854
Hungary	-48	-48	-50	2282	2806	1908	.680
Ireland	-40	-40	-50	1182	608	1289	.471
Italy	-37	-37	-50	13,615	15,738	10,838	.689
Latvia	-63	-63	-50	504	643	554	.784
Lithuania	-60	-60	-50	851	826	1125	.734
Luxembourg	-62	-62	-50	144	61	198	.307
Malta	17	17	-50	108	137	49	.355
Netherlands	-49	-49	-50	4255	3272	4490	.729
Poland	-62	-62	-50	9166	8859	10,641	.833
Portugal	-6	-6	-50	2422	3053	1608	.527
Romania	-55	-55	-50	5140	5990	5208	.858
Slovak Rep.	-57	-57	-50	1317	1277	1531	.834
Slovenia	-45	-45	-50	458	502	398	.792
Spain	-21	-21	-50	9580	11,335	7025	.620
Sweden	-23	-23	-50	2254	2716	1661	.612
UK	-47	-47	-50	15,495	14,683	15,208	.948

[1] Overall emission target for EU in 2042: 50% of 1990 levels (in lieu of 1990 for: Bulgaria (1988); Hungary (1985-87); Poland (1988); Romania (1989)); for Cyprus and Malta only CO_2 emissions from energy combustion have been considered.

[2] Underlined figures show the maximum.

Cost Implications of Different Allocation Options

Different allocations of emission entitlements imply different compliance costs for the individual member states. Compliance costs depend on the emission reduction obligation and the emission (reduction) costs. The reduction obligation to be considered before a certain commitment period has started is the difference between business as usual emissions and the entitlements distributed.[26] Compliance costs are the

[23] For equations see ibid.

[24] While the total budget for the EU is always the same.

[25] At least for the three options reviewed here.

[26] In case banking of entitlements is allowed they also have to be considered.

costs incurred due to domestic abatement plus the costs for the purchase of entitlements on the market. An exact quantification of the different compliance costs is beyond the scope of this paper. Yet, one may question whether it is reasonable to do so for a period of more than 20 years. First of all, the development of future emissions and thus reduction obligations is highly uncertain. A great number of scenarios exist.[27] Furthermore, the development of future abatement costs for the time-horizon considered is highly uncertain. However, the ratio between minimum and maximum allocation for extreme allocation rules may give an indication of the relevance for individual member states.

Conclusion

Sharing the burden of limiting GHG emission into the atmosphere has been done between different countries in the past at both the global and the European levels. Differentiated agreements are likely to play a vital role in the future, too. Experience from the past shows that burden sharing agreements are more likely to be an outcome of a political bargaining process than to be based on a certain equity principle. A review of the three approaches that may result in extreme allocations for individual member states results in considerably different allocations at least for single member states. As the different allocations will influence the countries' compliance costs they are likely to have strong negotiating positions where this difference is large. Experienced and skilful negotiators may thus play a very important role in the future, as they have in the past.[28] In order to avoid this bargaining process an auction of emission entitlements at the EU level may solve this problem. Whether this is a politically feasible option cannot be answered here.

[27] Cf. for example IPCC: Special Report on Emissions Scenarios, Intergovernmental Panel on Climate Change [Electronic Version, CD-rom] 2000; Zhong Xiang Zhang: The economic effects of an alternative EU emission policy, in: Journal of Policy Modelling, Vol. 24, 2002, pp. 667-677.

[28] Lasse Ringius: Differentiation, Leaders and Fairness – Negotiating Climate Commitments in the European Community, CICERO Report 1997:8, here p. 35.

Sebastian Oberthür*

The European Union in International Climate Policy: The Prospect for Leadership

Will the international leadership of the European Union (EU) on climate change continue? To many, this question may seem heretic given that the EU has remained unrivalled as a champion of this policy area since it emerged more than 15 years ago. Only in March 2007, the European Council again underlined "the leading role of the EU in international climate protection". However, there are no natural givens/constants in politics. In order to assess the prospect for continued EU leadership on climate change, we first need to understand which factors have driven that leadership in the past. Secondly, we need to assess how quickly the factors can and do change. What are the current trends and the dynamics of their evolution? To what extent are they stable or show signs of change?

In the following, I shall attempt to give an answer to these questions in seven steps. First, I will clarify the meaning of leadership in general and EU leadership on climate change in particular. Second, I shall give an account of the history of EU leadership on climate change. The next four steps are devoted to different clusters of factors that might help us understand and explain this leadership: the domestic institutional frameworks, domestic politics, domestic climate policies, and international politics. Finally, I argue on this basis that future EU leadership on climate change is likely to face more challenges than in the past – and that we may therefore actually be at the beginning of better times for international climate policy.

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Leadership

The literature on leadership in international affairs typically distinguishes three types of leadership. *Structural or power-based leadership* is based on the general power resources that an actor can bring to bear. *Instrumental or directional leadership* is primarily based on unilateral action and its credibility on the international scene. The most prominent aspect of this kind of leadership is "leadership by example" in going ahead of others internationally and domestically. Finally, *entrepreneurial leadership* relies on the skills of individuals in international negotiations to broker deals and find innovative solutions. These three types of leadership are not mutually exclusive but can be exerted concurrently.

EU leadership in international climate policy can be conceived of as a mixture of structural and directional leadership. Neither policy-making nor scholars substantiate their claims for EU leadership on climate change with reference to individual EU negotiators exerting entrepreneurial leadership. Structural and directional leadership are most closely linked to aggregate actors such as the EU and provide the foundations for these leadership claims. The structural component of this EU leadership mainly follows from the EU's general influence and standing in international affairs, which is based on its overall and issue-specific political and economic weight (rather than any particular action). It is this influence that gives the EU's international policies a "structural" backing that smaller players lack. The following analysis of EU leadership on climate change therefore focuses on the EU's international position and its credibility achieved through domestic action.

Evidently, and importantly, leadership is both a *relative* and a *normative* concept. A leader is always in the lead relative to others. The international climate policy of the EU does not as such constitute leadership, but only in relation to the weaker policies pursued by others. As a consequence, analysing EU leadership on climate change implies comparing EU action to that of other relevant actors. As regards the normative dimension, finally, an international actor can in principle lead in various directions. Since "leadership" in general has a positive connotation, I will only speak of leadership on climate change if an actor leads into the direction of strengthened climate protection, which is increasingly accepted as a commonly shared objective of humankind.

EU Leadership on Climate Change in Historical Perspective

Ever since the negotiations on the UN Framework Convention on Climate Change began in 1991, the EU has been the major leader in international climate policy. Internationally, the EU has regularly had the most progressive substantive position of all major actors. In the negotiations on the Climate Change Convention, the EU (unsuccessfully) supported an international legally binding commitment by the industrialised countries to stabilise their CO_2 emissions at 1990 levels by the year 2000. In the negotiations on the Kyoto Protocol from 1995 to 1997, it led the crowd by proposing a target of reducing the CO_2 emissions of the developed countries by 15% by 2010. The emission target of -8% inscribed in the Kyoto Protocol for the EU and its then 15 member states is the highest of the major industrialised countries. In the negotiations on the Marrakesh Accords of 2001 establishing the rulebook for the implementation of the Kyoto Protocol, the EU defended the "environmental integrity" of the Protocol in particular by supporting limits on the use of the "flexible mechanisms" (most importantly, emissions trading) and on the use of carbon sinks (most importantly, in agriculture and forestry). After 2001, the EU was the major international proponent of ratifying the Protocol and was instrumental in convincing Russia to bring the Protocol into force. In the ongoing discussions on the future of international climate policy, the European Council in March 2007 made an "independent commitment" for the EU to reduce its greenhouse gas emissions by 20% from the 1990 level by 2020. It also declared its intention to commit to a 30% reduction in the case of comparable commitments by other industrialised countries and adequate contributions by advanced developing countries.

The EU has also made increasing efforts to underpin its international position with domestic measures. Domestic climate policy measures at both EU and member state level only weakly supported the EU position throughout most of the 1990s. However, the EU's credibility was upheld because more stringent domestic efforts could be argued to follow from firm international commitments. Furthermore, the EU supported its 15% reduction proposal in the Kyoto negotiations with an internal burden-sharing agreement distributing differentiated emission targets among the then 15 EU member states. At the latest since the beginning of the 21st century, the EU has increasingly implemented domestic climate policies, most importantly the EU emissions trading scheme. At the same time, actual

emission mitigation has shown some weakness. We shall return to the progress of domestic climate policies in the EU below.

EU leadership in international climate policy over the past 15 years or so has remained largely unrivalled. On the part of the industrialised countries, the USA would in theory be the only potential competitor for structural and directional leadership because both Russia and Japan lack the resources required and/or show little prospect of leading internationally on this issue. Large and growing developing countries such as China, India, Brazil and South Africa could in principle also exert leadership on climate change, while the established "leadership" of the alliance of small island states (AOSIS) lacks the political clout necessary for moving international politics. To be sure, developing countries could not base their international leadership on exceeding the EU's unilateral commitments. However, they could – on the basis of the recognised principle of common but differentiated responsibilities and respective capabilities – combine own (ambitious) commitments with demands for stronger action by industrialised countries.

The leadership gap between the EU and the USA seems to have widened since the 1990s. In the negotiations on the Climate Change Convention, the USA refused to subscribe to a legally binding restriction of its GHG emissions. In the Kyoto negotiations it attempted to prevent a reduction target, but eventually accepted a target of -7% (also as a result of the personal commitment of then Vice-President Al Gore). In the aftermath of Kyoto, the USA focused on softening the impact of this target by asking for maximum flexibility in its implementation (flexible mechanisms, sinks). Since 2001, however, the USA has, under the administration of President Bush, abandoned its involvement in the Kyoto process and has consequently not made significant contributions to the discussions on the future of international climate policy beyond 2012. If anything, the USA has distanced itself more from international leadership on climate change since the 1990s.

Developing countries have also not seriously challenged the EU leadership position on climate change. For most of the history of international cooperation on climate change, they were preoccupied with preventing obligations of their own on mitigating GHG emissions and with securing assistance from the North. Their determination to pressure industrialised countries to take strong action has fluctuated somewhat over time, depending on how much they have seen such action as being in their interest. The Kyoto Protocol has strengthened this interest, because the demand for projects in developing countries under the Protocol's Clean Development Mechanism follows from the commitments of industrialised countries.

Furthermore, some recent events point towards the possible emergence of a Southern challenge to EU international leadership. In discussions on the future international climate policy framework, some bigger developing countries have complemented their traditional call for the recognition of the historical responsibility of the North with indications of the possibility of more flexibility regarding own contributions towards mitigating climate change. For example, South Africa has become an ever more independent voice taking an active role in advancing international discussions and making related proposals. Similarly, Brazil has increasingly recognised the need to itself take further measures in the global fight against climate change. However, these recent signs do not yet amount to a serious and consistent challenge to EU leadership, because they stop short of suggesting own international commitments.

Institutional Underpinnings

If we compare the domestic institutional structures of the EU with those of other major international players, EU leadership seems to be well-founded. The institutional conditions for the articulation of environmental interests are relatively favourable within the EU. Interest in environmental protection and the mitigation of climate change is generally dispersed and lacks strong organised "natural" lobbies (in contrast, for example, to large industrial interests). Different political systems provide varying conditions for the articulation and influence of such dispersed interests. The parliamentarian democracies prevailing in most EU member states have been found to provide relatively favourable conditions for the aggregation and penetration of dispersed green interests. This is evident from, among other things, the maturation of green parties in many European electoral systems. As a consequence, ignoring public concern about environmental issues and climate change has significant "domestic audience costs" for European political leaders.

In comparison, the presidential political system of the USA is less favourable to the articulation and penetration of dispersed environmental interests. First of all, the US President and his/her administration enjoy a comparatively high degree of independence from the

legislature. This provides room for presidential "leadership", which has clearly played out unfavourably under the administration of President Bush since 2001. Furthermore, the electoral system does not give US voters the chance to select among a variety of parties so that a green party has never become relevant. In this institutional framework, environmental concerns are easily outweighed by the wealth of other prominent issues on the political agenda. Finally, not least as a result of the US electoral system that makes candidates dependent on donations, well-organised lobby groups commanding significant economic and financial resources heavily influence political decision-making. Overall, these lobby groups have so far rarely been in favour of environmental and climate protection.

Whereas conditions for the articulation of green interests vary among developing countries, such interests on average are much weaker than in industrialised countries. In countries like China, bottom-up interest-formation and articulation is much constrained due to the communist political system. The political systems of countries like Brazil and India may in principle be more open. Overall, many developing countries are characterised by strong positions of established political elites. We cannot do justice to the variety of political systems in developing countries here. It should be sufficient for our purpose to state that, while institutional conditions are frequently suboptimal, the weakness of environmental and climate interests may in many cases be the result of politics rather than institutional underpinnings.

Domestic Politics of Climate Change

Overall, the domestic politics of climate change have so far constituted a competitive advantage for EU leadership. While societal support as well as key economic interests and the attitudes of political and economic elites vary significantly across countries, conditions have become more favourable to climate protection both in major developing countries and in the USA. This suggests that the competition for international leadership on climate change might intensify in the medium term.

Societal support for action on climate change has been relatively strong and growing in both the EU and the USA, while it has remained less pronounced in developing countries. Polls have quite consistently shown considerable support for climate protection in both the USA and the EU for some time. Public support has been somewhat lower in the USA, but the difference seems to have decreased with the upsurge of the political salience of climate change and as a result of the recent enlargements of the EU. Under these circumstances, understanding the persisting transatlantic differences in public perception and discourse on climate change may require taking into account differences in risk perception and attitudes towards multilateralism. Societal support in developing countries for action on climate change has remained lower and has taken a back seat if compared with more urgent development issues, although it has also grown recently.

As regards key economic interests, EU politics also compare favourably to the USA and developing countries, but with a tendency to diminishing differences. In contrast to the USA, China and India, the EU has no major stake in the production of fossil fuels in general and coal in particular. In contrast, it has developed a particularly strong and increasing interest in the development and export of renewable energy technology (especially wind and solar), in which it has a globally leading position. However, growing concern about rising energy prices and energy security has overshadowed these differences in recent years. All actors investigated here are significant net importers of energy resources (mainly fossil fuels). In addition, Brazil has developed a growing interest in promoting ethanol as a substitute for gasoline because of its leading position in this bio-fuel's world market.

Support for climate protection among political and economic elites in the relevant countries is growing dynamically with the result of a diminishing gap between the EU and others. There has for a long time been strong support for climate policy in the EU. While this support was put in question to some extent after the eastward enlargement of the EU, it has recently even further strengthened as is most evident from the political discussions surrounding the aforementioned European Council of March 2007 which committed the EU to further significant GHG reductions. Perhaps more significantly, the political climate in the USA has shifted. With climate change likely to be one of the major issues in the presidential election campaign in 2008, all main candidates – both Democratic and Republican – have announced their support for binding commitments to limit and reduce US GHG emissions. Enhanced by the power shift towards the Democrats in the US congressional mid-term elections of 2006, a growing legislative majority for related legislation – to be passed either before or after the elections in 2008 – also appears to be forming. Finally, support for such action is also growing in business. For example, the car industry seems to be learning its lesson that pro-

ducing more economical cars actually creates business opportunities. And even Exxon Mobile (a long established fervent opponent of climate policy) now appears to give cautious support for taking action. At this stage, significant domestic legislative action on climate change seems imminent in the USA – at the latest once a new president moves into the White House.

A similar trend can be discovered in important developing countries such as Brazil, China and South Africa, although under different societal conditions and under different auspices. In all three countries, especially the political elite has shown a growing awareness of the problem and commitment to action. Most notably, the political elite in China has, to a large extent driven by concerns over energy security, increasingly supported action on climate change. As a result, energy efficiency improvements and the expansion of renewable energy have become two prime political objectives. The 2007 National People's Congress, under the leadership of Prime Minister Wen Jiabao, focused much attention on environmental protection and climate change with a particular emphasis on energy efficiency (see below).

Domestic Climate Policy

We may assume that policy development is to some extent path-dependent in that it builds on past experience and success, which facilitate policy learning. The history of policy making and implementation may thus be a useful element for the explanation of current policies. And actors that have acquired experience and expertise in developing and implementing climate policies may be expected to also be more likely to continue to do so in the future. Policy development thus to some extent acquires its own momentum.

Without doubt, the EU has made important progress in the development and implementation of climate policies. Most importantly, the EU has implemented an emissions trading scheme with mandatory participation of all EU member states, which covers around 40% of the EU's CO_2 emissions. The trading scheme's pilot phase started operating in 2005 and will enter its second phase with the start of the Kyoto Protocol's commitment period in 2008. An apparent over-allocation of emission allowances for the period 2005-2007 has led to more stringent review arrangements for the second phase of national allocations. Furthermore, the trading scheme is scheduled to be revised, expanded and further developed in time for the start of the next trading period in 2013.

A number of further climate policy measures have been taken at EU and member state level. While a detailed review of all these measures is beyond the scope of this paper, we can summarise that the development and implementation of climate policies has advanced considerably within the EU in the new millennium and in particular since the entry into force of the Kyoto Protocol. At the EU level, existing policies and measures address, *inter alia*, the promotion of transport bio-fuels, renewable energy, the energy performance of buildings, the use of fluorinated GHGs, energy efficiency and energy services. Planned measures concern a further increase of the use of renewable energy to 20% of total electricity production by 2020 (as approved by the European Council in March 2007), an increased use of bio-fuels in transport, the promotion of CO_2 capture and storage, and enhanced energy efficiency.

While this progress looks impressive, emissions trends have not been as favourable and leave a somewhat ambiguous picture. For a long time, it looked as if the EU15 was set to meet its Kyoto target of a GHG emission reduction of 8%. However, recent emission trends have cast doubt on this. Originally, the EU had intended to achieve its targets only, or at least overwhelmingly, through domestic measures. Taking into account the use of the Kyoto flexible mechanisms, it looked as if the EU would be able to over-fulfil its targets. However, the safety margin of projected emissions in 2008-2012 has declined and eventually disappeared over the years. The most recent projections available foresee a precision landing – if all planned additional measures are implemented and the use of the flexible mechanism and carbon sinks contributes more than 3 percentage points to the 8% reduction required. This leaves doubts as to the success of the climate policies pursued by the EU and its member states.

While no comparable action has become visible at the federal level in the USA, action on other levels is significant and limits the gap regarding climate policy with the EU. The Bush administration cannot be said to have undertaken significant action on domestic climate change mitigation. When withdrawing from the Kyoto Protocol in 2001, it also announced that it would not develop its mitigation policies further before 2012. Its unilateral target of reducing GHG intensity by 18% between 2002 and 2012 was generally assessed as reflecting business as usual and was not supported by effective measures. Since then, however, significant developments in the USA have in particular oc-

curred at state level and in the business sector. Most prominently, California has begun implementation of stringent climate measures and several north-eastern US states are in the process of setting up a regional emission trading system. Five Western states have also joined forces with similar plans. Several states have also established schemes for increasing the production of electricity from renewables. In 2007, even President Bush jumped on the bandwagon by announcing a programme that would reduce gasoline use by 20% below business as usual within 10 years (primarily by promoting bio-fuels). While the impact of this measure on overall US CO_2 emissions would be moderate, the Bush administration remained opposed to a binding limitation of US GHG emissions.

Also as a result of growing sub-national action, a slow-down in economic growth and increasing energy prices, US GHG emission growth slowed in the first half of this decade. Emission figures for 2000-2004 therefore compare relatively favourably when compared with those of the EU. However, US GHG emissions in 2010 are projected to be 30% above their 1990 levels, as compared with the 8% reduction of the EU (if realised). It is unclear whether recently announced action at various levels may lead to future reductions of US emissions relative to existing official projections.

Significant action has also increasingly occurred in developing countries. Among other things, China is aiming to enhance its energy efficiency (per unit of GDP) by 20% between 2005 and 2010 and has enacted a law to increase the share of renewable energy to 15% by 2020. It has also elaborated a more comprehensive climate policy programme and is the prime host country for CDM projects. Brazil has been particularly successful in promoting the substitution of gasoline with domestically produced ethanol. India and South Africa are actively supporting broader deployment of renewable energy technology. South Africa is also in the process of elaborating a comprehensive set of climate policies. The impact of these measures on actual GHG emission growth in these countries, however, has been modest so far. China is expected to supersede the USA as the world's no. 1 GHG emitter within the coming years. It has also faced severe implementation difficulties that endanger its energy efficiency aspirations.

Overall, a considerable but not necessarily insurmountable gap thus exists in the development of climate policies between the EU on the one hand, and the USA and most developing countries on the other. Since the beginning of the 21st century, the EU has clearly taken the lead in developing and implementing domestic climate policies, which may lead to significant learning effects in the future. Significant policy development has, however, also been initiated in the USA and developing countries, which may provide a basis for the evolution of similar dynamics in the future.

International Politics at Large

Climate change has increasingly become a high-politics issue both in the EU and internationally. The issue regularly figures prominently in bilateral and multilateral meetings of Heads of State and foreign ministers. It has been one of the major priorities of both the UK and Germany in their respective Presidencies of the EU and the G8 in 2005 and 2007, respectively. Climate change is firmly established on the agenda of political leaders around the world. As such, it shapes, and is shaped by, international politics at large.

The position of the EU in the international system in general and its strategic orientation in this system generally support EU leadership on climate change. The EU has for some time entertained the desire to assume a bigger role as a global actor. Given its limited "hard", military capabilities as well as economic power resources, it is not in a position to realise its global aspirations in all political fields alike. In this context, assuming a leadership position on climate change may be particularly suitable and strategically beneficial. Analysts have therefore suspected for some time that EU leadership on climate change has also been motivated by the desire to strengthen the EU's role in international politics at large.

The USA's strategic position within the international system is ambiguous. Since the end of the Cold War, and in particular since the beginning of the 21st century, it has increasingly prioritised unilateral solutions, building on its unrivalled position as the most powerful state in international politics. However, the Iraq debacle and other conflicts demonstrate the limits of this approach and of the actual ability of the USA to determine world politics. Despite deep-rooted skepticism over multilateral solutions, the demonstration of this reality provides an opening for a strategic re-orientation towards a "realistic" or "selective internationalism" and thus to US international leadership. Given the current shift in domestic interests and policy in the USA, climate change could well become a primary field of such leadership.

The position of Brazil, India, and South Africa as rising middle-powers should principally provide favourable conditions for their international leadership on climate change. All three countries have aspira-

tions towards a stronger role in international politics in general, as is evident from their demands to become permanent members of the UN Security Council. Their aspirations might also provide an important motivation for taking a leading role on climate change. They may indeed be part of the motivation and explanation of South Africa's more proactive role in international climate policy in recent years.

China's position as an emerging superpower leaves the country, just like the USA, in an ambiguous position. On the one hand, it could provide a rationale for taking a less active role on climate change. Such restraint could help China avoid spending valuable political capital on an issue that is potentially divisive *vis-à-vis* the USA, while the country wants to focus on developing its domestic resources. On the other hand, China's ongoing rise in international economy and politics might provide a rationale for taking international responsibility in order to strengthen multilateral cooperation and diffuse fears that China may strive for power and supremacy (especially if compatible with the domestic agenda).

Conclusion: Shifting Tectonics?

This analysis leads to a two-sided conclusion. On the one hand, the various factors investigated indicate that EU international leadership on climate change is built on a sound basis. Domestic political systems in the EU provide comparatively favourable conditions for the articulation of environmental interests. Climate policies also enjoy broad public and elite support and are backed by a constellation of economic interests with comparatively low stakes in fossil fuels but a growing interest in climate-friendly energy sources and energy security. The EU is also a clear leader in the implementation of domestic climate policies, and its general position in, and multilateral approach towards, world politics provides an additional rationale for its international leadership on climate change.

On the other hand, the current dynamics and recent trends of international climate politics question the long-term stability of EU leadership. The conditions for the articulation of "weak" environmental interests may in the future lose relevance. As climate change has become a high-politics issue and the need for action is increasingly accepted, the ability of political systems to implement far-reaching policy change may become crucial. In this respect, presidential systems such as the one in the USA as well as systems dominated by relatively small elites may even have an advantage – if their respective leaders so desire. Furthermore, energy security constitutes an ever more important interest in support of climate policy also for other actors than the EU. Furthermore, support for climate protection has broadened significantly among political and economic elites in the USA and major developing countries, and climate protection measures are increasingly implemented in these countries. As a result, the climate policy gap between the EU and others is smaller than one may suspect. International politics also provides openings for the USA and major developing countries to engage more proactively in international climate politics.

In the medium term, the international leadership position of the EU on climate change may therefore well face challenges by other countries. While this may not yet constitute an acute prospect, it might become an increasingly concrete possibility after the next US presidential elections, and as China and other developing countries gain experience and confidence with the implementation of domestic measures (which will require that they overcome significant implementation difficulties). Once these actors decide to engage fully in the fight against climate change, their political systems may provide them with a competitive edge in the pursuit of global leadership.

In this situation, the opportunity for the EU lies in fully exploiting and expanding the first-mover advantage it possesses in the elaboration and implementation of domestic climate policy. Domestic polities and the international system are notoriously difficult to change. And one of the most promising ways to modify climate politics is the implementation of suitable policies. For example, the promotion of renewable energies and the implementation of the EU emissions trading scheme have already changed the political process in Europe and beyond. Through continued and strengthened climate protection efforts, the EU has the chance to further advance its international leadership on climate change.

The rise of other actors who challenge EU leadership may paradoxically prove the success of this leadership. After all, leadership in general aims to motivate others to follow suit. Consequentially, the followers may challenge the original leader. The protection of the world's climate would benefit from the resulting leadership competition. If the trends identified in this article prove to be stable, the standstill of international climate policy may give room to a new dynamic that increases the chances that EU leadership on climate change could be challenged. We may therefore hope for and, at last, see significant progress in international climate policy in the not too distant future.

Jason Anderson*

Climate and Energy Policy in Europe

The link between climate change and energy use is obvious – fossil fuel combustion in the energy sector accounts for 59 per cent of the European Union's carbon dioxide emissions, and the transport sector for a further 21 per cent.[1] Achieving deep reductions in emissions means doing something about energy.

And yet, in many ways energy policy and climate policy have long been like strangers on a crowded train – inevitably headed in the same direction but maintaining the fiction that they have some privacy, and are not in fact mashing uncomfortably on each others' toes.

For some time now climate change has garnered high-level political and press attention around the time of summits and major agreements, but has had the air of a political dance to the tune of future music – commitments made have been tentative first steps, often requiring no extra effort beyond existing trends, while uncertainty reigned about the probability and magnitude of any more serious long-term effort.

Energy policy, meanwhile, is the province of high finance, of fundamental inputs to our daily lives, and of matters important enough to forge international alliances and go to war. It is in fact at the heart of the European Union – the European Coal and Steel Community brought Europe together in 1951, and the European Economic Community (EEC) came into being together with Euratom in 1958. This tells us two things: although it is often noted that there is no energy chapter in the Treaty, energy has always been important to Europe, and the emphasis on creating sufficient supply of fossil fuels and nuclear power is deep-rooted in the Community.

Now, however, the emphasis is shifting. Entry into force of the Kyoto Protocol in 2005 gave some certainty to climate policy. Activation of the EU Emissions Trading Scheme in the same year began to put the structure in place which will force carbon accounting into business' most sensitive spot – its financial ledger. With the recent publication of the Intergovernmental Panel on Climate Change's summary of current climate science, attributing global warming with yet more certainty to human influence, the Stern Report's message of economic savings through emissions mitigation and Al Gore's star turn in Hollywood, public momentum on climate change is at an all-time high. At the same time, high oil prices and the spectre of Russia flexing its muscle through dominance of EU gas supply have created unprecedented concern about energy.

For Europe, the most recent crucible of this confluence of interests was the European Council, held on 8 and 9 March 2007, where climate and energy proposals featured side by side, and a number of high profile decisions were taken. These included a commitment to a 20 per cent reduction of greenhouse gas emissions below 1990 levels by 2020, with the goal of making that a 30 per cent reduction if it can be part of an international follow-on to Kyoto. A binding renewable energy target of 20 per cent by 2020 and 10 per cent biofuels in the transport sector by that year further show the Council's enthusiasm for the proposals tabled to this effect by the European Commission.

In the run-up to the Summit it seemed energy policy issues might steal the limelight – Member State cooperation in dealing with external energy suppliers, legal unbundling of energy companies – matters of high finance and politics. However, as the Summit approached, the tone shifted, reportedly due to the influence of German Chancellor Angela Merkel, playing a leading role given Germany's presidency of the European Council during the first half of 2007. Climate and renewable energy policy shifted front and centre, and took the headlines with historic agreements.

An Energy Policy for Europe

The European Commission's "Energy Package," a set of Communications released on 10 January 2007 collectively entitled "Energy for a Changing World," and headed by the Communication "An Energy Policy for Europe" (COM(2007)1), may be seen as a collection of disparate initiatives, but the Commission was keen to present it as a new direction in energy policy. Energy Commissioner Andris Piebalgs emphasised that this is "not just a new strategic target to shift the direction of Europe's energy policy. It has equally tabled a concrete, coherent Action Plan … inter-linked measures that will put us on course to achieve it."[2]

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[1] The European Commission and European Environment Agency report these breakdowns for the EU-15; this data is from the "EEA Technical report No 6/2006: Annual European Community greenhouse gas inventory 1990–2004 and inventory report 2006 Submission to the UNFCCC Secretariat".

[2] Andris Piebalgs, Energy Commissioner: Energy for a Changing World: The New European Energy Policy, speech at the EU Energy Law and Policy conference, Brussels, 25 January 2007.

Interlinkages are highlighted throughout the messaging: the goal is to create supply security for economic growth in the context of meeting climate change mitigation targets. The stated priorities underlying the effort are not to exist side by side, but to rest upon each other, such that the success of each is dependent upon the other. In its conclusions of 9 March, the Council approved the action plan, with alterations reflecting the political agreements made (as noted below).

The Priorities and the Papers

The first priority, which underlies everything else, is the internal energy market – all of the policies proposed have to be compatible with liberalisation, which it is argued will have a range of environmental benefits once completed, but some drawbacks until then, hence the urgency. Second in the list of priorities is "Member State solidarity" in matters of security of energy supply, and international energy policy – in particular relating to the all important gas supply which comes from, and passes through, only a handful of countries but upon which all of Europe relies. Energy efficiency and renewable energy are the next priorities. While it is likely that Member States will largely fail to meet indicative renewable energy targets by 2010, the Commission is setting, and the Council has agreed to, even more ambitious targets for 2020. To help achieve ambitions in low-carbon energy, research into energy technologies is needed, which is the next priority. Although this is as important for renewable energy as anything else, the focus here is on clean coal and CO_2 capture and storage. Also included is a mention of nuclear energy, which the Commission notes is "cheap and clean" and supplies 30 per cent of EU electricity. In mentioning nuclear energy, the Council carefully reiterates the primacy of "Member States' choice of energy mix", steering the middle path between pro and anti-nuclear camps.

The proposals discussing these priorities are important to examine in more detail, as they represent the most recent thinking of Europe's lawmakers, and are likely to shape energy policy for some years to come.

The Playing Field: Liberalised Energy Markets

The energy package included two main documents on the internal market, "Prospects for the internal gas and electricity market" (COM(2006)841), and an implementation report with Member State information (SEC(2006)1709); it also alludes to an accompanying document, COM 2006(851),[3] which examined market problems.

While the purpose of releasing so many documents together as an energy package was ostensibly to note the linkages between energy markets, climate change and clean energy, these liberalisation reports are rather insulated from environmental considerations. The internal energy market "project" of the EU has long engendered debate about the environmental implications, which were always clearly secondary issues for those interested in pushing forward liberalisation. Insofar as environmental aspects were considered, they were largely afterthoughts and wishful thinking. Prior to the second electricity market liberalisation Directive (2003/54/EC), for example, a study under the Save programme in 2000[4] indicated just how difficult it would be to achieve demand-side efficiency in liberalised markets, and recommended a stand-alone Directive to counteract negative incentives created through market liberalisation. Such a Directive (2006/32/EC) was delayed until 2006 due, essentially, to a lack of good ideas, and in the end it is light on details.

One can therefore say that while the Commission consistently tries to put liberalisation in the light of environmental objectives, this is just window-dressing for a project with origins in philosophies of optimal market economics, not optimal environmental performance.

Energy Commissioner Andris Piebalgs stated on 25 January[5] that, "Without an Internal Energy Market that is truly characterised by intense European-wide competition, none of the EU's core energy objectives will be achieved." In other words, it is the framework upon which sustainability and growth inevitably must hang, but which is as yet incomplete, putting those other goals at risk. The Commission has become increasingly critical of the pace of liberalisation; last year it launched 34 infringement proceedings against 20 Member States.

Still the optimism about clean energy remains – according to the Commission it is supposed to emerge from an efficient market due to the compatibility with instruments such as emissions trading and energy taxation, and due to the possibility for consumers to choose green products. Further, "efficiency" is spurred by transparent and liquid markets – though all indications are that this is only true for the supply side, while in fact there are clear incentives for energy companies to seek increased demand to raise revenues.

The Communication recognises that the liquidity, transparency and efficiency of the market are currently insufficient to create all of the advantages it could

[3] Inquiry pursuant to Article 17 of Regulation (EC) No 1/2003 into the European gas and electricity sectors (Final Report).

[4] Stefan Thomas et al.: Completing the market for least-cost energy services. A study under the save programme, available online at http://www.ukace.org/pubs/reportfo/DSMfinal.pdf.

[5] Search for Commission press release by date on http://europa.eu/rapid/.

have – however, it does not point to any inherent failings in the design or conception of liberalisation; specific pieces of legislation are only planned to increase the likelihood of success through strengthened market conditions. Those concerned about environmental issues have now long resigned themselves to the fact of liberalised markets, having initially been rather sceptical. But market instruments like emissions trading continue to stumble over the rocky playing-field, and at a certain point in the future, if conditions do not improve, one will have to wonder if it is a matter of "if" markets will become well functioning, and not "when".

Rehabilitating the Old Guard: Nuclear and Fossil Fuels

Nuclear energy is the third rail of European energy and climate policy – although a low-carbon electricity source, it is always approached with great care, and rightly so. Few other energy issues can spark so much emotion.

Nuclear energy is unique in European energy policy in that there is policy competence in the area – in fact there is a whole treaty dedicated to it, Euratom. The Coal and Steel treaty may have expired, but Euratom plugs along like some kind of 1950s vision of the future that looks all wrong when viewed in retrospect. Its core mission of promoting nuclear energy is out of step with the times, and even the requirement to which the recent Communication (COM(2006)841) responds could not have anticipated how controversial nuclear energy would become: "periodically publish illustrative programmes indicating in particular nuclear energy production targets and all the types of investment required for their attainment."

Whether by some kind of institutional memory or through real conviction, the Commission has largely remained a pro-nuclear organisation. But it has to be careful, and while so keen to take on greater centralising responsibility in other areas of energy policy, it hides behind subsidiarity to claim that it would of course not dream of telling Member States what to do on this most sensitive of issues.

As a result, it focuses on those areas which are unlikely to ruffle too many feathers: safety and security. In keeping with the tenor of the energy package, the role in security of supply and climate change is also highlighted. The Communication states:

"Nuclear energy generation has a role to play in … security of supply, competitiveness and sustainability. At the same time, nuclear safety, decommissioning nuclear reactors at the end of their active life, management, transport and final disposal of radioactive waste together with non-proliferation are important issues that must continue to be actively addressed."

It takes around 10 years to construct a new nuclear power plant, and given that the average age of most plants in Europe is between 20 and 30 years, there is not much time to consider new construction if we wish to maintain production at current levels – something the Commission considers necessary.

However, the liberalised market is not kind to nuclear. It has high upfront investment costs, which are difficult to finance, hence "the IEA indicates that for the private sector to invest in new nuclear projects, governments may need to take measures reducing investment risks." On a life-cycle basis nuclear is claimed to be economical – the Communication confirms this fact by citing the World Nuclear Association. It is argued that nuclear is one of the largest potential sources of CO_2 reductions, as well as offering possibilities of creating hydrogen and heat, hence "the role of nuclear power should continue to be taken into account in the discussions on the EU Emission Trading Scheme."

Despite these rhetorical salvos, the Communication does not represent the spearhead of a major new push to renew nuclear energy. It is a rather tame restatement of the benefits of nuclear energy, arguing for renewed consideration of its role. No specific legislative proposals are likely to flow from this other than ones already in the pipeline. The Communication does state there will be more emphasis on public opinion (as the public is "not well informed"), which will take the form of "creating a database accessible to citizens" – sure to be a huge hit. Emphasis on the national debate thus continues to be the main element of importance, as repeated by the Council.

Quite different is the current enthusiasm for "sustainable fossil fuels", which equates to the use of carbon dioxide capture and storage (CCS) – an emerging technology which may significantly reduce the emissions of large point sources of CO_2. Although there has been research funding in Framework Programmes 5 and 6 (and much more upcoming in 7), inclusion of CCS in policy and regulatory activity has only started to emerge in earnest. The Commission will produce draft legislation to facilitate CCS by the end of the year, and plans for power plants with capture are springing up quickly around Europe.

COM (2006) 853 on "Sustainable power generation from fossil fuels" and the associated impact study (SEC(2006) 1723) indicate how far CCS has come, quickly – while hardly a subject of conversation in the Commission a couple of years ago, CCS is now portrayed in an extremely positive light, and there is a range of ambitious actions planned to facilitate its commercialisation. While much of this enthusiasm may be warranted, several statements are not supported by research to date.

For example, despite assurances that there is more than enough available geological storage space in Europe, this amount is still subject to very imprecise estimates. Availability will be important to show before putting an obligation on companies to capture CO_2 (e.g. they will have to have confidence there is somewhere to put it).

Secondly, although CCS is often called "zero" or "near zero" emissions, and the figure of 90 per cent reductions is mentioned here, this is probably optimistic. A study comparing the various CCS options[6] found that most likely reduction rates were between 72 and 90 per cent taking direct emissions into account, but when accounting for the indirect emissions associated with the extra fuel needed to power the capture process (including things like methane release from coal mines and gas transmission), the total reductions fall to between 65 and 79 per cent.

Finally, reported costs in the future are likely to be quite optimistic and depend on reductions through experience – if less experience is gained in the coming decade than hoped (such as an inability to get pilot projects off the ground as quickly as planned, which one has to recognise seems to be the inevitable fate of all pilot projects) then cost reductions will be more modest.

These critiques of the Commission's paper may be argued in two almost opposite ways. They are used by Greenpeace to say that CCS is not the solution many think it is, and hence CCS should not be supported with public funding or incentives – rather, this effort should be redoubled to renewables and efficiency. Meanwhile, the power industry may use these arguments to try to get out from under any hard requirements to use CCS – for example the idea floated in these documents that any new power plants should be "capture ready" by 2010 and include capture by 2020 (which was watered down to an R&D goal by the Council). Industry could say that there haven't been the cost reductions anticipated, that storage has yet to be proven, and hence they can't be held to this requirement.

It would be risky policy to rely on CCS for big reductions when the technology and the will to use it still have to catch up with each other. It is very similar to the situation with the auto industry, where a political commitment was first taken to a 120 gm/km target, then renegotiated years later once the target was obviously going to be missed. Entering into this kind of horse trading on CCS may mean that its use slips past the date when many of Europe's power plants will need replacement. The worst outcome is that the prospect of CCS induces governments to offer coal power planning permission, but the technology never emerges, so we are locked into high-emitting power for more decades. The fox is in charge of the henhouse – government is asking industry to develop a technology so that it can then be forced to use it (at great expense), so one might expect progress to be at the pace industry thinks it can get away with rather than the socially optimum tempo.

Government-mandated Revolution: Renewable Energy, Biofuels and Efficiency

Nowhere is the nexus between climate and energy more evident than in the promotion of renewable energy and energy efficiency. Within the Energy Package there are Communications that focus on renewable energy – the first a report on "Progress in Renewable Energy" (COM(2006)849) and the second a "Renewable Energy Road Map" (COM(2006)848). These are joined by the energy efficiency action plan published last October (COM(2006)545).

The action plan calls for a non-binding reduction of 20 per cent less energy use than would have taken place under baseline conditions. As targets go, this is the equivalent of taking a mild interest – not only are the targets indicative, the baseline to which reductions will be compared is one which does not include many measures already in place. Thus there is some question as to added value. Initiatives such as higher efficiency requirements in office, street and domestic lighting, and a new international agreement on efficiency are positive, and it is hoped that requiring efficiency action plans may force Member States to recognise opportunities that they might have overlooked.

On renewable energy, the Commission anticipates that the EU will fall short of the target of 12 per cent renewables in energy supply by 2010, although the contribution of renewables has increased by 55 per cent since 1997. Ten per cent may be more likely. Uptake of biofuels has been very uneven, with only Germany and Sweden reaching the Directive's "reference value" of 2 per cent of all fuels in 2005. The Directive target of 5.75 per cent biofuel in 2010 is unlikely to be achieved.

The Commission's reaction to the likelihood of missing the targets is interesting – rather than being too difficult, they state that the 12 per cent target was "insufficiently ambitious to drive change". So it proposes, and the Council ultimately backed, a new mandatory target be set at 20 per cent for renewable energy's share of energy consumption in the EU by 2020 – covering electricity, heating and cooling, and transport. The proposed target sits directly between

[6] Peter Viebahn: Paper as reported in the presentation "Comparison of Carbon Capture and Storage with Renewable Energy Technologies Regarding Structural, Economical, and Ecological Aspects", German Aerospace Centre, 11 December 2006.

the targets previously suggested by the Council and European Parliament of 15 per cent and 25 per cent respectively.

What distinguishes this 20 per cent target from the previous 12 per cent effort is that it is to be binding rather than indicative, the source of much discussion at the Council meeting. Controversy was diffused by an agreement that differentiated national targets will have to be negotiated "with due regard to a fair and adequate allocation taking account of different national starting points and potentials".[7] Secondary targets for specific uses of renewable energy would be left to Member States to decide. Of course, the Council cannot itself make targets binding – this has to occur through legislation, which goes through the usual decision process. And even if, after having gone through that lengthy process, the targets are still decided to be binding, then we have an inducement to comply which has not always seen the most compelling success. 798 environmental law infringement cases were open against Member States at the end of 2005;[8] that may be worrying enough, but worse is the evidence from a cornerstone of European policy – failure to comply with the public deficit requirements under the Stability Pact in the Eurozone has resulted in a tactical decision by the Council to avoid taking real action – hardly instilling confidence in the "binding" nature of such commitments. Still, the message from the decision an renewables targets is clear; the Council is taking as firm a stand as it can on these commitments, which is firmer than many expected.

As part of the overall renewables target, the Road Map also puts forward the idea of an additional target for biofuel utilisation – a minimum binding target of 10 per cent of overall consumption of petrol and diesel in transport by 2020, conditional on certain environmental quality considerations.

Biofuels are regarded by the Commission as a key measure not only to reduce greenhouse gases from the problematic transport sector, but at least as important to reduce the EU's heavy dependence on imported oil, the bulk of which is for transport, and much of which comes from politically unstable parts of the world.

Thus security of supply is a key driver, and with the possibility of oil prices remaining high more or less permanently, the balance of payments is also a significant issue. The Council concurred with the binding target of 10 per cent of all road fuels by 2020, and even higher numbers are mooted in the biofuels papers associated with the Package. This is well beyond what is either technically possible through current or envisaged levels of blended fuels, and probably also beyond Europe's capacity to supply its own needs – at least if much of that demand will continue to be supplied through first generation food crop-based production.

The report contains a fairly realistic assessment of the extent and variability of greenhouse gas savings from European biofuels, and notes, in particular, that biofuels grown on drained wetlands would have an extremely adverse greenhouse gas balance, and that clearance of rainforest should also be avoided. On the other hand, it concludes that to produce enough biofuel to substitute 14 per cent of road fuels would have impacts in agriculture that would be "manageable".

This statement appears to be based on the "Review of economic and environmental data for the biofuels progress report" (SEC(2006)1721), which accompanies the review. There are a number of concerns with the analysis, which is based on a land use model that is not transparent, with results which appear counterintuitive. Problems include overlooking alternative uses of some possible fuels, the soil impacts of biofuels crops, the risk of growing biofuels on High Nature Value farmland, and a variety of environmental risks which are glossed over.

The Communication envisages a future switch to second generation production processes as these become available. These permit using woody crops and cellulosic residues to create ethanol, allowing higher yields on poorer land. It argues for an incentive system that encourages "good" biofuels and discourages "bad" ones, but is less than specific as to how this crucial distinction will be achieved.

On the whole, the experience of biofuels indicates the complexity of climate change and energy policy – even linking these two fields is insufficient. In fact, scientific and policy considerations from the fields of agriculture and nature protection have to be given a far greater role in biofuels policy before good decisions can be made. The tendency for percentage commitments to be thrown into the ring as signs of good intentions, but without sufficient study or safeguards, may backfire if the price we pay is wrecked ecosystems and higher prices for both food crops and mitigation effort. Bioenergy needs to be viewed in its totality, where in most cases the best use of energy crops will be heat and electricity production, and where development of second generation biofuels is crucial. Council conclusions open the door to more

[7] Presidency Conclusions, European Council, 8-9 March 2007, on www.EU2007.de.

[8] As reported in ENDS Environment Daily, 21 September 2006: "EU Green Law Infringements Down in 2006"; www.endseuropedaily.com.

analysis and conditionality before hard targets are set, an opportunity that must be used.

The Means to Get There: Pushing with Technology …

A criticism levelled at the United States over the past few years has been that, although research and development into energy technologies is quite well funded, without a carbon price or emissions limitations of some kind there is little reason to move them from the lab to the market. Given the US Government's underwhelming enthusiasm for climate policy, technology development has come to be seen by many observers as a form of smoke and mirrors to hide a lack of interest.

Having posited itself as the opposite pole to the US' climate scepticism, Europe has approached the role of technology in climate policy with some caution, choosing to emphasise international target setting and economic instruments. But technology clearly has to play a major role in helping us reach the goal of avoiding global warming beyond 2 degrees C. European governments have to steer a course between laissez faire and picking winners, promoting enough of the right kind of technology with reasonable investment to get real results – no small order.

The Communication "Towards a European Strategic Energy Technology Plan" (COM(2006)847) sets out the ambition to formulate a strategic plan for the improved coordination of energy technology development at the European level. The Strategic Energy Technology Plan (SET-Plan) would support the general aims of the energy package to achieve more competitive, secure and sustainable energy by achieving more efficient use of resources (fewer overlaps between Member States' activities); supporting major technological projects which require collaboration between Member States; contributing to stable market forecasts (to stimulate investments); exploring export potential (with worldwide energy infrastructure investments expected at 16 trillion euro between now and 2030); and generally speed up the development of energy technologies.

The SET-Plan communicates a sense of urgency in furthering energy technology development. It is hoped that a "paradigm shift" in the use of energy technologies will be achieved by 2050. The emphasis of the Plan is on collaboration in order to achieve more coordination and synergies between investments in Member States and at the EU level. It will be supported by a number of existing initiatives, including the 7th Research Framework Programme (FP7), the Competitiveness and Innovation Programme (CIP) and the Intelligent Energy for Europe initiative, which will explore non-technological barriers to market uptake. It remains to be seen whether coordination will be the key to unlocking technological breakthroughs and opening new markets, but the principle is commendable.

… and Pulling with Targets

All of the aforementioned plans, programmes, ambitions and pronouncements are in the service of reducing greenhouse gases. How much effort is needed will hinge crucially on the reductions we aim to make – studies show that, for example, the cost of meeting emissions limitations which achieve 450 ppm[9] stabilisation is twice that of a 550 ppm target, which is itself twice that of 650 ppm; on the other hand, the benefits of avoiding damage from more warming outweigh the costs of meeting the lower stabilisation levels.[10] The headline outcome of the European Council in March was a commitment to a 30 per cent reduction in emissions by 2020 if also agreed among other developed countries (with developing countries playing their part as well), with a 20 per cent reduction if not. This was the formulation proposed by the Commission in COM(2007)2. As noted in the accompanying impact assessment, a 30 per cent reduction is consistent with the conclusions of a scientific meeting held in Exeter, UK in 2005, which compiled modelling on the probability of keeping global warming under 2 degrees above 1990 levels, based on various assumptions about reduction effort.[11] This roughly equates to achieving a 450 ppm CO_2eq. stabilisation target.[12]

The fact of a longer term target is an important evolution in climate policy, with big implications for energy. It creates a useful framework for energy investment decisions – innovations take a long time to penetrate the market, large scale energy infrastructure takes a long time to build, and it lasts for decades. So while long-term targets may appear daunting, they can ease the mind of industry by at least letting them know what is coming and allowing them and governments to plan ahead.

With an era of deep emissions reductions now beginning to dawn, it will not be possible for climate pol-

[9] Meaning 550 parts per million of CO_2-equivalent (e.g. all greenhouse gases converted to equivalent the global warming potential of CO_2) in the atmosphere. It is currently 385 ppm CO_2, which in addition to the other greenhouse gases covered by the Kyoto Protocol is around 420 ppm CO_2 equivalent.

[10] Michel den Elzen: Costs and benefits of meeting climate targets, presentation from the workshop "Cost of Inaction", DIW Berlin, 11 and 12 April 2006.

[11] "Avoiding Dangerous Climate Change": Report of the international scientific steering committee of the "International symposium on the stabilisation of greenhouse gas concentrations", Hadley Centre, Exeter, UK, May 2005; symposium held 1-3 February 2005.

[12] Emphasis on "roughly", as the link between emissions levels, stabilisation and temperature change is determined probabilistically; secondly, the impact of Europe's efforts depend on their being part of a total global effort with others taking on commitments in line with their abilities to do so.

icy to be mere rhetoric while energy policy continues to the beat of an old drummer. Science tells us that reduction commitments will have to be large to achieve our goals, which means major changes to energy systems. These have of course occurred in the past, as we shifted from wood to coal to oil and gas, but never because of an idea – a common commitment to defend the public interest, regarding a phenomenon which will necessarily remain something of an abstraction. Even those who have been urging changes to energy systems for some time now may not realise what it means to see this happen in reality. In some cases it means accepting paths some might not have preferred, like fossil fuels with CCS. But it also means wringing the waste out of energy use and exploiting the renewable sources in massive abundance all around us,[13] which it will take only our ingenuity to turn from small players to major forces, and to ultimately commonplace realities. For all the pitfalls and foibles of European policymaking, recent events show that there is emerging political commitment with real substance. Matching it with effective implementation would truly mean a paradigm shift of great importance is under way.

[13] It is estimated that there is on the order of 10,000 times more solar energy hitting the earth than the total human energy use.

Rainer Walz*, Wolfgang Schade**, Claus Doll**

Interaction of EU Transportation Policy and Climate Policy

Climate policy and transportation issues are among the most prominent policy fields in the European policy arena. The high ranking importance of both fields can be traced back at least until 1992, when the Earth Summit in Rio put climate change at the top of the agenda, and the EU formulated its Common Transport Policy (CTP).[1] Since then, important developments in European transportation policies have included the liberalisation of transport markets, the implementation of the trans-European transport networks, the implementation of the Single European Sky and the European Train Control System (ETCS), and the harmonisation and enhancement of technical and social standards particularly in commercial road transport. In 2001, the White Paper on European Transport Policy until 2010[2] was published, which defines four main priorities for action and 76 related policy measures. The most recent important step was the Mid Term Review (MTR) of the White Paper which analysed the progress in implementing the measures and which was published as a Communication in summer 2006.[3]

Climate policy has appeared on the list of the top political problems ever since the Earth Summit in Rio in 1992. The negotiations concerning the Kyoto Protocol, the EU Burden Sharing Agreement, and the introduction of the EU emissions trading scheme (EU ETS) are among its highlights. Major recent reports, like the various reports of the International Panel of Climate Change (IPCC) or the Stern Review,[4] continue to push climate policy onto the agenda of meetings of the Council or of the G8 and underline the fact that there is currently a strong interest in, and need to develop, further climate policies until 2020 and beyond.

From an analytical point of view, both policy fields are highly interrelated: transportation accounts for roughly 20% of the EU's carbon dioxide emissions (not including international aviation).[5] The latter is responsible for another 3% and shows the greatest increase among all transport modes. The share of transport CO_2 emissions has been increasing in the past and, according to EU forecasts,[6] CO_2 emissions from the transport sector will continue to increase to 1104 Mt in 2010 and 1158 Mt in 2020, and will only return to their 2010 level in 2030.

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[1] EC: The future development of the common transport policy. A global approach to the construction of a Community framework for sustainable mobility, COM (1992) 494, Brussels 1992, European Commission.

[2] EC: European Transport Policy for 2010 – Time to Decide, Office for Official Publications of the European Communities, Luxembourg 2001, European Commission.

[3] EC: Keep Europe Moving – Sustainable Mobility for our Continent. Mid Term Review of the European Commission's 2001 Transport White Paper, Communication from the Commission to the Council and the European Parliament, Brussels 2006.

[4] N. Stern: The Economics of Climate Change – The Stern Review, Cambridge 2006, UK HM Treasury and Cambridge Press.

[5] EEA: Transport and environment: on the way to a new common transport policy, EEA report No. 1/2007, Copenhagen 2007.

[6] L. Mantzos, P. Capros: European Energy and Transport Trend to 2030 – Update 2005, Report to the European Commission, Luxembourg 2006, Office for Official Publications of the European Communities.

Earlier Commission Communications and the 2001 White Paper put a lot of faith in decoupling transport growth and the resulting emissions from economic growth. However, this is expected to be only partially successful when looking at three groups of transport activities: for passenger transport, the current demographic trends will tend to slow growth in transport demand, except aviation, and together with increasing fuel efficiency and a shift to biofuels this should lead to a decline in CO_2 emissions. Freight transport will undergo significant growth driven by the continued evolution of the EU common market and by globalisation; at best, organisational and technological changes will only manage to keep CO_2 emissions from freight transport at a stagnating level. For air transport, most projections foresee a growth in the range of 3-5 % per annum in the next decades, which overcompensates any organisational or technological improvement. Thus, the CO_2 emissions from aviation can be expected to continue to grow strongly.

Against this background, it is easy to see how slogans such as "surging transport threatens EU Kyoto goals"[7] or "road subsidies hit Europe's emission efforts"[8] make international headlines. However, it is surprising that the interaction between the two policy arenas has not yet been given higher priority in analytical terms. In this article, we use a heuristics for evaluating the interaction of policy fields[9] which distinguishes three levels to discuss whether or not transport policy is neutral, complementary (that is reinforcing) or contradictory to climate policy: first, the interactions of the targets and goals of the policy fields, second, the interaction arising from the logic of the policy instruments, and third, the level of implementation of the policies.

Interaction of Transport and Climate Policy Goals

Transportation policies in the EU are subject to various goals. The 2001 White Paper on the European Transport Policy and the 2006 MTR show the full range of different targets.

- First of all, the transportation sector must be able to meet the mobility and accessibility needs in Europe. Thus, it must offer a high degree of mobility to people and businesses throughout the EU, must eliminate bottlenecks and must connect the EU member states internationally.
- Second, transportation policies should help to protect the environment and to ensure energy security for the EU. This means that mobility should be disconnected from negative external effects.
- Third, transportation policies must promote minimum labour standards and work towards the protection of passengers.

These three different types of goal differ with regard to their interaction with climate policy. Since increasing mobility tends to lead to increased CO_2 emissions, the first type of goal tends to conflict with the goal of climate policy to lower GHG emissions. The second type of goal is clearly complementary to climate policy; the third one tends to be neutral. This result is not surprising. Each policy field tends to have multiple goals, and conflicting and complementary interactions between policy fields are the rule and not the exception. Thus, it is more interesting to look at the importance assigned to each goal, and changes over time. It is especially important to look at the interpretation and rationale of four different cross-cutting issues which substantiate the policy goals and drive any change in their importance: first, the role of energy security; second, the role of the shifting modal split from the perspective of the EU; third, whether or not transport growth is considered to be a framework condition or a variable to be influenced; and fourth, the role that is assigned to transportation policy in supporting the EU goals of full employment and world leadership in terms of competitiveness.

The goal of European energy security has been given more attention recently. High oil prices and the re-concentration of fossil fuel reserves in a few countries are behind this development. The postulation of energy security reinforces the need to improve transport energy efficiency and the shift towards alternative non-fossil based energy sources for transport. This major goal integrates climate policies and transport policies. Its increasing significance is an important development which will make transportation policy more complementary to climate policy.

In the past, shifting transport towards railways has been an important cornerstone of making transport more environmentally friendly. The MTR has changed the focus of EU transport policy from a modal shift in favour of more environmentally friendly modes towards improving the major modes and implementing "co-modality", which means supporting each mode in its strongest market segments. This change tends

[7] Reuters: Surging transport threatens EU Kyoto goals: report, 26 February 2007.

[8] Financial Times: Road subsidies hit Europe's emissions efforts, 22 February 2007.

[9] N. Gunningham, P. Grabosky: Smart Regulation – designing environmental policy, Oxford 1998, Clarendon Press.

to increase the conflict between transport policy and climate policy.

The level of mobility and transportation needs which the transportation sector has to fulfil is strongly influenced by two other high-ranking European goals: building the EU common market and promoting EU cohesion. The common market is a key goal of EU policy. The economic rationale behind this is that a common market will bring about a higher division of labour and that associated productivity will increase, making Europe more competitive and improving the welfare of its citizens. Cohesion policies are imperative to combat regional disparities. If successful, these policies result in a greater dispersion of economic activities within Europe, and counteract the centralisation of activities. This gives rise to additional transportation needs, and transportation policies must accommodate these additional needs – resulting in additional CO_2 emissions.

If additional transport is seen as a necessary consequence of policies increasing productivity and employment, then transportation is interpreted as a framework condition and not as a variable to be influenced. This is especially true because the assessment of the Lisbon goals has led to a renewed interest in streamlining EU policies towards more growth and employment. Thus, the rationale to strengthen the supply side of transportation becomes even more important. However, the question has to be posed whether transportation supply actually forms a bottleneck for economic success. First, the results of Schade et al.[10] neither support the notion that the level of transportation infrastructure in Europe is too low, nor that the transport system in Europe, in general, is less competitive than the US system. Second, this line of argument neglects another important aspect of European competitiveness. Central to Europe's role on international markets are those technologies in which Europe enjoys technological advantages and is able to build a lead market. Policies which generate an early home market for innovations, such as in the case for renewable energy, also enable learning effects and contribute to further innovations and future market success,[11] and ongoing work indicates that sustainable transportation technologies might be good candidates for such a strategy. Europe benefits from considerable technological advantages, especially with transportation-related technologies which also favour the environment. Among them are not only efficient cars and motors, but also railways and supporting infrastructure. Thus, the increased importance of promoting employment policies does not necessarily lead to a trade-off with climate policy efforts. Indeed, in line with the major goal of EU energy security, the specific contribution of transportation policies to employment and growth might be exactly such a strong focus on environmentally friendly transportation systems, increasing energy efficiency, and the use of biofuels and hydrogen, all of them coupled with the introduction of strong and smart regulations to ensure early diffusion and learning in the home market.

Thus, to sum up the argument so far, the interaction between transportation and climate policy goals shows both conflicting and complementary aspects. The increasing role of energy security will move both fields closer together. Other developments in transportation policy, however, such as the call for co-modality, seem to strengthen the perception of the conflicting goals. Part of this can be attributed to the increased importance of policy areas outside typical transportation policies, such as the focus on the increasing competitiveness of the EU. However, transportation policy must also recognise that it can play an important role as a "green" industrial policy which fosters innovative climate-friendly technologies in all modes, and thus benefits the growth and competitiveness of the EU.

Interaction of Instruments in Transport and Climate Policies

The conflicts and synergies arising from the logic of instruments are analysed by grouping them into five categories: economic instruments, liberalisation, subsidies, transport planning and investments, and technological standards.

Economic instruments include pricing, taxation and cap-and-trade-systems. Transportation and climate policies have experienced a similar trend, with both policy arenas moving towards the greater use of economic instruments. These economic instruments make it possible to steer transport demand and thus make it more compatible with climate protection policy under the prerequisite that the latter is adopted as a priority goal. So far, the economic instruments used in transportation policy have been implemented mainly to introduce the user pays principle in order either to pay for existing or new transport infrastructure, or to tackle congestion. Taxation policies have been implemented to generate funds for the general government budget

[10] W. Schade et al.: COMPETE – Analysis of the contribution of transport policies to the competitiveness of the EU economy and comparison with the United States, Report of Fraunhofer ISI, Karlsruhe 2006.

[11] R. Walz: Increasing Renewable Energy in Europe – impacts on competitiveness and lead markets, in: Energy & Environment, Vol. 17, No. 6, 2006, pp. 951-975.

and have been adapted to partially include a fraction of the external (environmental) cost of transport, but not its full cost (see below). Recently, the discussion has moved in the direction of using economic instruments in the transportation sector explicitly to reduce CO_2 emissions. In particular, the taxation of fossil fuels is seen as manageable and hence the most appropriate instrument to internalise the climate impacts of transport. Cap-and-trade systems for the CO_2 emissions of transport constitute the most obvious connection between transport and climate policies. Three variants of such systems are being discussed: upstream systems requiring certificates from the suppliers of fossil fuels, midstream systems requiring them from the vehicle manufacturers and downstream systems requiring them from the transport users. The manageability and the impact of the three variants on transport users vary, while the impact on CO_2 emissions is defined by the cap. To sum up, there are concepts for using economic instruments which would render transport policy and climate policy very complementary, but whether they are implemented will depend on the political economy and the importance attached to climate protection.

For the three instruments liberalisation policies, subsidies and investment programmes, the interaction with climate policy is similar. On the one hand, they aim at increasing the ease of transport, which may lead to additional transport and CO_2 emissions. On the other hand, depending on the specific circumstances and the implementation, they can also be complementary to climate policy.

- If liberalisation benefits a modal shift towards less carbon intensive modes, it is complementary to climate policy. The early liberalisation of road transport contributed to the shift away from railways, but the liberalisation and interoperability of the latter sector is expected to level the playing-field between these modes (see below).

- According to the results of Best et al.,[12] transport subsidies tilt the level playing-field among transport modes and EU countries. Many of them have negative social and environmental impacts. However, the subsidisation of less CO_2 emitting modes or increased fuel efficiency is complementary to climate policy.

- Targeted investment programmes could reduce CO_2 emissions by shifting demand to less CO_2 emitting modes. From a climate policy point of view, which aims at stronger modal shift, rail and port investments should be fostered, while road and airport extensions should be kept to a minimum to avoid the most severe bottlenecks. Recently, the EU has made a huge attempt to strengthen the market position of railways by co-financing trans-European rail links. Thus, on the European level, this type of instrument has mostly been complementary to climate policy.

Technological standards in transport have been proven to be successful in decreasing adverse environmental impacts. The emissions of air pollutants from transport have been reduced by several orders of magnitude since the introduction of the first catalytic converters and the Euro emission standards for cars. A similar approach in line with climate policy could limit the CO_2 emissions of cars. Two difficulties have to be overcome. First of all, the political pressure, and second, there are numerous "soft context factors" which determine the effects of such an instrument and which require careful policy design.[13] One particularly important factor is the long-term orientation of the policies. Standards must be dynamic over time in order to continuously give technology providers the incentives to innovate, and this development must be known well in advance so that the innovation system can adapt to the requirements early on.

To sum up: economic instruments can be complementary to transport and climate policies; liberalisation, subsidisation and investment programmes have to be targeted at shifting modes or increasing efficiency in order to make them complementary and technological standards could work for climate policy with only negligible impacts on transport demand.

Interaction of the Implementation of Transport and Climate Policies

The interaction of transportation with climate policies also depends on the implementation of the policy instruments. The state of implementation of EU transport policies differs among the instruments, modes and countries.[14] This paper can touch on only a few of these measures which seem to be particularly relevant for the interaction between transport and cli-

[12] A. Best, B. Görlach, E. Interwies, U. Becker, R. Gerike, A. Rau: The Use of Subsidies, Taxes and Charges in the EU Transport Sectors, Final draft report to the European Environmental Agency (EEA), Copenhagen 2007.

[13] R. Walz: Innovation effects of energy policy instruments in Germany, in: Energy & Environment, Vol. 15, No. 2, 2004, pp. 249-260.

[14] G. de Ceuster et al.: ASSESS – Assessment of the contribution of the TEN and other transport policy measures to the mid-term implementation of the White Paper on the European Transport Policy for 2010, Final Report, Leuven/Brussels 2005.

mate policies: transport pricing for all modes, fuel tax harmonisation and subsidies for alternative fuels, the liberalisation of railways and technological standards for road vehicles.

In general, the Commission has promoted the application of marginal social cost prices in all modes in order to decrease environmental burdens, to promote clean modes of transport and to increase the overall efficiency of infrastructure use. But the concept includes a number of pitfalls, and abstracts from financing needs, the long-term effects of investments and data availability. Accordingly, operating with deviations from marginal social cost pricing is frequently suggested, including average cost based, peak load or Ramsey tariffs. This diversity of approaches is reflected in practice when looking both at EC directives and the actual implementation in the member states. While Directive 38/2006/EC requires the application of road user charges to equal average infrastructure costs for the trans-European network, including the costs for planning, construction and financing, Directive 14/2004/EC calls for the application of marginal social cost based tariffs in the railway sector. Consequently, in the case of road charges, member states follow different strategies and traditions, ranging from kilometre-based motorway tolls according to the environmental standards of the vehicles (Germany) through private motorway concessions (France, Italy, Spain, Portugal and Austria), vignette solutions for HGVs (Belgium, Netherlands, Luxembourg, Denmark, Sweden, Hungary) up to no charge at all. In the railway sector, the Scandinavian countries apply marginal social cost based track access charges, while central and southern European countries apply full cost schemes. However, none of these transport charges is specifically designed to be complementary to, or to specifically support, climate policy. Nevertheless, two examples demonstrate that pricing policies could be better linked to environmental impacts and to climate policy. First, the German HGV toll differentiates the charges for trucks according to environmental performance standards; this example calls for including the CO_2 emissions as well. Second, the London congestion charge discount for clean vehicles like hybrids or alternatives demonstrates how users and manufacturers react to environmentally motivated incentives and provide and use more environmentally compatible vehicles. These cases show that pricing and regulation can be beneficial to climate policy. However, in order to make these policies complementary to climate policies, unequivocal signals are necessary. Thus, it represents a major challenge to introduce climate protection imperatives in the full range of the different pricing approaches. There is a nucleus to start from, but much wider application is necessary.

There is also a great deal of distortion within the European Union and among the transport modes with regard to taxation. Some of these distortions are in strong contradiction to climate policy. The most prominent issue is the aviation sectors' exemption from fuel excise duties, which provides an incentive for strong growth. The aviation sector's case is due to the international agreement of Chicago dating back to 1944 and about 130 follow-up agreements on international air traffic. The EC proposal to include inter-European air travel from 2010 and international aviation from 2011 now attempts to address the climate problem of this sector from a European perspective. But also in road haulage, the different fuel, vehicle acquisition and vehicle registration tax rates indicate that the Community is still a long way away from a unified taxation policy which also addresses climate issues. Two improvements can be observed: first the definition of minimum tax rates for transport fuels recently proposed by the EC,[15] which explicitly mentions the reduced environmental impacts, and the tax reductions for biofuels and other alternative fuels, which are favourable in terms of lowering the CO_2 emissions from transport.

The free access to international haulage markets obtained by removing internal European border controls and the relaxation of cabotage rules has boosted road shares in the freight transport markets of the new member states, but also throughout western Europe. To slow this trend or even reverse it, an equally effective liberalisation in the rail sector is necessary. The example of the USA, where railways carry a much higher share of freight transport, should also work in the EU. In liberalised markets, freight rates decline faster and accordingly rail market shares perform better than on protected networks.[16] But a powerful European rail market requires the opening of the still nationally dominated networks to private sector competition. Since the second monitoring report on network access and liberalisation,[17] a number of railway network operators

[15] EC: Proposal for a COUNCIL DIRECTIVE amending Directive 2003/96/EC as regards the adjustment of special tax arrangements for gas oil used as motor fuel for commercial purposes and the coordination of taxation of unleaded petrol and gas oil used as motor fuel, Brussels 2007, European Commission.

[16] Deutsche Bank Research: Competition in European Railway Markets – Morning has broken, EU Monitor 39, Frankfurt/Main 2006.

[17] IBM Business Consult: Rail index 2004 – Comparison of the market opening in the rail markets of the Member States of the European Union, Switzerland and Norway, Summary report in conjunction with Humboldt University, Berlin 2004.

have given access to private rail carriers as EC legislation requires the full opening of national rail markets to competition from 1.1.2007 on. First alliances are emerging, such as "Railion," which provides a very successful freight traffic service from Scandinavia to Italy. But the newcomers' access to profitable markets remains limited as some national rail companies have still not yet separated the networks from service operations. Furthermore, interoperability is a pre-condition for competition.[18] This requires additional technical interoperability measures and at least some level of tariff harmonisation in order to make railway liberalisation more complementary to climate policy.[19]

The EU has a long history of technological standards and regulatory attempts to enhance the sustainability of the transport sector. The harmonisation of exhaust emission standards of road vehicles, with the standards becoming more and more ambitious over time, is the best known example. This approach also has an enormous potential for reducing CO_2 emissions.[20] However, the history of the debate within Europe also shows the problems associated with implementing such a policy. In its renewed EU Sustainable Development Strategy, the Council reaffirmed the 120 g/km CO_2 target for the average new car fleet in 2012. Disappointment with the progress achieved under the voluntary commitments by European, Japanese and Korean automobile manufacturers' associations has led the Commission to announce that it will propose binding technical standards.[21] However, the debate about the level of emissions standards shows how hard it is to overcome political obstacles. Perhaps even more important is the lack of a clear medium to long-term perspective of the standards. In 2005, the EU Parliament already called for mandatory limits in the order of 80-100 g/km for new vehicles in the medium term. In the review of the Community strategy to reduce CO_2 emissions from cars,[22] it is stated that further reductions after 2012 will also be explored. However, there is neither a clear statement about the binding nature of future targets nor about their stringency, but only a vague declaration that the EU will support research efforts aiming at a new car fleet average of 95 g CO_2/km in 2020.[23] It is exactly this uncertainty of the future development of technical standards which must be overcome in order to make technical standards an important driver of the innovation processes. EU policymakers must grasp that standards not only push technology diffusion, but are also a tool for demand-oriented innovation policy which can be used to shape the development of technologies and new markets.[24]

Making Transport Policy Complementary to Climate Policy

Following our line of arguments, transport and climate policies need not be contradictory. However, the status of policy implementation (e.g. not including climate protection in pricing and internalisation policies, tax exemptions for aviation), the timing of policies (e.g. road liberalisation much earlier than rail liberalisation) and the lower importance attached to shifting modes hinder the implementation of instruments capable of profiting from all the potential synergies between the two policy fields. Lately, the increasing importance of the security of energy supply, the push for the liberalisation of the railways and the proposals for changing tax policies and introducing mandatory CO_2 standards are clear signs for developments to reduce the conflict between transport and climate policies. However, in order to make transport and climate policy really complementary, the relationship between traditional growth policy and transport policy must be reversed. As long as economic growth policy is strongly linked with the conventional growth of transport demand and not with raising the growth potential inherent to "green" innovations in the transport system, transport policy will be in conflict with climate policy. Instead, Europe should focus on "green" transport innovations and on making Europe a lead market in these fields in order to reconcile growth, transport and climate policy. For policymakers, this requires transforming the traditional sectoral policy approach into a much more systemic approach which accounts for the numerous "soft context factors" within the innovation system of transport technologies.

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[18] W. Rothengatter: Issues of Interoperability in the European Railway System, in: INTERECONOMICS, Vol. 41, No. 6, 2006, pp. 306-311.

[19] Ibid.

[20] W. Schade, C. Doll, L. Müller, N. Helfrich: Politikszenarien für den Klimaschutz im Verkehr, Working Paper, Fraunhofer ISI, Karlsruhe 2007.

[21] EC: Results of the Review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles, Communication from the Commission to the Council and the European Parliament, COM(2007) 19, Brussels 2007.

[22] Ibid.

[23] Ibid.

[24] K. Blind, B. Bührlen, K. Menrad, S. Hafner, R. Walz, C. Kotz: New Products and Services: Analysis of Regulations Shaping New Markets, Luxembourg 2004, Office for Official Publications of the EU; Fraunhofer Institute for Systems and Innovation Research: Nachfrageorientierte Innovationspolitik, TAB Arbeitsberichte No. 99, Berlin 2006.