Greenhouse gas emissions trading and complementary policies.

Developing a smart mix for ambitious climate policies

Report commissioned by

German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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Berlin, June 2010

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Summary

A debate has – most notably as a result of the introduction of fixed caps within the framework of emissions trading – been raised about the need for using additional instruments of climate and energy policy. A common line of argument is that the targets set within the emissions trading scheme are going to be met with a high degree of certainty, and flexibility among the regulated stakeholders will lead to market-based discovery processes. Additional instruments would only generate additional costs and would therefore have to be rejected.

However, closer analysis of these fundamental arguments shows that they are constructed on a very high level of abstraction and sometimes rely on strongly simplifying or idealising assumptions. Their theoretical assumptions are, at least in part, very questionable and do not correspond to conditions in the real world for climate and energy policy.

At the same time the debate about policy instruments cannot be held autonomously of the specific context of the problem at hand. In this sense the very extensive (complete) and above all effective decarbonisation of the economies of industrialised countries in a comparatively short time frame is the key basic condition for the analysis, assessment and design of the climate policy mix. Essentially, the question is what the best instruments are for purging the whole economic system almost entirely of CO_2 emissions within a period of only forty years.

The introduction of emissions trading schemes for greenhouse gases in an increasing number of OECD countries undoubtedly constitutes an important landmark of climate policy. They:

- provide a high degree of certainty in terms of meeting targets;
- create, on the basis of a standardised price signal, a clearing mechanism for the broad spectrum of emission reduction options close to the market, at least in the short to medium term; and
- represent, by means of linking, an interesting option in terms of the globalisation of climate policy.

Closer examination of the practical implementation of the European Union Emissions Trading Scheme (EU ETS) shows very clearly that substantial differences to an ideal type of emissions trading scheme have to be taken into account, which can or should only be eliminated in the longer term or, for practical reasons, not at all.

Further, analysis of the market development of the EU ETS up to now demonstrates that a strategic, robustly developed climate policy which meets the ambitiousness described also has to factor in the possibility that an emissions trading scheme *cannot* produce any long-term scarcity signals for different reasons (e.g. continual opportunities for revision in democratic systems, operational realities) and can thus always only serve the – essential – purpose of clearing emission reduction options close to the market which are available in the short to medium term.

In this respect a number of considerations support the necessity and legitimation of complementary instrument approaches:

1. For reasons of effectiveness, but also of dynamic efficiency, well-directed measures for increasing radical innovations (backstop technologies of ambitious climate protection strategies, such as many renewable energies or CCS technology) are necessary. The range of instruments suited to this end span both supply- and demand-side innovation approaches and include targeted research funding and early market introduction programmes (e.g. the German Renewable Energy Sources Act). For the concrete – and necessarily dynamic – development of instruments, it is crucial that the fulfilment of innovation policy targets is made verifiable through effective guidelines and corresponding monitoring.

2. Many of the (foreseeable) emission reduction options to be realised in ambitious climate policies entail high investments in infrastructure (transmission grids and smart grids for electricity, CO_2 pipeline networks). However, experiences gathered with infrastructure development show that extensive re-organisation of infrastructures cannot occur in the form of private initiatives only – the public sector has to play a fundamental role. Energy infrastructure will also have to be increasingly seen as a public sector task. Furthermore limiting incentive systems to consistently technology-neutral ones (e.g. emissions trading) would render the whole re-design of the power system ineffectual in many areas (e.g. offshore wind energy or e-mobility) due to the long lead times for the essential re-design and expansion of infrastructures. Complementary instruments in conjunction with (necessary) infrastructural development – e.g. planning, risk hedging and within the context of the general regulation of infrastructure – thereby constitute a second, strategically essential approach to developing a robust climate policy.

3. A number of climate options are – in spite of their high (national) economic attractiveness – not implemented due to diverse barriers and preferences geared to other ends (above all, energy-saving measures). The range of instruments that are useful and necessary in this context is also broad, encompassing not only regulations and standards (for highly standardised applications such as buildings, electrical appliances and vehicles), but also support programmes and measures for structural barriers (information, adjustments of provisions within rental law). The range of appropriate instruments can and should also incorporate specific market-based approaches (e.g. white certificates for energy savings). At the same time, a cost-benefit test needs to be carried out prior to implementation of these complementary instruments.

4. The necessity of decarbonising an existing energy or economic system which involves very capital-intensive or durable capital stock in important areas in a comparatively short time frame can necessitate the well-directed change of market design and/or the creation of new sub-markets, which in combination with carbon pricing would only then make possible the implementation of low-

emission solutions in the specific context of competition (e.g. capacity or storage markets as an addition to current bulk energy markets based on energy amount).

5. Since emission trading schemes that are currently being implemented or are under development will (have to) remain incomplete in terms of the sectors and areas covered, at least in the years ahead, complementary measures are necessary to improve the effectiveness of the emissions trading scheme, e.g. with regard to combined heat and power or to combat leakage effects. A (significant) sectoral expansion of, for example, the EU ETS is basically conceivable, yet a comprehensive suitability assessment is still required for important issues. Taxation could be considered as an alternative option.
6. In the case of sectors for which the robust and consistent determination of emission data is not possible (agriculture, forestry, land use, and land use changes), regulatory or support instruments will have to be used while a cap-and-trade instrument like emissions trading inevitably requires reliable data to be available under very tight tolerance limits for data uncertainties.
7. For a number of the issues discussed within the scope of complementary instruments for the emissions trading scheme (innovation, infrastructure, potentials hindered by barriers, etc.), specific solutions also have to be developed for the sectors not covered by emissions trading or corresponding taxation.

At the same time, there are also objectives originating in other fields of policy which can and should be integrated in climate policy on a strategic and instrument level:

8. In order to limit the vulnerability of consumers and economies to high and – above all – volatile energy prices determined via global commodity markets, and increase security of supply, energy efficiency measures which have their own targets and approaches to instruments are particularly effective.
9. Well-directed approaches to strategies and instruments can contribute to the development of lead markets, the strengthening of specific business locations, and acceleration of the process of ecological modernisation.
10. Rents arising for sellers of emission allowances as a result of the introduction of cap-and-trade instruments can sometimes make well-directed interventions based on distribution policy necessary; they can also be implemented using complementary instruments.

In summary it can be concluded that against the background of the empirical findings that have been made available up to now and especially against the background of the (necessary) ambitiousness of future climate policy, effective climate protection can only be achieved through the interplay of different instruments. A balanced mix of an emission trading system, or other measures of carbon pricing, and other instruments is urgently needed. It is not expected that severe efficiency losses will result from the implementation of additional strategies and instruments to complement emissions trading.

On the basis of careful analysis and comparison of the different approaches to possible action, inefficiencies which arise from certain combinations of instruments can be circumvented.

Should the foundations for the use of complementary instruments change or disappear, these instruments would have to be adapted or even abandoned. Clear reasoning or specific targets, accompanied by constant monitoring and evaluation of the complementary instruments of energy and climate policy are therefore important to the creation and development of a comprehensive, effective, economically efficient, robust, politically achievable, and inclusive climate policy mix.

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1 Introduction and background

Since climate policy established itself as a distinct (national) policy field, wide-ranging bundles of measures are being continually adopted within it to implement fixed emission reduction commitments. As early as the publication of the report prepared by the CO_2 reduction inter-ministerial working group – on 7 November 1990 after the first basic resolution of the German government was passed on 13 June 1990 to reduce CO_2 emissions to 25% below 1987 levels (the base levels used at that time) and appoint an inter-ministerial working group – a focus was placed not only on emission reduction targets, but on a broad panoply of instruments of climate and energy policy. Both the range and degree of intervention of the complete portfolio of climate policy instruments have been substantially expanded in the two decades of German climate policy that have passed since. On the one hand this can be traced back to climate targets[1] tightened over the course of time, and their binding nature under international law[2]; on the other hand, it is also due to the incorporation of all emission sources and the highly differentiated approaches to intervention. As a result of the implementation of the European Union Emissions Trading Scheme (EU ETS) in 2005 and the substantial revisions introduced in December 2008 for the period up to 2012, however, the framework conditions for climate policy have radically changed in two key ways:

- With the EU ETS, an extensive cap-and-trade scheme was introduced for the first time. This covers a major share – currently approx. 50 % – of the total greenhouse gas emissions of Germany.
- Upon the introduction of an EU-wide cap-and-trade scheme, more flexibility has been introduced in Europe to meet targets. As a consequence the emission reductions of Germany do not necessarily have to be realised within the country itself. Moreover, through the flexibility provided by the project-based mechanisms of the Kyoto Protocol (Joint Implementation, Clean Development

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1 Besides the 25% reduction target for CO_2 emissions up to 2005 (initially compared to 1987 levels, updated in 1995 to 1990 levels – neither reduction target was met), these climate targets are: the reduction commitment agreed in 1997 with the framework of EU burden trading whereby all greenhouse gases covered by the Kyoto Protocol are to be reduced by 21% compared to the base year of the Kyoto Protocol (1990 for CO_2, methane and laughing gas; 1995 for fluorinated greenhouse gases); the reduction commitment agreed with conditions in the German coalition agreement of 2002 whereby emissions are to be reduced by 40% by 2020 compared to 1990 levels (should the EU agree to a 30% reduction; otherwise the commitment is only for a 30% reduction); and the commitment agreed without conditions in the German coalition agreement of 2009 whereby emissions are to be reduced by 40% by 2020 compared to 1990 levels.

2 This includes the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which was negotiated in 1997, came into effect in 2004 and covers targets up to 2012; the corresponding agreements on target differentiation within the EU; the EU Energy and Climate Package decided upon in December 2008, which includes targets up to 2010; and the upcoming international agreements on targets for 2020 and beyond.

Mechanism), a limited share of emission reductions can even be realised outside of the European Union.

A debate has – most notably as a result of the introduction of fixed caps within the framework of emissions trading – been raised about the need for using additional instruments of climate and energy policy. If it can be assumed that the targets set within the emissions trading scheme can be met with a high degree of certainty, and flexibility among the regulated stakeholders leads to market-based discovery processes, additional instruments would only generate more costs and would therefore have to be rejected. The key strands of this discussion concentrate specifically on the promotion of renewable energies in Germany; at the same time, however, other measures of energy and climate policy (a ban on incandescent light bulbs, promotion of the replacement of night storage heaters, etc.) have also been addressed. The discussion on the legitimation and design of an energy and climate policy mix has taken on a new dimension with the practical introduction of the first ambitious cap-and-trade scheme. The basic objections to complementary instruments require appropriate analysis and classification.

Against this background this discussion paper will present considerations on different levels. In chapter 2 the various discursive approaches to the debate are presented. Section 2.1 provides an overview of the theoretical debate about emissions trading and complementary instruments. In section 2.2 the question of what consequences emerge from the specific nature of the climate problem for the debate on instruments is addressed. Section 2.3 comprises a discussion on several aspects derived from practical experiences gathered with the EU ETS to date. In chapter 3 corresponding conclusions are drawn for the design of approaches to developing effective instruments. Section 3.1 will focus above all on the starting points of climate policy; section 3.2 will subsequently examine the question of the areas in which it may be possible to replace complementary instruments by developing a broader framework for the emissions trading scheme. Relevant aspects originating in other policy fields are taken into consideration in section 3.3 and the resulting need for coordination are discussed with reference to the energy and climate policy mix in section 3.4. Lastly, selected conclusions will be presented in chapter 4.

The work presented here is the result of a wide-ranging discussion and comment process with a number of colleagues. Special thanks are due to Patrick Graichen and other colleagues from the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Christoph Kühleis, Kai Kuhnhenn and Benjamin Lünenburger (German Federal Environment Agency), Jochen Diekmann (German Institute of Economic Research), Joachim Schleich (Fraunhofer Institute for Systems and Innovation Research), Uwe Leprich (Saarland Institute for Future Energy Systems), Katja Schumacher, Hauke Hermann and Martin Cames (Öko-Institut) and Hans-Joachim Ziesing. This paper has been translated into English by Vanessa Cook (Öko-Institut).

Any errors or inaccuracies remain the sole responsibility of the author.

2 Key dimensions of the discussion

2.1 Theoretical discussion of emissions trading and complementary instruments

A first facet of the theoretical discussion on the relationship of emissions trading and other policy instruments is geared – with some different characteristics and priorities – towards a very fundamental level[3]:

- If there is a fixed emission cap, the separate promotion of renewable energies, energy efficiency, CHP, etc. would not lead to additional emission reductions in the overall system.[4]
- On their own complementary policies and measures would increase the costs of meeting emission targets, thereby eroding the cost efficiency of climate policy as a whole.
- Implementing certain emission reduction options by means of additional instruments would lead to lower CO_2 prices for emissions trading and thereby decrease investments in and/or innovation efforts aimed at low emission technologies in sectors and segments covered by emissions trading; it would also lead to higher costs for GHG emission reduction.
- Lastly it is also argued that complementary instruments introduced alongside the emissions trading scheme could, particularly in the European arena, impair acceptance of climate policy.

The starting premises and derivation of conclusions differ in part and are not always – in themselves and in comparison – unambiguous. However, what the different lines of argument in the above-mentioned analyses have in common is that they are constructed on an exceptionally abstract level and sometimes rely on strongly simplifying or idealising assumptions which can, at least in part, be challenged and do not always correspond to conditions in the real world for climate and energy policy. These aspects shall be addressed in more detail below.

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[3] Above all these include the statements made by the Council of Experts to the German Federal Ministry for Economics and Technology (WB BMWA 2004, WB BMWi 2008) as well as those of Weimann (2008), Blankart et al. (2008), Sinn (2008+2009), the Kronberger Kreis academic research group (Donges et al. 2009), the German Monopolies Commission (2009, pp. 39-41), RWI (2009), Herzog et al (2010) and the Council of Experts to the German Federal Ministry of Finance (WB BMF 2010). Lines of arguments which concern the interactions between leading climate policy measures, international fuel markets, and international negotiation processes, and regarding the allegedly associated counteraction of other climate policy measures, ands which have also sometimes been tabled, are not discussed further in the following.

[4] However, this is inconsistent with the concurrently expressed demand of the Council of Experts to the German Federal Ministry for Economics and Technology (WB BMWi 2008) to introduce price caps for emission allowances.

Analyses which examine the relationship between (national) energy policies and the EU ETS based on a broad approach pursue a considerably differentiated approach. Such analyses apply, for example, the following lines of argument[5]:

1. With a view to a cost-efficient CO_2 reduction policy, it is not possible to legitimate complementary instruments from a very general perspective. They would not lead to additional emission reductions and when perfect framework conditions are assumed (i.e. excluding market failures which go beyond the external costs arising from GHG emissions, etc.), they lead to higher costs for society.
2. Nevertheless complementary policies and measures can be legitimated, taking into account cost efficiency, on the basis of four reasons:
    - to improve the flanking of the emissions trading scheme (in its real-world design – see chapter 2.3);
    - to compensate further incidences of market failure which should be addressed as static efficiency (e.g. information asymmetries or market power which hinder the implementation of principally economic potentials), as long as the corresponding measures can be legitimated by a cost-benefit test;
    - to compensate for market failure related to dynamic efficiency (e.g. in terms of the development and market introduction of technologies which reduce the future costs of emission reduction); and
    - to fulfil other objectives of energy, climate or economic policy (ranging from distribution issues to security of supply).

This short outline of the essentially theoretical debate alone shows that the analytical framework chosen in each case is crucial. Comparison of these very general (and very idealising and abstract) lines of argument which draw on differentiated approaches strongly underlines the following:

- First of all, the extent to which key assumptions of the neo-classic model (that the decision-making of economic subjects is completely rational, the existence of perfect foresight, that some transaction costs can be ignored, there is no difference between social and private discount rates, etc.) sufficiently reproduce the real conditions of the economic segments affected by the climate problem can generally be questioned.
- The range of market failure characteristics which need to be taken into account in developing an effective and – in a statistical and dynamic sense – efficient energy and climate policy is significantly more wide-ranging than is generally assumed in the analyses summarised above. Alongside the so-called negative

[5] See, for example, – with different focuses – Sorrell/Sijm (2003), Sijm (2005) or Fischedick/Samadi (2010).

externalities (i.e. making demands on the atmosphere at the expense of third parties), additional characteristics of market failure (asymmetrical information, market power, other structural barriers such as the user-investor problem, instabilities, etc.) should be taken into consideration. Moreover, so-called positive externalities (such as the impact of innovations that are not automatically rewarded in markets) should also be addressed accordingly.

- Furthermore, the question needs to be raised of whether efficient resource allocation as a key function of the neo-classical model can be applied as the sole assessment factor in the real world. Distribution issues, practicability, effectiveness, system conformity (in a legal and economic sense), and the robustness of the market makes for a very dynamic environment and when long-term capital formation plays a strong role, etc. cannot be excluded from the design of a real-world policy field if there is a substantial long-term capital commitment.
- The extent to which there may be an equivalent in the real world of the implicitly idealising model of an emissions trading scheme – above all founded on arguments constructed on an exceptionally abstract level – should also be considered (see chapter 2.3).
- A useful, well-directed debate about the development of instruments for a particular policy goal cannot be conducted independently of the time and regional characteristics of the problem at hand or the corresponding counter-strategies (see chapter 2.2). Specific consideration of the ambitiousness of the targets and the time available for implementing them has substantial consequences for, on the one hand, the scope of search processes and, on the other hand, the significance of possible efficiency losses of the second- or third-best solutions (to the extent that they are characterised as such from a theoretical perspective).

The general considerations mentioned above underline that the practical design of energy and climate policy must have a broad horizon in view. Its design cannot be confined to largely abstract considerations of principle within the context of idealising framework conditions. At the same time a broader horizon of legitimation for energy and climate policy also requires a concrete foundation. The incidences of market failure addressed in each case have to be specified; the corresponding measures should also be subjected to a cost-benefit test and the innovation effects to comprehensive monitoring. Only in this way can it be avoided that a one-dimensional discussion is replaced by approaches where the instruments are arbitrary.

2.2 The specific problem of global warming

Discussions on the appropriate design of a policy mix for a particular field cannot be abstracted from the concrete problem requiring a solution. The challenge of climate protection contains a number of specific characteristics based on which restrictions or the degree of flexibility for the practical policies and measures are determined. Such restrictions and the degree of flexibility must be incorporated in the analysis when the robustness of certain political instruments is being assessed. At the same time they are of not unsubstantial importance to the classification of any efficiency losses or distribution effects.

Three aspects are particularly important for political counter-strategies, especially in the context of the global warming challenge:

- the ambitiousness of emission reduction targets overall (which has consequences for the classification of basically feasible technical and structural options);
- how ambitious the time frame is in which emission reductions have to be realised (which has consequences for the restrictions or degree of flexibility resulting from the "lifetime" or necessary approach of the different reduction options); and
- expectations of opportunities for improving flexibility in the realisation of emission reductions in an international context (i.e. the opportunity to reduce emissions in other regions, to use these reductions to help fulfil domestic targets and, in this way, relaxing restrictions which may arise from the afore-mentioned points).

In recent years analysis of anthropogenic climate change has significantly increased pressure for intervention:

- The target of limiting the global mean temperature to a level of below 2°C (compared to pre-industrial levels) is increasingly becoming an appropriate and accepted goal.[6]
- Within the climate debate in research the budget approach is increasingly becoming more important in the context of greenhouse gas emissions still permitted within the framework of the 2°C target. According to recent model calculations (Meinshausen et al. 2009), the emission budget for the period of 2000-2049 still amounts to approx. 1,000 bn t CO_2 or 1,500 bn t CO_2-eq for all greenhouse gas emissions, with a 75 % probability of meeting the 2°C target. On this basis WBGU (2009) has determined a global CO_2 emission budget of 600 bn t CO_2 for the period of 2010 to 2050, with a 75% probability of the target being met.
- In light of the particular responsibility accorded industrialised countries (which cause by far the largest share of total historical emissions[7]), industrialised

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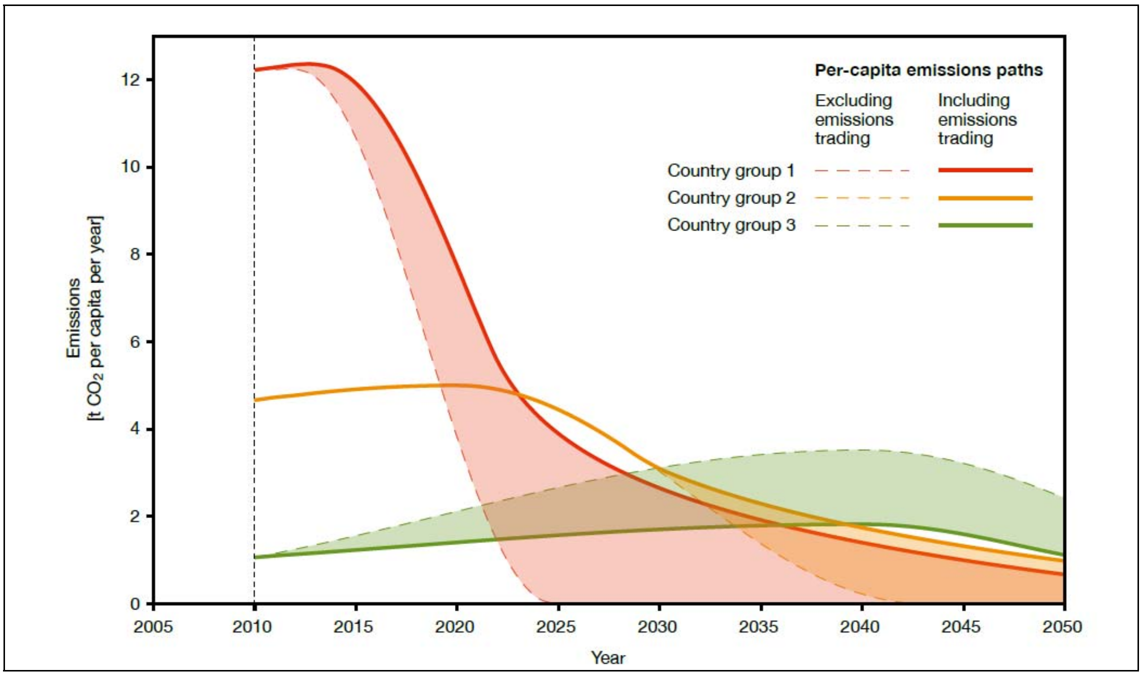
6 For a classification of climate science see Richardson et al. (2009); for a classification of climate policy, see G8 (2009) and MEF (2009).

7 In 2005 the share of OECD countries and Russia of the cumulated CO_2 emissions from the combustion of fossil energy carriers since 1900 amounted to approx. 80% (approx. 35 percentage points of which came from North America and approx. 27 percentage points from

countries would have to reduce their own greenhouse gas emissions to zero as well as finance substantial emission reductions in developing and newly industrialising countries. However, the growth in emissions in developing and newly industrialising countries would also have to be drastically reduced (WBGU 2009).

Figure 1 Emission paths according to the WBGU carbon budget approach, 2005 to 2050.



Source: WBGU (2009)

Figure 1 clearly shows, on the basis of an example, the implications of the carbon budget approach for the necessary emission reductions of different country groups (shown as per-capita emissions). For industrialised countries (red lines) CO_2 emissions would have to be reduced by over 90% up to 2050; the main share of emission reductions would need to be achieved by 2030. Emission reductions achieved in other countries via emissions trading or other transfer mechanisms are not counted in these emission reductions. For newly industrialising countries like China (orange lines), per capita emissions decrease from 2020 onwards and move onto a radical decarbonisation path from 2030 onwards. Further substantial reductions have to be achieved on the basis of international flexibilisation mechanisms (emissions trading, etc.), which

European OECD countries). In a situation of unbroken growth of emissions, e.g. according to the pattern of emission development given by the World Energy Outlook of IEA (2009), the share of industrialised countries would – according to my own calculations – still amount to approx. 60 % in 2025 (24 percentage points of which come from North America and approx. 17 percentage points from the European OECD countries).

nevertheless should not supplant the need for decarbonisation domestically. For developing and newly industrialising countries which have very low per-capita emissions (e.g. India) the per-capita emissions could roughly treble by 2040 (green lines). However, taking into consideration the global emissions trading scheme or other transfers, the emissions of these countries would also effectively have to be reduced to a level of below 2 t CO_2 per capita.

When the politically agreed 2°C target and the carbon budget approach of WBGU are used to form the climate strategy, a number of important framework conditions arise for the design of the climate policy mix:

- Adherence to the global greenhouse gas budget will involve extensive use of international flexibility mechanisms (e.g. via a global emissions trading scheme). This will especially be the case for industrialised countries of Annex 1 (which would also have to completely decarbonise their economies by the third decade of the 21st century) as well as for Annex 2 countries (whose minimum requirements would be slightly reduced at times by transfers).
- However, for 2050 and taking into consideration improved international flexibility in bringing about emission reductions, extensive decarbonisation will have to be achieved in Annex 1 countries (and to a slightly lesser extent in Annex 2 countries). The substantial emission base that remains in industrialised countries when emission reductions are achieved abroad thus tends to be, on the one hand, more counter-productive than effective in tackling the problem at hand. At the same time the consequences of any efficiency losses which can arise from the combination of certain instruments are to be regarded as generally low for substantial emission reductions of this kind (when the targets are met effectively).[8]
- The goal of extensive decarbonisation of the economies of industrialised countries has two wide-ranging implications. Firstly, production and consumption patterns that are almost entirely free of emissions have to be realised in almost every sector. The variety of options to chose from to this end is not unsubstantial; however, their costs can be estimated, at least approximately, and easily compared (Prognos/Öko-Institut 2009, McKinsey et al. 2010). Secondly important fields of action involve either directly (buildings, power plants) or indirectly (infrastructures) capital stock, the normal technical and economic lifespan of which is about the same order of magnitude as the overall time available for meeting the reduction targets (approx. 40 years). Against this background the opportunities for “trial and error” search processes are limited.

When the focus is placed on the specific problem of global warming, the very extensive (complete) and above all effective decarbonisation of economies in industrialised countries in a comparatively short time frame constitutes a key framework condition for the

[8] See, for example, Golkowsky (1997) or Goulder et al (1999).

analysis, assessment and design of the climate policy mix, particularly with a view to possible reduction options, the period of time in which action can be taken and the lead time required for these changes.

2.3 EU Emissions Trading Scheme as a real-world reference

Against the background of the fact that many discussions about the climate policy mix refer to a rather abstract model of an emission trading scheme, it is useful and necessary to pay careful attention to the concrete design of emission trading schemes which have been implemented in the real world or are in development:

- Time frame: Although both the EU ETS and emissions trading schemes which are currently planned or under discussion internationally have a long time horizon in view (with reduction targets of approx. 75 - 80% up to 2050)[9], they are – against the background of the revision mechanisms and limitations on the borrowing of emission allowances – effectively multi-period schemes and will remain so for the time being. This is especially the case with emissions trading schemes in democratic societies in which each and every decision can be revised at regular intervals. In multi-period schemes which may involve recurrent allocation decisions and other updating components (shutdown rules, free allocation for incumbents, etc.), the CO_2 price signal can be distorted by allocation decisions, thereby weakening the efficiency of the scheme (Öko-Institut et al 2005).
- Sectors and gases covered: For reasons of efficiency (transaction costs, cost sensitivity, etc.) or practicability (uncertainties with regard to the determination of the volume flows to be regulated, e.g. relating to CO_2 sinks or non-CO_2 greenhouse gases) existing and foreseeable emission trading schemes are partial emission trading schemes which do not cover all greenhouse gases.[10]
- Regionality: There are a number of linking mechanisms (above all those currently available through project-based mechanisms[11]); some have been devel-

9 The draft bill passed by the US House of Representatives in 2009 (U.S. Congress 2009) plans an 80 % reduction of the greenhouse gas emissions covered by the scheme up to 2050 (compared to 2005 levels). The EU Emissions Trading Scheme continues to be formally organised into commitment periods (2005/2007, 2008/2012, 2013/2020, etc.), the introduction of a non-time-limited linear reduction of the available emission budget produces an emission reduction of approx. 75% for 2050 based on the 2005 reference level.

10 From 2013 onwards the EU ETS will cover only large point sources of CO_2, N_2O and perfluorinated hydrocarbons (PFC), corresponding to approx. half of total greenhouse gas emissions; the ETS (initially) planned in the USA (U.S. Congress 2009) covers approx. 85% of greenhouse gas emissions, while it is planned that small-scale consumers (transport, households, etc.) are to be covered by a regulation of CO_2 quantities brought into the transport sector (upstream ETS).

11 However, the projects of the Clean Development Mechanism (CDM) in its current implementation are encountering fierce criticism in terms of the real additionality of the emission

oped in such a way that they are directly linked to other emissions trading schemes (e.g. in Norway) or which can be expected to become so in the medium term (USA, Australia, possibly Japan too). In view of strong interactions with complex international commitments, a global emissions trading regime can only be developed gradually. Experiences gathered with the implementation of the EU ETS show that carefully designed implementation periods and robust governance structures are useful and necessary for complex instruments of this kind. It will only be possible to develop a global emissions trading scheme – which is undoubtedly desirable – on the basis of a number of different stages staggered over a long period of time.

The specific design characteristics of emission trading schemes can also lead to the need for complementary policy instruments in order to ensure both the effectiveness and efficiency of the scheme. From this perspective possible starting points for complementary instruments are, for instance, measures involving combined heat and power (CHP). In the power sector this technology is confronted with markets regulated by emissions trading; in terms of heat, however, it is used in markets where the CO_2 costs of the emissions trading scheme have not (yet) become effective. Distortions or counter-productive effects (sector leakage) can result. Another starting point can be found in the regional boundaries of emissions trading schemes. As a result of CO_2 costs, there can be incentives to delay production or investments in non-CO_2 regulated regions, which can have a counterproductive impact on global emission reductions (leakage).

Of course there is also the possibility that these problems can be solved primarily by a corresponding sectoral and/or regional expansion of the scheme. Two aspects need to be considered here – whether such an expansion is realistic and whether the described effects can be effectively avoided in the real world as a result (see chapter 3.2).

Alongside the design issues of real-world emission trading schemes the question also arises – now that real practical experience has been gathered with the EU ETS – as to the basic potential of the scheme for the longer term. Is an emissions trading scheme in a position to create long-term scarcity signals or is it and will it remain a real-world emissions trading scheme with unavoidable uncertainties and risks (and the resulting discrepancy between social and private discount rates[12]) which is only ever an impor-

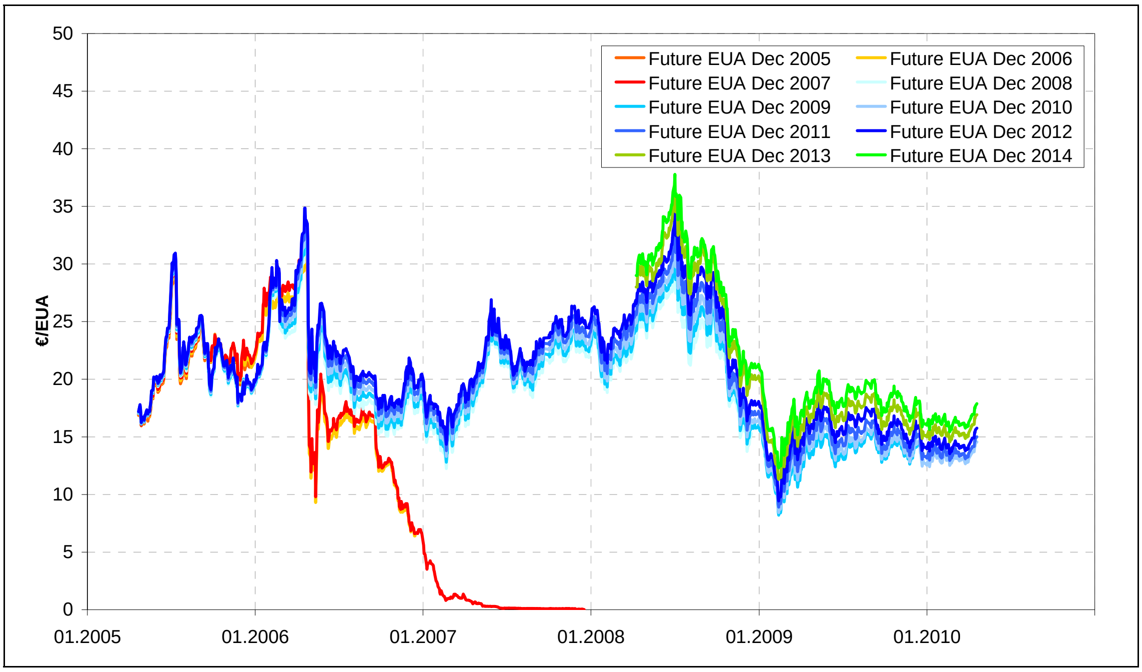
abatements achieved, i.e. its ecological integrity (Michaelowa/Purohit 2007, Wara 2007, Schneider 2007+2009, Wara/Victor 2008, Glachant et al. 2009, Haya 2009). If the ecological integrity of the CDM or appropriate alternative/subsequent mechanisms is not secured by appropriate procedural or design changes and the use of CERs is not strictly limited, there can be significant erosion of effective target achievement.

12 First of all there can be different discount rates as a measure of time preferences from the private economic perspective and from the overall economic perspective since decisions on private risk factors and risk surcharges are taken into consideration, which do not (have to) play a role from an overall economic perspective. In terms of the overall economic discount rate, the revenues from very low-risk government bonds (with lead times of two to three decades) are applied as a rule (historically, these amount to 2.5 - 3% (UBA 2007)); these levels

tant (if short- to medium-term) clearing mechanism for abatement options close to the market?

Figure 2 provides an overview of the price development of EUAs up to now in the EU ETS in ECX, the European emissions trading exchange (it should be noted that future contracts for the time subsequent to the second trading period of 2008-2012 can already be traded on this exchange).

Figure 2 Price development of EUAs in the EU ETS, 2005 - 2050



Source: Calculations by Öko-Institut

The analysis of price developments for delivery contracts with different fulfilment times demonstrates a number of interesting aspects:

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can be as high as desired in the case of private discount rates, depending on the sector and level of risk. Furthermore very long-term (i.e. above all generations of) wide-ranging welfare effects also have to be taken into account from the overall economic perspective; for their classification fundamental ethical decisions have to be made. Stern (2006) uses, for example, a discount rate of 0.1% for very long-term considerations relating to climate policy.

The wide-ranging impact of the decision to use a particular discount rate is demonstrated by the following comparisons. A private discount rate of 15% (a common rate for industry) means that costs arising in 10 years are assessed with a reduction of 80%, in 20 years with a reduction of 96 % and in 30 years with a reduction of 99%. In the case of an overall economic discount rate of 3%, the reductions amount to 26 % for costs arising in 10 years, 46% in 20 years and 60 % in 30 years. In the case of the discount rate used in the Stern report (2006) for very long-term considerations (0.1%), the reduction for costs occurring in 30 years amounts to 3%.

- The price development of the contracts to be fulfilled in the first trading period (2005/2007) can initially be easily explained by uncertainties with regard to the implementation of the scheme (successive approval of the National Allocation Plans for each Member State, and thereby only gradual clarity on the cap), which led accordingly to the prices being volatile. Following publication of the verified emission data for the first time in April 2006, substantial over-allocation in the first trading period became evident. As a result of the non-permitted use of EUAs from the first trading period in subsequent years (ban on banking) the CO_2 price collapsed.
- The prices of emission allowances for the second period of the EU ETS (2008-2012) initially remain in the range of 15 - 25 €/EUA. Subsequently they underwent huge growth in the course of huge price increases on commodity markets up to mid-2008 and substantially decreased during the financial and economic crisis. Since mid-2009 they have settled at approx. 15 €/EUA.
- However, it is notable that neither the prices of EUAs with a delivery time falling in the second trading period, nor those involving deliveries in the third trading period (2013-2020) demonstrates a reaction to legal regulations having been passed for the third trading period. With the revision of the EU Emissions Trading Directive a long-term cap was implicitly fixed (through setting a linear reduction factor with no end date), representing an emission reduction of approx. 75% for 2050 based on the intermediate target for 2020 (21% under 2005 levels).[13] Further, it is not remarkable that the allowance prices are very similar for the second and third trading periods in the light of the fact that the EUAs for the second trading period can be used without restrictions in the third and subsequent trading periods (unlimited banking).

In view of compulsory long-term emission targets, also in the EU ETS, from 2009 onwards and the option of unlimited banking, the observed price developments seem to call for an explanation since they show no perceivable reaction whatsoever to the radically tightened (long-term) targets. It could of course be argued that these long-term reduction targets have been under discussion since 2008 and that the markets could have already incorporated them in their prices, with the result that no radical price changes would have had to occur in 2009. Yet what remains unexplained is the fact that for the sectors regulated by the EU ETS a CO_2 price of approx. 15 €/EUA would not be sufficient in any way to meet the long-term targets specified above.

[13] The “linear reduction factor” is based on the EU-wide cap of the second trading period (annual average of 2008-2012) and decreases the amount of available EUAs so that it corresponds to a linear path of 1.74% from 2010 onwards. A decision on changing the linear reduction factor is planned for 2025 (Art. 9 of Directive 2009/29/EG of 23 April 2009). The regulations on the cap in the revised Emissions Trading Directive are thus clearly laid down for the longer term. The steadily decreasing cap goes beyond 2020, thereby corresponding to an emission reduction of approx. 75 % when an unchanged linear reduction factor is assumed.

Very different interpretative models have been deployed to explain this empirical finding:

- The real price development is, according to one line of interpretation, a consequence of the lack of long-term emission targets. However, since such long-term targets are already legally in place, this approach cannot be viewed as sound.
- Alternatively, the markets are viewed as regarding the long-term targets as reliable and incorporating them in the price accordingly. If that were the case, emissions trading markets would not able to produce any long-term scarcity signals, at least for the time being. Also the question arises as to what policy or legal commitments would have to be or could be made in order for the markets to fully reflect the binding nature of such targets. In any event, the process of building trust in this would require a long time in the case of long-term targets. It can also be questioned in this context whether long-term scarcity signals can be produced in markets per se based on policy decisions on scarcity (as emission markets are) and existing in the framework of democratic systems which provide repeated opportunities to revise decisions and the mechanisms used to enforce (particular) interests.
- It can be doubted whether for economic reasons markets and market mechanisms (e.g. because they are affected by private discount rates) are generally in a position to produce price signals for scarcity over several decades or whether market mechanisms could basically constitute only short- to medium-term clearing mechanisms for marketable abatement options.
- According to another line of interpretation, the markets could have already anticipated the existence of extremely low-cost abatement options in the long term. However, in view of current discussions about ambitious abatement paths in the long term (Prognos/Öko-Institut 2009, McKinsey et al. 2010), this does not seem to be a sound line of argument.

Empirical evidence gathered up to now is far from sufficient for a reliable and resilient classification of the second and third hypotheses (the classification of which is in particular relevant) to be undertaken. Nevertheless, a strategic, robust climate policy which matches the ambitiousness described in chapter 2.2 has to factor in the possibility that an emissions trading scheme might always be only able to serve the purpose of clearing emission reduction options close to the market that are available in the short to medium term.[14]

[14] At the same time the huge significance of this clearing process should not be underestimated. For instance, the emission abatements realised in Germany through the EU ETS amount – at least for the time periods in which a CO_2 price signal was generated – to approx. 10 m t CO_2/a (Ellerman et al 2010).

3 Relationship between emissions trading and complementary instruments

3.1 The need for complementary instruments in climate policy

According to experiences to date, particularly those gathered with the EU ETS, a considerable number of abatement options can be tapped with the CO_2 price signal generated by the scheme (Ellerman et al. 2009):

- The price signal has, particularly in the case of electricity production, entered production optimisation. Operating strategies for power plants (merit order) which have changed as a result of the CO_2 price signal and the corresponding emission abatements can be clearly identified.
- A number of very inexpensive abatement options have been tapped (technical optimisation of power plants, co-firing of biomass, other fuel switch).
- A whole number of incremental innovations (efficiency increases in natural gas and hard coal power plants) have been at least partly triggered by the price signal of the EU Emissions Trading Scheme.
- The CO_2 price signal is – especially in the electricity industry – entirely passed through via the value added chain. In this way price signals have also been generated based on electricity demand and have led, where appropriate, to demand reactions.

Carbon pricing by means of the EU Emissions Trading Scheme has also been successfully put into action and undoubtedly constitutes a key pillar of climate policy.

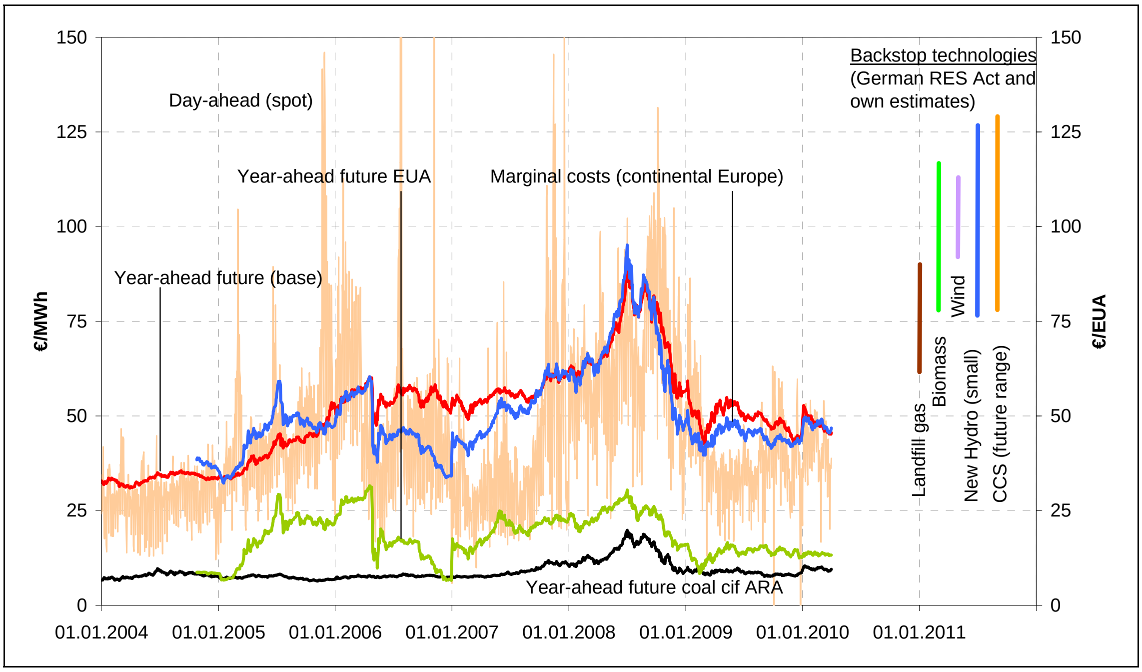
Figure 3 shows the effect of carbon pricing based on the example of contracts for base load deliveries (Phelix Base) in the subsequent year, comparison with basic explanatory factors (hard coal and CO_2 prices) and the resulting short-term marginal costs for a statistically determined marginal power plant. Future contracts[15] for hard coal (black line) and emission allowances (green line) determine, in conjunction with a hypothesis for each price-setting power plant[16] (blue line), that the observed price development for Base Futures (red line) is relatively good. The only exception is the period from after the collapse of the emission allowance market in spring 2006 to the end of the pilot phase of the EU ETS, induced by the specific constellation of the first trading period

[15] Data analysis has been carried out using future contracts since short-term factors of influence do not have an impact on the electricity price (temperature, wind energy feed-in, short-term interruptions, etc.) in the case of future contracts. The prices – as clearly shown by Figure 3 – are therefore much less volatile. In this way, significantly more robust results for fundamental explanation of the electricity price can be derived from an analysis based on future contracts than on spot market data.

[16] On the basis of statistical analyses the representative marginal power plant for future contracts was determined to be a hard coal power plant with an efficiency of approx. 34%.

(data uncertainties or over-allocation combined with a ban on banking into the next trading period).

Figure 3 Carbon and hard coal prices as explanatory factors for electricity price development in continental Europe compared to the costs of important CO_2-free electricity production options, 2004 - 2010



Source: European Energy Exchange, calculations by Öko-Institut

However, this overview also shows that wholesale electricity prices reached approx. 90 €/MWh when emission allowance prices were relatively high (approx. 30 €/EUA), as was also the case for hard coal prices (calculated as approx. 20 €/MWh for delivery to north-western Europe). If hard coal prices had not reached the peaks observed in 2008, CO_2 allowance prices of approx. 60 €/EUA would have been necessary to reach this electricity price. However, comparison of these cost levels with the costs of electricity production options which will or could, with relatively high probability, feature strongly in ambitious climate strategies used on the road towards complete decarbonisation shows that these electricity production options can, at their current costs and even with comparatively high fuel and CO_2 prices, only to a certain extent become economically efficient. For the abatement options (renewable energies, power plants with CCS), for which substantial innovations can and have to still be tapped within a short period of time for technology, costs or system integration, the CO_2 price signal constitutes a basis of sorts, but it does not bring about sufficient incentives for extensive innovation efforts by a long distance. The current debate about CCS technology is a good example, in this respect.

If the CO_2 markets cannot, where appropriate, generate any long-term scarcity signals beyond a period of approx. 10 years, and the modernisation and innovation cycles for technologies involving substantial emissions (power plants, buildings, etc.) exceed this period several times over, complementary instruments of climate policy geared towards **accelerating innovations for future backstop technologies** will have to constitute the *second pillar* of an ambitious climate policy mix, alongside putting a price on CO_2 emissions. Particularly in an emissions trading scheme which is incomplete for policy or distributional reasons, the situation can arise where the generated price signal does not really reflect the shadow price of the total greenhouse gas reduction. In the case of extensive emission abatements realised in a relatively short period of time, having a technology-neutral search process within the market will – keeping in mind the necessary effectiveness of climate policy – not be able to secure the reduction options involving durable capital stock robustly enough. Moreover, theoretical considerations (Fischedick/Samadi 2010) and integrated model analyses in which the development of the energy system and the associated costs with and without investments in experience curves have been examined (IEA 2000) show that substantial benefits for dynamic efficiency can also be tapped using such strategies. However, a key requirement for tapping such efficiency benefits is that it is possible to realise innovation-based progress through specific promotion as part of suitable strategies for technology transfer available globally. Against this background, expansion of the emissions trading scheme by means of regulatory provisions (especially standards) or specific promotion measures to be aimed strictly at innovation is useful and effective.

Without a doubt well-directed governmental policy on innovation will not be mistake-free and will have to be capable of correcting its path accordingly. However (not forgetting that market-based search processes tend to be geared to the short term) it is generally likely that similar undesirable developments are not, with high probability, avoidable even if innovation processes are driven by emissions trading schemes alone.

The concrete design of government innovation policies (between the priorities of measures strongly geared to research and development and early introduction to the market or, above all, industry-driven innovation) shall not be discussed further here[17]. However, the learning curve effects originating in electricity production from renewable energies which significantly go beyond those arising from conventional technologies (Nitsch et al. 2008) strongly indicate that the approach used in Germany up to now of a policy supporting early introduction to the market can bring about substantial benefits when its design is geared to innovation. Reliable and verifiable innovation effects are required, above all in the case of costs, and are an important monitoring indicator for the choice, adaptation and, where appropriate, cancellation of complementary instruments in the climate policy mix.

Technology-neutral approaches to climate policy also have to be expanded in a *third pillar* of the mix. The (foreseeable) available abatement options involve substantial investments in infrastructure in many cases (from wind energy production to smart grids as a basic framework condition for electric mobility). However, huge **changes to infra-**

[17] See, for example, OTA (1995) und PCAST (1999) for basic considerations.

structure require long lead times and have to be implemented in a highly regulated environment (ranging from extensive approval processes to increasingly strictly regulated networks). Against this background the necessary re-design of infrastructures (even if there is a significant CO_2 price signal) can only be realised in exceptional cases in a purely market- or purely private sector-based way. It will barely be possible to tap abatement options which involve high investments in infrastructure when a strictly technology-neutral approach is pursued, which sometimes has serious consequences on both the long-term effectiveness and long-term efficiency of climate policy.

A *fourth basic climate policy approach* is also necessary, especially with a view to the abatement options aimed at energy efficiency. A large number of bottom-up analyses (geared to technical engineering) have shown time and again that there are technical and organisational measures which have **negative abatement costs**.[18] There are manifold reasons for such abatement potentials existing, ranging from incomplete or asymmetric information on structural barriers (e.g. the user-investor dilemma) to preferences in use of available capital. Against this background the expansion of the emission trading scheme by means of administrative regulations (efficiency standards, etc.), corresponding support measures and/or the creation of specific cap-and-trade schemes (e.g. white certificates for energy efficiency) is a necessary and useful approach that can be legitimated. However a key framework condition and therefore also an important monitoring parameter for the choice, adaptation, and – where appropriate – discontinuation of corresponding complementary instruments is a cost-benefit test for the relevant measures.

The process of transforming an energy and economic system towards complete decarbonisation does not begin from square one. All policy steering instruments function within the context of an existing capital stock and within the scope of the existing markets. In this way – at least in a (long) transition period – quite different effects come about from the new CO_2 cost factor generated by the emissions trading system in the differently configured markets. In an electricity production market dominated, for historical reasons (and in no way as a result of market processes) by coal-fired power plants, the CO_2 risk for investors that every rise in the CO_2 price increases one's own cost risk is, for example, thereby reduced. This economic effect is, however, (over-)compensated by increased revenues when the market price-setting power plant is very emission intensive due to efficiency expected to be lower, and therefore has over-proportionally higher marginal costs, bringing about a corresponding increase in the wholesale electricity price. Therefore, in a market characterised by low-emission marginal power plants, the same CO_2 price can lead to investment decisions having very different results. As a consequence there is strong interaction between market design and the implementation of climate-friendly technologies in the case of the "pure" bulk energy markets which currently distinguish the electricity sector. Investments generally

[18] On the range of these potentials, see Wuppertal-Institut (2006), McKinsey (2008) and Öko-Institut et al (2009).

have to be refinanced from the difference between the new power plant and the price-setting marginal power plant in terms of short-term marginal costs (operational costs). Whether investments can be refinanced on this basis and in spite of high CO_2 prices in a power system strongly characterised by fluctuating energy production (e.g. wind energy) and therefore, at least at times, by very low electricity prices is not certain. In this context complementary measures such as specifically created capacity and sink markets are being discussed (Prognos/Öko-Institut 2009, RAP 2010, Ofgem 2010). The well-directed creation or adaptation of **market structures**, which also effectively facilitate climate-friendly investments, can thus be regarded as the *fifth pillar* of ambitious climate policy.

Provided that the sectoral or regional scope of implemented emission trading schemes is incomplete, **system boundary effects** can arise. On the one hand this has an impact on transfer effects that may arise between emission segments that are regulated differently (energy production in CHP as a sector covered by the EU ETS with heat deliveries in sectors not covered by the EU ETS is one such example). On the other hand, so-called leakage problems can arise if, due to CO_2 costs, productions or investments are transferred outside the framework of the scheme, thereby ultimately resulting in emission levels that are globally higher. In this context, complementary measures to the emission trading scheme (e.g. promoting CHP to reduce the sector-based problem of system boundaries or investment subsidies or other complementary measures to avoid leakage) are the most effective counter-measures in many cases (Neuhoff/Matthes 2008), thereby constituting a *sixth pillar* of an ambitious overall strategy of climate policy.

3.2 Sectoral expansion of EU Emissions Trading Scheme as an alternative option

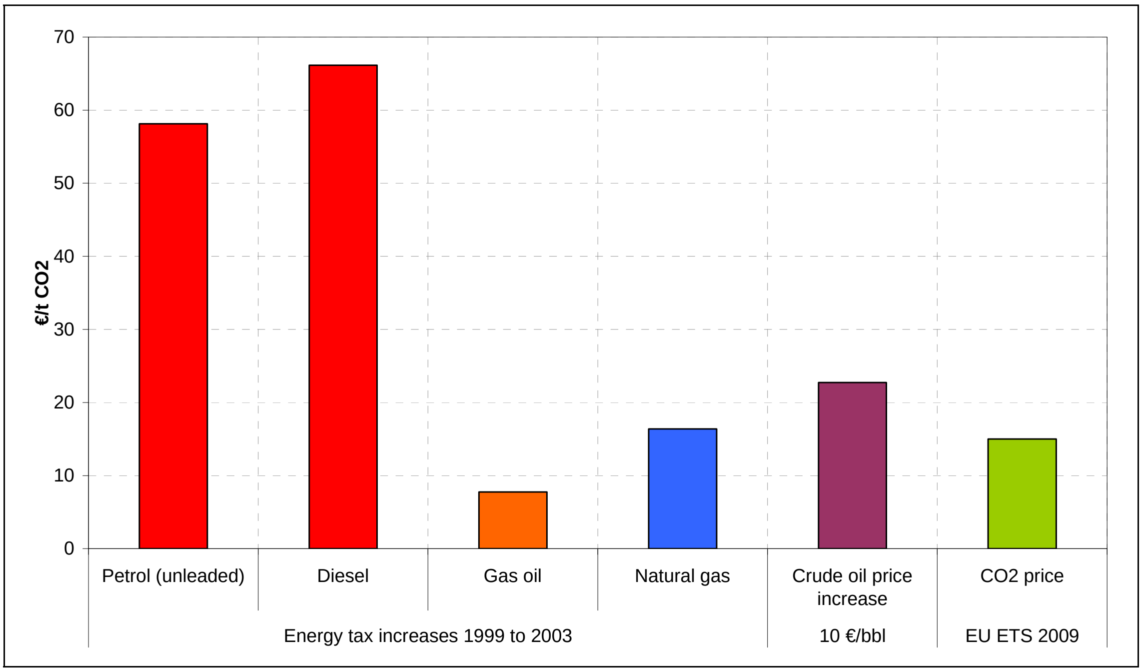
While the regional expansion of the EU ETS – above all via linking with other emission trading schemes – is one of the declared and, in the final analysis, non-controversial goals of climate policy, complex questions have to be taken into account in terms of any kind of sectoral expansion of the EU ETS. Basic arguments for the expansion of the scheme beyond its present framework are:

- Determination of the cap could be designed much more simply since the discussion about separating total reduction targets set by policy into a target for the sectors or plants covered by emissions trading and a reduction target for emission sources that are regulated differently would be rendered largely redundant.
- The incorporation of sectors not yet covered by emissions trading (most notably the residential sector and – besides aviation – the transport sector) could simplify the development of instruments of climate policy overall and, in some cases, lead to additional efficiency gains.
- The creation of an emission trading scheme for all sufficiently precise collected data on greenhouse gas emissions (above all CO_2 and large point sources for other greenhouse gases) could make complementary instruments superfluous, given that the need for such instruments primarily arises from system boundary problems (e.g. in the case of CHP) (see section 3.1).

Even though the sectoral expansion of the EU ETS in the past has not been pursued - for good reasons – and is also not currently on the agenda, it remains an option worth considering in discussion of the climate policy mix for the above-mentioned reasons. However, a number of complex circumstances need to be taken into account.

With regard to the incorporation of segments such as the residential or transport sectors there is, in a first instance, the question of transaction costs to address – due to, for example, the need for certified data of an ensured consistency in the trading of emission allowances and providing proof – along with the consequences that result. Experience gathered with the EU ETS in the sectors covered up to now demonstrates that transaction costs which are no longer in relation to the efficiency gains that may be achieved swiftly materialise for small plants in particular. In principle the incorporation of small emitters could be started by adapting the Emissions Trading Scheme accordingly. In this way a segment of the Emissions Trading Scheme could be created whereby the bringing of fossil fuels into the market in terms of implicit CO_2 emissions (i.e. the carbon content) rather than the release of greenhouse gases into the atmosphere (downstream approach) is regulated via the Emission Trading Scheme (upstream approach). In theory such upstream systems or corresponding hybrid models (which combine the downstream and upstream approaches) seem a simple and elegant solution. However, it should be noted that a number of practical problems still need to be solved in the case of upstream systems or components of this kind. Further, the question of whether in reality – as assumed in models used in theoretical discussions – the costs of emission allowances are always passed along the corresponding carbon flows is of great importance. If it is seriously considered to be possible that, given the not unproblematic competition environment of the energy sector, the costs of emission allowances will be disproportionally passed on to various consumers with low price elasticities, not only will distribution problems, but also – in light of drastic distortion of the CO_2 price signal – substantial efficiency problems will result. Against this background considerable theoretical and empirical analysis is still required on the use of the upstream approach for emission trading schemes.

Figure 4 CO_2 price equivalents of selected fiscal measures outside of the ETS and selected energy market developments



Source: Calculations by Öko-Institut

What degree of impact an emissions trading scheme which covers additional sectors or the possible substitution of other instruments (promotion, standards, etc.) can have is, of course, also a question that needs to be addressed with the new potential sectors covered by the EU ETS. Figure 4 enables a classification of this question based on a comparison of the implicit CO_2 price effects of different measures of energy and climate policy and the general development of the energy market in the last decade:

- The increases in fuel tax implemented between 1999 and 2003 (the German Eco-tax Reform Act) brought about measurable, but overall rather limited, GHG reduction effects. Even these comparatively low effects could only be initiated with relatively high (implicit) CO_2 prices (approx. 60 €/t CO_2 and above).
- Only low effects from heat insulation were triggered by the increases in fuel tax or increases in fuel prices originating within the market. Substantial abatement

effects can only be expected when (implicit) CO_2 prices reach a significantly higher level.

Sectors which involve high capital lock-up, very long-term replacement and modernisation cycles (e.g. buildings) or strong structural barriers to emission reduction (user-investor dilemma in the rented residential sector) as well as sectors which involve a very long innovation lead time (e.g. vehicles) could in principle be incorporated in an extensive emissions trading scheme. At the same time, however, considerable consequences are expected to arise when such sectors are covered by the scheme and the use of complementary policies and measures (administrative law, fuel taxes, specific support measures) is eschewed or even abandoned altogether:

- With the observed price signals generated by the EU ETS up to now, emission abatements would only be realised to a small degree in the beginning in the new sectors covered by the scheme due to low price sensitivity (e.g. in the transport sector) or for other reasons (the user-investor dilemma with building new rented properties, etc.).
- Against the background of the goal of complete decarbonisation described in chapter 2.2, very high abatement costs (probably a three-figure Euro sum) and thus very high CO_2 prices would emerge in the medium to long term – combined with the price sensitivity of this sector being in any case low up to now – without far-reaching well-directed progress on innovation (e.g. by means of efficiency standards for vehicles). These could entail distribution effects for the sectors covered by the EU ETS to date which may be substantial.
- For a residential sector characterised by a particularly durable capital stock the windows of opportunity in which action occur only at intervals of several decades and would not be systematically tapped. If effective emission reduction is needed in this sector, it would also lead to substantial abatement costs and thus substantial allowance prices.

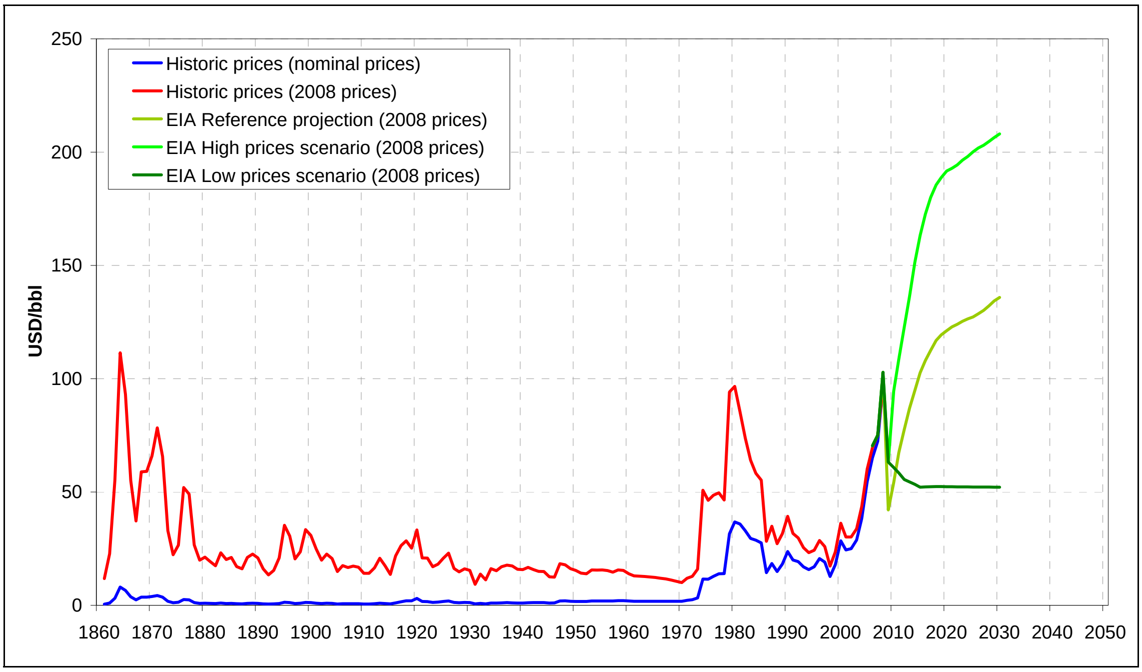
The aspects discussed above underline that a sectoral expansion of the Emission Trading Scheme could be pursued for different reasons, even when a number of related questions that are sometime very basic (e.g. securing an undistorted price signal in upstream emission trading schemes) are yet to be solved. An expansion of this nature would, however, in no way automatically entail that sector-specific (and then complementary) measures are rendered redundant. Without such complementary instruments considerable distribution effects could result from huge increases in CO_2 prices in the long term. Furthermore lock in-effects – which ultimately also call into question the effectiveness of climate policy – could come about, especially in the transport and residential sectors, as a result of innovation and infrastructure efforts implemented without sufficient preparation.

3.3 Climate policy and development of instruments in the context of other policy fields

Even if – given the pressing nature of the climate problem – climate policy has to develop into one of the key guide rails for the development of economies in the years and decades ahead, other policy fields and other goals will influence the composition of the energy and climate policy mix:

- Policy field I - Global bulk energy markets: There are extreme uncertainties about future developments in global bulk energy markets. According to the current projections of the Energy Information Administration (EIA 2009), both extremely high and very low developments can be expected for crude oil prices (Figure 5). Against this background, decreasing the sensitivity of consumers and economies to high and volatile energy prices proves to be a separate policy goal. In this context the approach that is most sustainable in the long term and which legitimates and requires specific instrument approaches is to bring about very extensive increases in energy efficiency.

Figure 5 Historical development of real & nominal crude oil prices and the current projections of EIA, 1860 - 2030



Source: BP (2009), EIA (2010), calculations by Öko-Institut

- Policy field II - International cooperation: The high distributional efficiency of climate measures is significant, particularly with a view to poorer economies. An emissions trading scheme designed with this in mind will, as the basis of an efficient climate policy and in spite of all the necessary complementary instruments, thus need to be a central feature of the policy mix and also form a suitable basis for international integration of carbon pricing strategies.

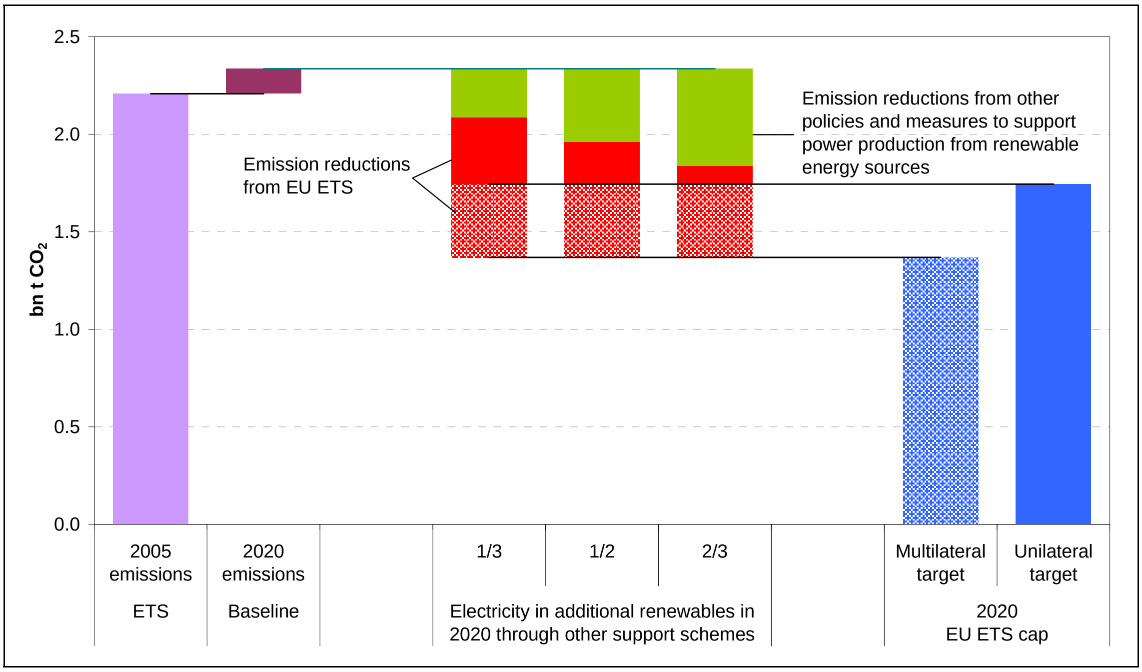
- Policy field III - Security of supply and resource diversification: The availability and regional concentration of reserves and resources (above all in the case of natural gas and natural oil) can be regarded as problematic from a geostrategic perspective (even when this view is and remains controversial, see Matthes/Ziesing 2005). If it is regarded as a useful strategy for reducing vulnerability by decreasing the imports of fossil fuels, domestic energy potentials can be tapped and huge increases in energy efficiency can be constructed as separate goals. In this context it can be justified to flank strictly technology-neutral incentive effects and indeterminate tapping of emission reduction potentials within the framework of an emission trading scheme with strategies and instruments geared to energy efficiency or tapping domestic energy sources.
- Policy field IV – Industry: Positive effects for the economy can be realised with a well-directed leading strategy ("ecological modernisation") if innovation benefits can be created for domestic industries via lead markets (BMU 2008, UBA/BMU 2009, BMU/UBA 2009, SRU 2008, Öko-Institut 2010).
- Policy Field V – Distribution: Implementing climate policy via cap-and-trade schemes will lead to additional rents (for the "producers" of emission reduction). However, distribution questions also arise because of these rents. Distribution questions in emissions trading schemes can, of course, be solved using appropriate allocation approaches in a relatively flexible and pragmatic fashion (this is one of the advantages of cap-and-trade approaches like emissions trading in comparison with tax-based solutions). From the view of distribution policy – especially in the case of long-term, very ambitious climate targets, the implementation of which also makes use of relatively expensive reduction options essential (the „steep" part of the abatement cost curve) – it may be advisable to tap particularly expensive abatement options using complementary instruments. In this way huge increases in the carbon price will be limited or avoided altogether and substantial inframarginal rents or a corresponding need for re-distribution will arise as a result.

Therefore, in terms of the legitimation of complementary instruments based on other policy goals, it is crucial whether and with what degree of urgency the other policy goals are legitimated. Vehement controversy has sometimes accompanied the need for additional targets in the discussions by critics of the energy and climate policy mix, which have been expressed from different perspectives and are generally constructed on a very abstract level (Donges et al. 2009, RWI 2009). Notwithstanding this, it has since become one of the key elements of energy and climate policy in both Germany and the EU, and the US.

3.4 The new challenge of coordinating energy and climate policy

Even if there is reliable legitimation for the use of instruments complementary to emissions trading, the Emissions Trading Scheme will encounter a problem with parameterisation when these instruments are implemented. If the specific promotion of each abatement option should not to bring about counterproductive effects in the overall system – i.e. if substantial distortions of the price signal and correspondingly counterproductive incentive effects for the incentive potentials that can only be tapped within the ETS are to be avoided – the impact of each complementary instrument has to be taken into account, especially in the process of determining the cap.

Figure 6 Example of interactions between the EU ETS and the complementary promotion of electricity production from renewables, 2005 - 2020



Source: Matthes et al (2009)

Figure 6 demonstrates this necessity on the basis of the EU ETS and the target of increasing the share of renewables within the framework of the EU.

Based on the emissions covered by the EU ETS in 2005 and the emissions growth expected in the reference case (shown by the two left columns) and both cap options for the EU ETS (shown by the two right columns)[19], the emission reductions to be made in this way are shown in the middle three columns. If EU Member States in-

[19] If there is an EU-wide (unilateral) reduction target of 20% compared to 1990 levels the derived cap would be 21% below 2005 levels according to current law. Should the EU take on a (multilateral) 30% reduction target, the cap would be 38% below 2005 levels according to the original proposals of the European Commission (see Matthes et al. 2009).

crease energy production from renewables to a third, a half or two thirds of overall production in the electricity sectors in order to meet the 20% target for these sources[20], a substantial share (shown by the green portion of the three middle columns) of the required emission reduction will be brought about by these measures alone, i.e. by the separate promotion of renewables in electricity production.

For the less ambitious cap (-21% compared to 2005) and high fulfilment of the German renewable energy target in the electricity sector (the 2/3 option), only very low contributions to emission reduction (16%) would have to be realised via the EU ETS. This could lead to a price collapse and possibly to incentive effects that are counterproductive in the long term.

For the more ambitious cap (-38% compared to 2005 levels) and a lower rate of meeting the renewable energy target in the electricity sector, this situation would not be diffused. The contribution made by renewables within the total electricity production would amount to approx. 40 - 50% in this case.

Ideally the emission-related effects of promoting renewable energies on determination of the cap for the EU ETS should be taken into account to the extent that the cap (of the incomplete emissions trading scheme) is determined ex ante (Diekmann/Horn 2008, Kemfert/Diekmann 2009). The specific promotion of renewable energies would not lead to distortions of the CO_2 price signal and thus also not to long-term counterproductive effects or inefficiencies for the emission reductions to be tapped by the CO_2 price signal alone.

This example shows that extensive analyses have to be carried out – also with regard to uncertainties – for complementary instruments that have very strong effects (e.g. renewables or energy efficiency) in order to enable robust determination of ETS caps which in turn generates a robust CO_2 price signal. Experiences gathered with the EU Climate Package demonstrate that such analyses are possible in principle and interaction problems can be limited, but also that the overcrowded architecture of many different instruments can substantially exacerbate such analyses. From a very different perspective this issue also forms a strong argument for the explicit need for legitimation and explicit determination of targets in discussions on incorporating complementary instruments in an inclusive policy mix.

At the same time it needs to be noted that the contribution to emission reduction made by the implementation of separate targets for renewables or energy efficiency should be considered strictly on the basis of the ex ante principle in the course of determining the cap. Changing the cap retrospectively and possibly repeatedly because of other

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[20] Increasing the use of renewables has been taken into account within the model analyses for the EU “20/20/20” target (COM 2008a+b), although only an approximate determination was possible. The final distribution of the additional energy production from renewables in the case of heating/cooling, transport and electricity production lies within the responsibilities of the member states.

policy goals (increasing expansion of the use of renewables, energy efficiency efforts, the service life of nuclear power plants, etc.) would lead to a huge increase in uncertainties on the emissions trading market and could possibly also entail counterproductive effects (making the cap higher), thereby eroding the effectiveness of emissions trading and, due to the consistent emergence of risk premiums, increasing emission reduction costs, too.

Against this background the interactions between emissions trading and complementary instruments should only be taken into consideration in the course of adjustments to the ETS cap that are already planned (after an international agreement has been made, or comparable agreements) and during revision of the linear reduction factor (see chapter 2.3).

The complex interaction of complementary policies and emissions trading demonstrates, at the least in the case of complementary policies and measures associated with very strong effects (renewables, energy efficiency, etc.), that long-term targets – as long as they can be legitimated – also have to be implemented with such policies in order ensure consistency with the long-term targets of the Emission Trading Scheme. At the same time, it should also be pointed out that when the ambitiousness of long-term climate goals increases, the possibly distortive effects of complementary policies and measures will prove to be less and less significant in the course of time.

4 Conclusion for an inclusive and ambitious climate policy mix

The introduction of emissions trading schemes for greenhouse gases in an increasing number of OECD countries constitutes an important milestone of climate policy:

- The introduction of emission trading schemes meant that a climate policy instrument was implemented which provides a high security of meeting the target. With a view to the radical increase (within the context of ambitious emission reduction requirements for relatively short periods) in the urgency with which climate policy action has to be taken, emissions trading is a very effective approach.
- Generation of a standardised price signal, especially for particularly price-sensitive emitters, constitutes a clearing mechanism – at least in the short to medium term – for the large range of abatement options close to the market.
- The possibility of (gradually) linking emissions trading schemes and other flexible mechanisms provides the foundation for the increasing globalisation of climate policy. Given the necessity of complete decarbonisation in industrialised countries and very extensive emission reduction measures in all other countries, tapping efficiency potentials will only be significant in the short term.

The need and legitimation of complementary instruments in the policy mix arise in the first place for climate policy reasons:

- The effects of carbon pricing on the effectiveness of innovation as observed up to now support the conclusion that emissions trading has triggered developments in terms of incremental innovations, but that incentive effects cannot be created for far-reaching (radical) innovations (backstop technologies of ambitious climate strategies, such as many of the renewable energies or CCS technology) via a short- to medium-term clearing mechanism. Well-directed and effective instruments of innovation policy thereby constitute a first complementary approach to a robust climate policy. The range of instruments geared to stimulating innovation ranges from promotion of relevant research to programs of early introduction to the market, thereby covering both supply and demand. For the concrete and (in this segment) necessarily dynamic development of instruments, it is crucial that fulfilment of specific targets of innovation policy can be verified by means of appropriate provisions and corresponding monitoring.
- Many of the (foreseeable) abatement options which need to be tapped in ambitious climate policies involve high investment in infrastructure. Prominent examples of this are: the unavoidable expansion of large-scale power grids for electricity supply systems with large shares of renewables; the essential creation of distribution networks which are capable of decentralised load management (smart grids) for the huge promotion of electric mobility; the corresponding storage and CO_2 pipeline network for CCS. In view of the long lead times needed for re-designing and expanding infrastructure and extensive regulation

of this infrastructure, incentive systems that are consistently technology-neutral can be ineffective. Complementary instruments combined with the (necessary) infrastructure development, e.g. in terms of planning, risk hedging and general regulation of infrastructure, constitute a second strategically essential approach for a robust climate policy.

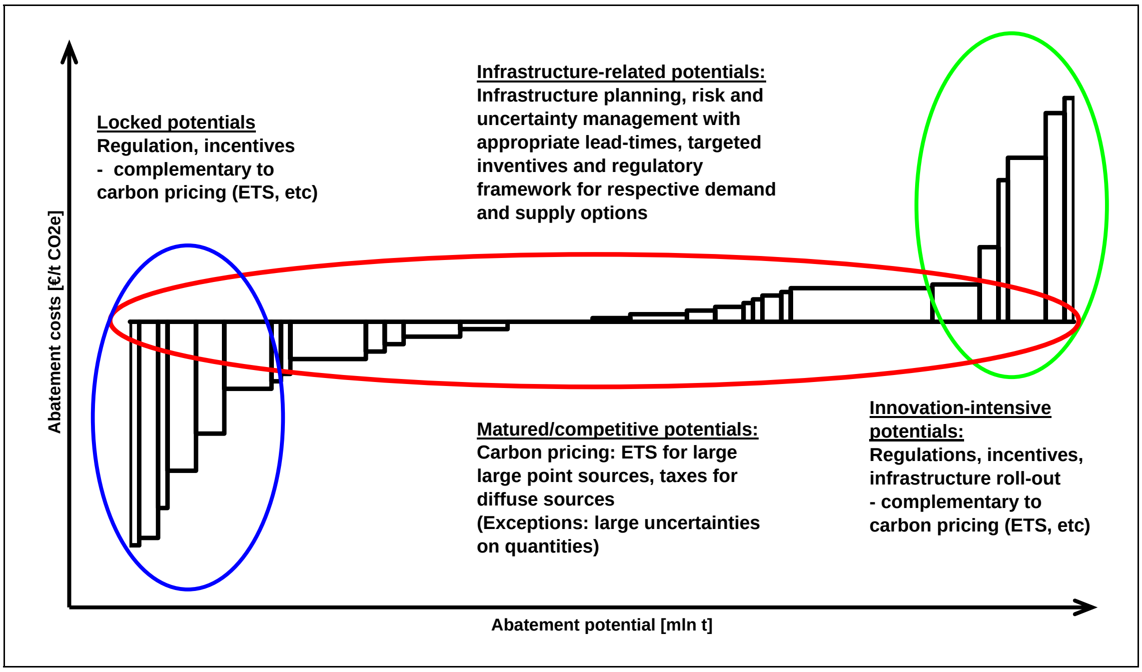
- A number of climate policy options are – in spite of their high (national) economic attractiveness – not implemented due to manifold barriers and preferences geared to other ends. One area in which this is the case is the many energy saving measures which are principally economic and are not tapped because of information asymmetries, structural barriers (e.g. the owner-tenant dilemma in the case of new buildings) and so on. Against the background of an effective and – from an overall economic perspective – efficient climate policy tapping these emission reduction potentials constitutes an important starting point for complementary policy approaches. Here, the instruments that are useful and necessary is also wide, ranging from provisions or standards (for very standardised applications) to support programmes or measures to reduce structural barriers (information, tenancy law adjustments), and can and should incorporate several market-based approaches (e.g. white certificates for energy savings). However, for these complementary instruments a cost-benefit test should be carried out first of all.
- The need to decarbonise an existing energy and economic system which involves very capital-intensive or durable capital stock in very important segments within a comparatively short time frame can necessitate the well-directed adaptation of market design or the development of new sub-markets which, combined with putting a price on CO_2, enable implementation of low-emission solutions in the given competition environment.
- Since the emissions trading schemes that have been implemented up to now or are under development are/have to be operated as incomplete in sectoral and regional terms at least in the short term, it will be necessary in some areas to reduce counterproductive incentive systems through complementary measures. Measures relevant to this end include those for flanking combined heat and power (as an effect of the EU ETS not covering all sectors) and compensation measures for investments (to combat the risk of leakage from the regions covered by existing emissions trading schemes). By expanding the regions and sectors covered by emission trading schemes, at least a share of these complementary instruments could be rendered obsolete. At the same time, new challenges can emerge as a result of a sectoral expansion of emissions trading, which could in turn bring about the need for certain complementary interventions.

Although emissions trading is a key instrument for important emission segments, other instruments will be used for a number of sectors:

- For the sectors in which the robust and consistent determination of emission data is not possible, price-steering instruments or cap-and-trade schemes are not appropriate. Administrative or support instruments will have to be engaged in these cases. Prominent examples of such sectors or segments in which this is the case are farming, forestry, land-use and land-use changes.[21]
- In principle (significant) sectoral expansion of the EU ETS is conceivable, but a suitability assessment still needs to be carried out for important issues. Taxation could be considered as an alternative option. One of these tax-based approaches could be basing the amount of tax, where appropriate, on the price of CO_2 allowances within a specific reference period.
- For a number of the issues discussed in relation to complementary instruments for the emissions trading scheme (innovation, infrastructure, locked potentials, etc.) specific solutions also have to be found for the sectors not covered by taxation or emissions trading.

Figure 7 demonstrates the fundamental logic of the policy mix, determined for the time being exclusively from the perspective of climate policy.

Figure 7 Schematic classification of grouped potentials for emission abatement and foci in policy development



Source: Öko-Institut

[21] The extent of methodological uncertainties and what extensive adjustments (have) to be made in relatively high frequencies are clearly demonstrated by comparison of different expenditure listed in the national GHG inventories for these segments (UBA 2008+2009+2010).

The pricing of greenhouse gas emissions forms the foundation of this policy mix and constitutes the key implementation instrument for reduction potentials close to the market. The need for or legitimation of complementary implementation instruments above all derives from the innovation potentials, the blocked potentials and the reduction potentials which are unsuitable because of uncertainties concerning the appropriate determination of the quantities to be regulated by cap-and-trade or price-setting systems. Special requirements for the development of instruments could ultimately also arise for abatement options, the implementation of which depends substantially on the creation of corresponding infrastructure.

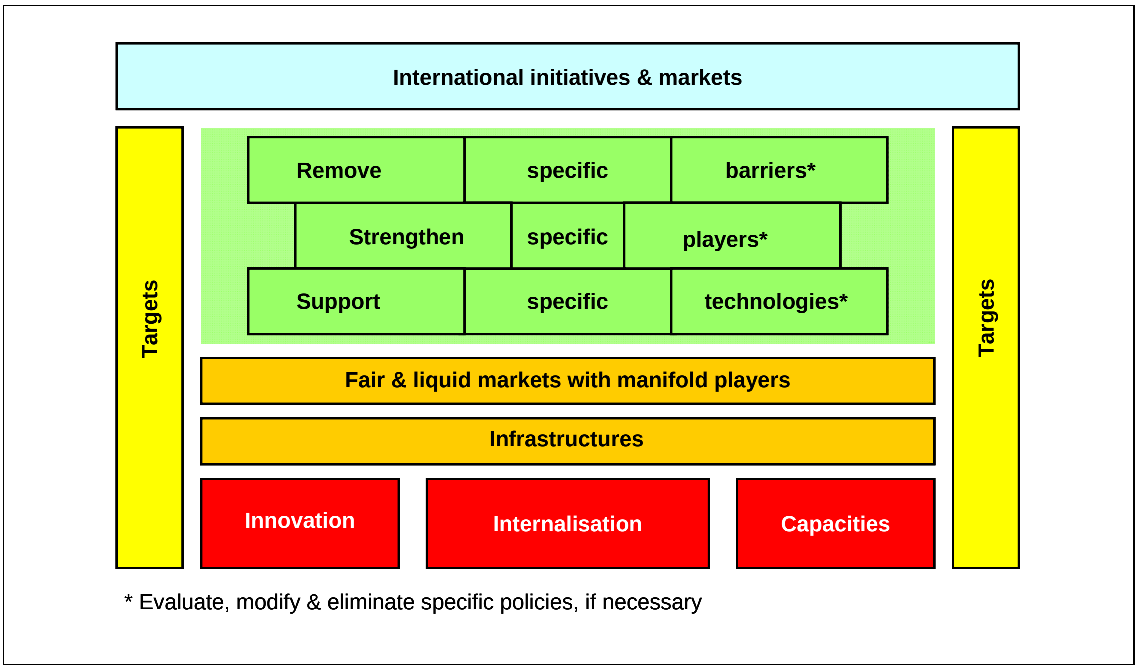
However, other policy fields also produce targets which can and should be strategically and instrumentally integrated in climate policy:

- Energy efficiency measures which have their own separate targets and approaches to developing instruments can in particular be used to limit the sensitivity of consumers and economies to high and above all volatile energy prices determined via the global commodity markets.
- Both energy efficiency and domestic energy sources – which are climate-friendly and low risk – can contribute to increasing security of supply.
- Well-directed approaches to developing strategies and instruments can contribute to developing leading markets, strengthening the business location and accelerating the process of ecological modernisation.
- The rents that arise for sellers of emission abatement when cap-and-trade schemes are introduced can sometimes make well-directed interventions of distribution policy necessary; these interventions can be realised using complementary instruments.

Against the background of the empirical findings made available up to now and in particular against the background of the (necessary) ambitiousness of future climate policy, it is not expected that severe efficiency losses will result from the implementation of additional strategies and instruments to complement the emissions trading scheme. On the basis of careful analysis and comparison of the different approaches to possible action, inefficiencies which arise from certain combinations of instruments can be circumvented.

Figure 8 provides a systematic overview of the interaction of different policy approaches and demonstrates the basic role of internalisation approaches for emissions trading schemes or special taxation. As an internalisation approach emissions trading has especially direct and close link-ups to the quantity-based targets of climate policy, but is also particularly significant in the globalisation of climate policy due to its linking with other systems. In the final analysis emissions trading schemes can also prove to be of substantial significance for a number of complementary instruments (e.g. support measures) by tapping new financial sources. In this way emission trading schemes constitute both a key building block and key linking elements of a comprehensive climate policy.

Figure 8 Schematic overview of the role and integration of different approaches to consistent climate policy geared to the long term



Source: German Bundestag (2002), expanded and adjusted by Öko-Institut

However, this overview also demonstrates that beyond the internalisation of external effects a whole number of other functionalities have to be realised which – for very different reasons – cannot (yet) be (sufficiently) addressed by emission trading schemes or corresponding taxation approaches or which arise from additional policy targets (security of supply, distribution policy, etc.).

Should the foundations for the use of complementary instruments change or disappear, these instruments would have to be adapted or, if necessary, abandoned. Clear and transparent reasoning or targets for each of the energy and climate policies and measures, accompanied by constant monitoring and assessment of the complementary instruments of energy and climate policy are therefore important to the creation and development of a comprehensive, effective, economically efficient, robust, politically achievable, and inclusive climate policy mix.

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