SRU

German Advisory Council on the Environment

Sustainable Development, Innovation and Climate Protection: A German Perspective

Selected chapters of the Environmental Report 2008

Volume 1

This publication is a partial translation of the 2008 Environmental Report "Climate Protection in the Shadow of Climate Change". For this reason, the numbering of sections and paragraphs follows the original German version and hence is not fully sequential.

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Preface

In June 2008, the German Advisory Council on the Environment has published its "Environmental Report 2008: Environmental Protection in the Shadow of Climate Change“. The report provides a comprehensive evaluation of national and European environmental policies in the reporting period (2004 to 2008). This period is characterized by two contrasting trends: On the one hand, environmental policy has in many areas come under pressure while, on the other hand, the alarming risks of climate change have received a high level of attention. The title of the report should be interpreted as a call for a more integrated approach which should more strongly recognize the interdependence between climate change and biodiversity. Under conditions of climate change, several other areas of environmental policy are in fact becoming more critical, either because of their potential contribution to mitigating climate change and its consequences, or because of the threat to environmental resources stemming from global warming. Special attention should be given to the importance of forests, moors and grassland, as well as to the key role played by soils as a store and sink for greenhouse gases. An inappropriate use of these resources will have negative effects for the climate.

Having perceived a considerable interest in the international community to learn more about German national environmental policy approaches, the Council has decided to translate key parts of the Environmental Report 2008, especially those which concern national policies with an international relevance. The translation is organised in three volumes, targeting different expert communities:

Volume 1: Sustainable Development, Innovation and Climate Protection:
A German Perspective

Volume 2: Land Use, Nature Conservation and Agricultural Policies in Germany

Volume 3: Toxic Substances and REACH

This first volume covers the German Sustainable Development Strategy, the benefits of innovation-oriented environmental policies and the new challenges of climate change. It aims to understand and assess the policies of an international leader in climate policy from an independent and critical perspective. Even though Germany is undoubtedly a latecomer in sustainability planning, its Sustainable Development Strategy is internationally leading in terms of ambition, seriousness and governance. In recent years, the dominant framing of the relationship between economic and environmental policy moved from a trade-off perspective to a model of convergence. The strategic role of innovation-oriented environmental policy-making for competitiveness and the dynamic growth of a new sector have been well understood. Both frames, Sustainable Development and “ecological industrial policy”, have supported one of the most ambitious national climate policies. German climate policy sets a unilateral national emission target for 2020 of 40 % on 1990 levels and puts into place a broad programme of measures (the integrated Climate and Energy Programme), which is supposed to deliver most of the necessary emission reductions.

The Environmental Report 2008 was finalized before the onset of the global financial and economic crisis. Nevertheless, the scientific foundations for the “Green New Deal” – called for today by many in the international Community – can already be found in this report in its analysis of the potential economic benefits of an ambitious climate policy.

The German Advisory Council on the Environment was founded in 1971 and is one of the first academic advisory bodies in the history of German environmental policy making.

The Environmental Council is characterised by its expertise and neutrality and as well as its interdisciplinary approach. It comprises seven university professors from a range of different environment-related disciplines. The members of the Council are appointed by the German government for a four-year period of tenure. The Council’s mandate provides it with the freedom to select the issues addressed in its reports and statements. The council operates autonomously and is bound neither by instruction nor order. It does not represent any economic interests and enjoys authority as the non-partisan voice of scientific expertise and provider of principles-based analyses and recommendations.

The Council’s key responsibility is the periodic evaluation of the environmental situation and of environmental conditions in Germany. It fulfils several functions:

– It acts as an ‘early warning’ system and highlights negative trends.
– It provides new ideas for German and European environmental policy.
– It has a broad advisory mandate which includes the German government, the sixteen German *Länder*, stakeholder organisations, and the general public.
– It actively monitors the ‘Europeanisation’ of environmental policy.

Responsible Council members for the Environment Report 2008 were:

– Hans-Joachim Koch (Chair), Universität Hamburg,
– Christina von Haaren (Vice Chair), Leibniz Universität Hannover,
– Martin Faulstich, Technische Universität München,
– Heidi Foth, Martin Luther Universität Halle/Wittenberg,
– Martin Jänicke, Freie Universität Berlin,
– Peter Michaelis, Universität Augsburg
– Konrad Ott, Ernst-Moritz-Universität Greifswald.

Since 1 July 2008 the composition of the Council has changed (see cover page).

Martin Faulstich
(Chair)

Christian Hey
(Secretary General)

1 Sustainability and environmental strategies in the European Union and Germany

Messages

The German Advisory Council on the Environment *(Sachverständigenrat für Umweltfragen – SRU)* has long been a proponent of strategic environmental and sustainability planning as outlined in the Agenda 21 management concept. That environmental and sustainability strategies have become a permanent component of European and German policy should thus be highlighted as a positive development. The quality and function of these strategies, however, are still under dispute. With this in mind, this document will evaluate the central environment-related strategy processes in the European Union (EU) and Germany.

The analysis of the EU sustainability strategy, the 6th Environment Action Programme and the "Cardiff Process" shows that these processes are largely lagging behind the Agenda 21 management concept. Shortcomings have been observed particularly with regard to goal and results orientation and in encouraging horizontal environmental policy integration. At the same time, the renewed Lisbon strategy for "Growth and Jobs" puts both the EU sustainability strategy and the 6th Environment Action Programme under pressure to justify themselves and deregulate.

The SRU recommends the following for improving the structure of European strategies:

– The EU sustainability strategy should be strengthened as an overarching framework, the primary goals of the Environment Action Programme and the Lisbon process "strategically" upgraded and their ongoing development and integration made possible *in the long term*.

– Preparations should get under way as soon as possible for the 7th Environment Action Programme which is scheduled to take effect starting in 2012. It will be more closely aligned with the Agenda 21 management concept and will provide an ambitious ecological foundation for the European sustainability process.

– Efforts at "reviving" the Cardiff process should instead be refocused on establishing environmental policy integration more firmly. The 7th Environment Action Programme could offer a suitable framework for these efforts.

Comparatively speaking, the German sustainability strategy has better institutional prerequisites with the State Secretaries' Committee for Sustainable Development *(Staatssekretärsausschuss)* and the Council for Sustainable Development *(Nachhaltigkeitsrat)* along with the 21 goals and indicators it has established. The independent reporting carried out by the Federal Statistical Office *(Statistisches Bundesamt)* should also be seen in a favourable light. The strategy, however, still needs improvement in key areas. For instance, the strategy mainly summarises existing goals and measures, therefore remaining an instrument without sufficient controlling effect. There are also pronounced shortcomings when it comes to policy integration.

The SRU recommends the following for improving the structure of the German sustainability strategy:

– Incorporating more goals relating to the condition of environmental media and a tighter feedback loop with environment-related sectoral policies,
– Developing *long-term goals* (through 2050),
– Strengthening the institutional and staff basis of the sustainability process by upgrading the "Green Cabinet" and holding regular "sustainability summits",
– Improving monitoring and evaluation by involving the departments more intensively and improving sustainability indicators,
– Improving horizontal policy integration by introducing a "sustainability audit",
– Improving vertical policy integration by linking the sustainability strategies of the Federal Government and the *Länder* more closely.

1.1 Introduction

1. The SRU has long been a proponent of strategic environmental and sustainability planning as outlined in the Agenda 21 management concept (see SRU 1996; 1998; 2000; 2002; 2004). The original discussion that took place about sustainable development in the early 1990s was shaped by environmental plans that focussed solely on ecological issues which were based on the Dutch environmental policy plan (1989) (JÄNICKE and JÖRGENS 2000). Since then, a "three-pillar concept" of sustainable development has gained acceptance internationally. Sustainability strategies today are seen as action plans created with the involvement of social actors that define media and sector-wide goals and priorities designed to ensure long-term, stable development of the economy, the environment and society. At first, this "three-pillar concept" was often associated with a restrictive understanding of environmental policy. In the meantime, this has given way to a view that breaks down non-sustainable developments into various fields of action and, in the process, attaches special importance to synergies between the environment and the economy. The SRU has emphasised the potential for innovation that exists here but, at the same time, represents an ecologically-oriented concept of "strong sustainability" that aims to keep the natural capital constant over time (see SRU 2002, Item 28 f.).

2. Since 1992, environmental and sustainability strategies have spread around the world more quickly than other environmental policy innovations (BUSCH and JÖRGENS 2005). Germany adopted a national sustainability strategy in April 2002 (Bundesregierung 2002). Several approaches are used at European level: these include (1) the EU sustainability strategy (2006), (2) the 6th Environment Action Programme (2002 to 2012) and (3) the "Cardiff Process" for environmental policy integration (1998). The Lisbon Strategy (4), which was refocused around the goals of "Growth and Jobs" in 2005, also has environmental relevance.

3. Even though environmental and sustainability strategies have become a permanent component of national and European environmental policy, their quality and function continue to be under dispute (see LUNDQVIST 2004; STEURER and MARTINUZZI 2005; GEORGE and KIRKPATRICK 2006; VOLKERY et al. 2006; MEADOWCROFT 2007; STEURER 2008). The issue here is also ultimately whether or not these types of strategies have added value as a new kind of "non-hierarchical management" (KNILL and LENSCHOW 2007). Using this debate as a starting point, the sustainability and environmental strategies in the EU and Germany are assessed in the section below so that recommendations can be made for how they should be structured in the future.

4. The strategies are evaluated on the basis of selected criteria that relate to the central management elements of Agenda 21 (1992) adopted in Rio de Janeiro (see SRU 2000, Item 1 ff.; 2004, Item 1198 ff.). These are the management elements that were also recognised as guiding principles for developing sustainability strategies in the "Rio Process". We will primarily assess the contribution to environment-related sustainability:

– *Goal orientation*: Formulation of quantifiable environmental goals with fixed timetables that further develop the existing system of goals to adequately address the problems.

A goal-oriented system serves as the basis for strategic environmental and sustainability planning. The goals in this system should be quantified with fixed timetables to ensure that they are binding and verifiable. The goals should also be "new" to the extent that they further develop the existing system of goals to address the problems adequately. This is the only way that the strategy can make a genuine contribution to management.

– *Results orientation*: Description of the planned implementation measures and definition of clear responsibilities for implementation.

In addition to the formulation of goals, concrete measures must be identified for attaining these goals. Defining the actors responsible for implementation determines who is responsible for what.

– *Monitoring and evaluation*: Binding reporting on the implementation and systematic evaluation of the policy results using indicators.

Monitoring and evaluation is required to manage goals and results. Reporting duties are defined for the actors responsible for implementation here. A system of indicators serves as the basis for evaluating the policy results.

– *Policy integration*: Integration particularly of environmental concerns into the polluting sectors (horizontal integration) and mobilisation of potential at various political levels (vertical integration).

Sustainability strategies should make a contribution to policy integration which plays a special role in environmental policy when it gets the polluter involved in solving the problem. Here, the way environmental concerns are taken into consideration in the primary polluting sectors (energy, agriculture, transport) has to be improved. Apart from this “horizontal” policy integration, the goal is also “vertical” integration between the political levels, which plays a significant role particularly in “multi-level systems” such as Germany or the EU.

– *Participation*: Active participation of actors from civil society.

The sustainability process should ultimately be supported by the active participation of associations and citizens from a broad social spectrum. Participative processes have a dual character here: on the one hand, they affect the decision-making process because they reduce the amount of information the decision-makers are lacking. On the other, they encourage implementation by getting people involved in the political arena.

1.3 The German sustainability strategy

50. Over time, Germany has both blazed trails and lagged behind with regard to environmental and sustainability planning. Germany assumed the role of pioneer at an early stage with the environmental programme of the social-liberal government (1971): this plan not only identified a number of long-term goals and concrete measures, it also made an early commitment to the idea of environmental policy integration which was translated into concrete terms with the institutions of the Cabinet Committee for Environment and the Permanent Committee of the Directors General for Environmental Issues (JÄNICKE et al. 2002). But, no later than under the conservative-liberal administration, strategic environmental planning lost support so that Germany lagged behind on this issue in the 1980s and 1990s. Even though the issue was put back on the agenda in the 1990s as a result of the Rio Process (1992), the successful work of two Commissions of Inquiry of the German Bundestag (lower house of parliament), and the “step-by-step process” initiated by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit – BMU) (1996 to 1998), this did not, however, lead to concrete results as was the case in many other OECD countries (Organisation for Economic Co-operation and Development) (for detailed information, see SRU 2000, Chap. 1; 2002, Item 274). It was only under the Red-Green coalition that a national sustainability strategy was successfully created and adopted on 17 April 2002 under the title “Perspectives for Germany” (Bundesregierung 2002).

Since 2002, efforts have been under way to implement and further develop the sustainability strategy. The first progress report was presented in the autumn of 2004 (Bundesregierung

2004). Just one year later, the Red-Green coalition government adopted a “Landmark Sustainability 2005” (Bundesregierung 2005) that replaced the second progress report scheduled for 2006 due to early *Bundestag* elections. After the change in government, the grand coalition affirmed its commitment to continuing and advancing the national sustainability strategy while retaining the established sustainability institutions (CDU et al. 2005, p. 58); it has yet to translate this commitment into concrete terms. Finally, an independent “Indicator Report 2006” was published (Federal Statistical Office 2007). This report gives a largely negative five-year assessment of the German sustainability strategy. The government is only on track for meeting its sustainability goals in renewable energies and – to a lesser extent – in climate protection. In contrast, hardly any progress has been made in meeting the goals set for resource conservation, land use, biodiversity and air pollution. As far as reducing the intensity of goods transport is concerned, developments to date are even diametrically opposed to the set goals.

1.3.1 Assessment

Goal orientation

51. At first glance, the German sustainability strategy appears to be highly goal-oriented. The starting point of the strategy is a fairly general “principle of sustainable development” which spans the four “coordinates” of intergenerational equity, standard of living, social cohesion and international responsibility. This principle is expressed in concrete terms, on the one hand, through a total of ten “management rules of sustainability” that go one step beyond the central management rules of the Commission of Inquiry for the “protection of people and the environment” in the environmental sector. The strategy also contains 21 core goals, most of which are quantified and have specific timetables (see Table 1-5). These individual goals are designed to be representative in covering the entire spectrum of sustainable development. Environmentally relevant goals are found for the areas of resource conservation, climate protection, renewable energies, land use, biodiversity, education, mobility, nutrition and air quality (SRU 2004, Table 3-3).

Including the 21 goals – most of which are verifiable – is a move to be welcomed and has rightly earned positive marks for the German strategy in an international comparison (e.g. VOLKERY et al. 2006; OECD 2006). The goal orientation of the strategy, however, still remains in need of improvement in several areas. On the one hand several (environmental) goals go way beyond existing agreements, something which distinguishes it from, for example, the EU sustainability strategy. These include the goals set in the areas of biodiversity, organic fapesticide use and land use. But overall, it lacks a comprehensive and, even more importantly, a long-term vision for the (environmental policy) goal structure. On the other hand, the environmental goals included up to this point have not been sufficient to cover the entire range of environmentally sustainable development. There are hardly any goals that have to do with the condition of the environment (e.g. water, soil; see also SRU 2004, Item 119 ff.) and this is precisely what long-term improvement has to focus on. Instead, central areas of the sustainability strategy rely solely on relative efficiency targets (e.g. doubling energy and raw material productivity by 2020). Relative efficiency gains are not very informative because they can be diminished, neutralised or even overcompensated if economic growth remains the same. This is confirmed by the “2006 Indicator Report” (Federal Statistical Office 2007, p. 5): for example, an increase in energy productivity of just under 31 % in the years between 1990 and 2006 only resulted in a relatively weak absolute decline in energy consumption of 3 % because the efficiency increase was largely offset by economic growth of around 27 %.

Table 1-5

Indicators and goals of the German sustainability strategy

		Indicator	Goal
1	Conservation of resources	Energy productivity	Doubling by 2020
		Raw material productivity	Doubling by 2020
2	Climate protection	Reduction of greenhouse gas emissions	21 % reduction by 2008/2010
3	Renewable energies	The proportion of total energy consumption attributable to renewable energies	4.2 % of primary energy consumption by 2010
			12.5 % of electricity consumption by 2010, 20 % by 2020
4	Land use	Increase in land use for housing and transport	Reduction in daily growth to 30 ha in 2020
5	Biodiversity	Stock of selected bird species	Stabilisation at high level in 2015
6	National debt	State deficit	Consolidation of the national budget
7	Provision for future economic stability	Ratio of gross fixed capital formation to gross domestic product (GDP)	Stimulating innovation
8	Innovation	Private and public spending on research and development (R&D)	Increase in R&D spending to 3 % of GDP in 2010
9	Education	Education situation of 25-year olds	Increase percentage of university graduates: 10 % in 2010, 20 % in 2020
			Percentage without secondary school diploma: 9.3 % in 2010 and 4.6 % in 2020
		Percentage of students starting at university	Increase to 40 % in 2010
10	Economic prosperity	GDP per capita	Economic growth
11	Mobility	Transport intensity of passenger and goods traffic	Passenger traffic: reduce to 90 % of 1999 by 2010, 80 % by 2020
			Goods transport: reduce to 98 % of 1999 by 2010, 95 % by 2020
		Percentages of rail transport and inland water transport in total goods transport	Percentage by train by 2015: 25 %
			Percentage by ship by 2015: 14 %
12	Nutrition	Nitrogen surplus in farming	80 kg yield/ha farmland by 2010
		Development of land for organic farming	Percentage of agricultural land: 20 % by 2010
13	Air quality	Air pollution	Reduction to 30 % compared to 1990
14	Health	Premature death	Decline
		Satisfaction with health	Stabilisation at high level
15	Crime	Burglaries	Decline in cases to 117,000
16	Employment	Employment rate	70 % in 2010
17	Perspectives for families	All-day day care for children in the West German *Länder*	30 % in different age groups
18	Equal opportunities	Women's average earnings as % of men's average earnings	85 % in 2015 (West German *Länder*)
19	Integration of immigrants	Foreign school dropouts without diplomas	Decline
20	Development cooperation	Public development cooperation	Percentage of development cooperation in GDP: 0.33 % in 2006
21	Opening markets	Imports to the EU from developing countries	Increase

Source: Bundesregierung 2004, p.37f.

Results orientation

52. The goals set in the strategy are to be implemented in concrete measures in eight fields of action: energy supply; environmentally friendly mobility; agriculture and consumer protection; demographic change; education; innovation; land use and global responsibility (Bundesregierung 2002).

The first three areas are classified as priorities for the period between 2002 and 2004 and supported by measures. Only a general work programme with no concrete measures is provided for the other fields of action. The “Progress Report 2004” also develops several other focal points. These include the potential of older people, a new energy supply structure, alternative fuels and the reduction of land take (Bundesregierung 2004). The “Landmark Sustainability 2005” report also identifies six areas of action (energy supply, biomass, forward-looking forestry management, protection of biological diversity, “intergenerational balance” and corporate social responsibility).

Defining high-priority fields of action and measures is necessary and thus seen as positive. Nevertheless, the measures remain inadequate because – similar to the goals – they only largely reflect those policies of the Federal Government that have already been introduced. More ambitious planning measures that go beyond the status quo are, in contrast, either vague or totally non-existent. Which means there are no concrete and long-term timetables for reaching the goals in traffic reduction, organic farming and ecological forest conversion (see also LITTMEIER 2004, p. 21). Also with regard to the ambitious goal of reducing land take, credibility can be only established by adopting suitable measures. Even though constructive improvements were made in this area in the “Progress Report 2004”, these measures continue to be insufficient – particularly without the involvement of the *Länder* (see also DNR et al. 2005, p. 25 ff.).

In terms of assigning responsibilities for implementation, the successful institutionalisation of the German sustainability strategy really stands out at first glance, even on an international comparison. In the “Green Cabinet” overseen by the head of the Federal Chancellery, the strategy has a “central development and implementation office” which – potentially – makes it possible to coordinate the focus on the goal of sustainability across departments and makes strategy easier to enforce. Lessons were thus drawn from the inadequate institutionalisation of the “step-by-step process” mentioned above (1996 to 1998). At that time, the draft of an environmental policy programme made up of key-points created by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety found no backing in the other departments and was never adopted.

In actual political practice, however, the “Green Cabinet” has only been able to fulfil its role as a central management office in certain areas. This is due, on the one hand, to the low political priority of the sustainability strategy which is underscored by infrequent and irregular meetings of the State Secretaries’ Committee for Sustainable Development (approx. one to three times a year). On the other hand, adequate human resources are lacking in the Federal Chancellery where a competent but undersized group is responsible for developing and implementing the strategy. In this respect, it has if anything been detrimental for the sustainability strategy to be part of the environmental department of the Federal Chancellery, and it is thus often perceived as a purely environmental matter in the conflict between departmental interests.

In the end, the implementation responsibilities borne by the individual ministries are – unlike, for example, those in the climate programme of the Federal Government – not binding. The strategy's binding character is thus weak. There are currently no plans to implement the national strategy in sectoral strategies in Germany as is the practice in several other countries (JACOB and VOLKERY 2007, p. 437).

Monitoring and evaluation

53. A positive feature of the German sustainability strategy is its clearly institutionalised and functioning monitoring process. The system of 21 key indicators provides a yardstick which makes the German sustainability policy verifiable. The indicators are monitored as part of biennial progress reports that are created by the State Secretaries' Committee for Sustainable Development and passed by the Cabinet. The "Progress Report 2004" not only highlights the development of the key indicators, it also contributes to their further development and improvement in individual cases (e.g. indicator for biodiversity). It is also positive that the "Indicator Report 2006" was written by an independent third-party, the Federal Statistical Office. A transparent and credible monitoring process has hence been successfully established. It does not gloss over the fact that most goals have gone unmet, and it suggests where more work can be done. The progress and indicator reports mentioned are also enhanced by the dialogue and critique processes of the Council for Sustainable Development (RNE) and the German Advisory Council on Sustainable Development.

Regardless of this positive assessment, there is still need for improvement in monitoring and evaluating the German sustainability strategy. This applies to the selection of indicators which – similar to the set goals – cannot adequately cover the entire spectrum of ecologically sustainable development. Indicators do not exist for the condition of environmental media, nor are there parameters for long-standing unsolved environmental problems (e.g. use of pesticides). Some environmental indicators also run the risk of painting a positive picture of development that is unwarranted. This applies in particular to indicators such as "energy and raw material productivity" that only express relative "impact intensities".

Environmental policy integration

54. A particularly positive highlight with respect to the stated goal of horizontal environmental policy integration is that the German sustainability strategy in its environmental policy focus concentrates on the central polluting sectors (energy, transport, agriculture, construction and residential areas). The strategy also has an institution, the "Green Cabinet" under the auspices of the Federal Chancellery, which is suitable in principle to push cross-departmental coordination with the aim of integrating environmental policy.

Still, genuine impetus for more horizontal integration has only been generated in individual cases by the German sustainability strategy. This is primarily due – as already explained – to the fact that there are hardly any environmental policy goals and measures that go beyond the status quo. In the area of "construction and housing" alone, an important integration process was introduced with the ambitious land use target which was translated into concrete terms in the "Progress Report 2004" and was ultimately pushed forward by measures – motivated by financial policy – such as the elimination of the owner-occupied homes allowance and the reduction of the distance-based tax allowance. Apart from that, it does not systematically confront polluters with the environmental damage they are responsible for, e.g. in the form of long-term, sector-specific targets and strategies. In addition, the sustainability strategy fails to institutionalise the principle of environmental policy integration through overarching mechanisms – as was the case in many other OECD countries (JACOB and VOLKERY 2007, p. 437). These include, for example the method of integrated impact assessment (e.g. EU, United Kingdom) or reviewing the budget in consideration of environmental and sustainability aspects (e.g. Norway). Another shortcoming is the missing link between the sustainability strategy and other strategy processes like "Agenda 2010". When the social security systems were restructured, an opportunity was missed to set an ecological trend by updating the ecological tax reform or eliminating environmentally harmful subsidies.

Nevertheless, considerable progress has been seen in integration in several polluting sectors (e.g. energy policy) over the last few years. However, this progress did not come about from the "top down" through the national sustainability strategy but can be traced to "bottom-up" factors in specific sectors (WURZEL 2008).

55. With respect to the stated goal of vertical policy integration, it is positive that the large majority of *Länder* now have their own sustainability strategy (see Bundesregierung 2007, p. 22 ff.; DNR 2007, p. 39 ff.). It should also be acknowledged that the Federal Government and *Länder* have continuously exchanged information about the goals and measures of sustainable development within the framework of the Federal and Regional Working Association on Sustainable Development (*Bund/Länder-Arbeitsgemeinschaft Nachhaltige Entwicklung – BLAG NE*) set up in 2001 (Bundesregierung 2007, p. 21 ff.). In addition, a common system of 24 environmental indicators was developed as part of the

"*Länder* Initiative for a Set of Core Indicators". This system is gradually becoming more and more consistent with the ecologically aligned indicators of the national strategy (for more details see EWEN and SCHÄFER 2007, p. 4).

Still, the vertical integration between the sustainability strategy of the Federal Government and the strategies of the *Länder* should be further developed overall (see also DNR 2007): the sustainability strategies of the *Länder* are mostly created without any – substantial – relation to the national strategy, meaning that the set goals are not really coordinated and that measures and reporting periods also vary. In addition, the increasing harmonisation of the ecologically aligned federal and regional indicators mentioned above is at risk due to continued differences in definitions and methods (for detailed information, see EWEN and SCHÄFER 2007, p. 4 f.). In the meantime, BLAG NE was absorbed into a new Federal and Regional Working Association on Climate, Energy, Mobility and Sustainability in September 2007. It remains to be seen what this means in concrete terms for the future institutional structure of federal-regional cooperation.

Participation

56. In terms of the participation of social groups in forming the goals, one highlight is the positive role of the Federal Government's Council for Sustainable Development (RNE). The RNE is currently made up of 17 public figures. It has effectively performed its dual function of advising the Federal Government on all questions regarding the sustainability strategy and of communicating the idea of sustainable development to the general public within the scope of its limited possibilities. In addition, numerous suggestions were made for the goals, measures and indicators in the sustainability strategy (for detailed information, see RNE 2007, p. 26 ff.) that were often taken into consideration in the (further) development of the strategy (see also OECD 2006, p. 25). Moreover, the Council for Sustainable Development has carried out a number of communication projects to strengthen the public perception of sustainability issues (for details, see RNE 2007, p. 20 ff.).

There are, however, also weaknesses here to overcome. Even though public consultations were carried out with the involvement of a number of social actors as the strategy (2001 to 2002) and the first Progress Report (2003 to 2004) were being created (www.dialog-nachhaltigkeit.de), the social participation was still criticised because the timeframe for the public consultations was extremely limited and the actual involvement in the process of formulating the strategy was probably quite low (VOLKERY 2004, p. 8). Instead, the key content of the German sustainability strategy was coordinated in a process in the Federal Chancellery with little public access that merged the content developed by the sectoral ministries. There was also extremely little involvement in this process by representatives of science and parliament. Overall, it also has to be said that the German public is largely unaware of the German sustainability process. This is due in part to the fact that the Federal

Government did not adequately promote the sustainability strategy – as they did, for instance, with “Agenda 2010”. The media also continue to show little interest in the rather abstract concept of “sustainability”.

Overall assessment

57. On an international comparison, the German sustainability strategy is considered a positive example (e.g. OECD 2006, VOLKERY et al. 2006). This assessment is based in part on the inclusion of the 21 – for the most part verifiable – goals, the meaningful institutionalisation through the “Green Cabinet” and the Council for Sustainable Development, and a largely functioning monitoring process. The German strategy still needs improvement in several key areas (see Table 1-6). It primarily summarises existing goals and measures and thus remains an instrument without adequate controlling effect. There are distinct deficits in policy integration.

Table 1-6

Evaluation of the German sustainability strategy

	Elements of strategic environmental and sustainability planning									
	goal orientation			*results orientation*		*monitoring and evalution*		*policy integration*		*participation*
	quantified	with timetables	„new“	measures	responsibilities	binding reporting	indicators	horizontal	vertical	
sustainability strategy (2002)	green	green	yellow	yellow	yellow	green	yellow	red	red	green

green: relatively comprehensive, satisfactory consideration

yellow: positive elements, but overall insufficient consideration

red: no or marginal consideration

SRU/UG 2008/Tab. 1-6

1.3.2 Recommendations

58. The SRU makes the following recommendations to improve the structure of the German sustainability strategy:

– *“Strategic” upgrade of existing (environmental) goals:* Within the framework of the German sustainability strategy, central goals with “sustainability standing” should be summarised as before in the short-term and hence upgraded in political terms. In doing so, other goals having to do with the condition of environmental media (e.g. water, soil) should be taken into consideration instead of relative efficiency targets. It must also be ensured that there is a tight feedback loop between the sustainability strategy (“top-down”) and the ecological sectoral policies ("bottom-up") so that the sector-based learning processes (for example, energy/climate) can be rapidly integrated into the sustainability process.

- *Development of long-term goals (through 2050):* At the same time, there has to be a place in Germany where *long-term* prospects and problems can be the focus of discussions. Long-term goals through 2050 should be developed with broad participation. The overarching planning process ("top-down") would thus offer the (ecological) sectoral policies a long-term orientation and it would be strengthened in its controlling effect.
- *Strengthening the institutional basis of the sustainability process:* The institution of a "Green Cabinet" is an important prerequisite for pursuing an ambitious sustainability strategy. The institutional basis, however, needs to be strengthened. We recommend defining a meeting cycle of at least once a quarter. An independent organisational unit should exist in the Federal Chancellery that is adequately equipped to handle its coordination functions. In addition, the ties between the Green Cabinet, the Council for Sustainable Development and other stakeholders should be improved.
- To accomplish this, we recommend holding a *sustainability summit* every two years that brings together the relevant actors for structured discourse (RNE, "Green Cabinet", interest groups, representatives of the *Länder* and the central associations of the local authorities). They would be responsible for assessing the sustainability process and adjusting its goal structure. It would also be conceivable to focus on specific issues (e.g. generating electricity from coal). The crucial factors are scientific input for long-term development and achieving the objectives (Federal Statistical Office, Federal Environment Agency), reporting by key departments on central problem areas (non-sustainable trends) and follow-up dialogue with stakeholders. The State Secretaries' Committee for Sustainable Development should be responsible for preparing the sustainability summit and coordinated with the Council for Sustainable Development.
- *Improving monitoring and evaluation:* The existing monitoring process could be improved by greater departmental involvement. It would be conceivable to have a process by which each department presents a sustainability report in the "Green Cabinet". This would create a political competition for contributions to the sustainability strategy. We also recommend improving the sustainability indicators. Other indicators having to do with the condition of environmental media should be integrated – as was the case with the goals. The role of the Federal Statistical Office in reporting on the sustainability process is considered a positive highlight.
- *Horizontal (environmental) policy integration through "sustainability audit":* The stated goal of horizontal policy integration should be institutionalised through the introduction of a "sustainability audit" as it is at EU level and in a number of member states. To achieve this goal, sustainability criteria need to be integrated into the ongoing legal impact assessment and applied there.

– *Improving vertical policy integration*: The vertical integration between the sustainability strategy of the Federal Government and the strategies of the *Länder* needs considerable improvement. A process would be conceivable by which the goals, measures and indicators are coordinated on a regular basis and the reporting periods harmonised. The institution of a “sustainability summit” could offer a suitable framework for this process. The Austrian national sustainability strategy by which the Austrian *Länder* contribute to the implementation of the national strategy in programmes of measures can provide orientation here.

2 Innovation-oriented environmental policy – a new mega-trend?

Messages

Ecologically efficient technologies feature unusually strong growth and are currently establishing a “mega-trend” in technological development. In the last few years, more and more industrialised countries – primarily in Europe – have set their sights on this development and have shifted to an environmental policy geared toward innovation. As the German Advisory Council on the Environment (SRU) sees it, however, the focus is less on environmental innovations in and of themselves, which have long been the subject of discussion. Instead, it is about an innovation process that effectively deals with environmental issues and fully exploits the considerable potential of this technology-based approach. The prerequisite for achieving this is an ambitious structure for innovation-oriented environmental policy. This structure still needs to be made more concrete both in Germany and the European Union (EU).

The following approaches should be pursued more vigorously:

- Focus on “strong” environmental innovations: Innovation-oriented environmental policy should concentrate on innovations that, on the one hand, aim to do more than just making incremental improvements and, on the other, achieve a high level of market penetration (internationally as well). Even the most radical improvement in environmental technologies will not contribute much to reducing environmental burdens if it does not meet with widespread acceptance.
- An active role of the government: Incremental innovations or those limited to niche markets can usually be left to the innate dynamics of the market. This is not usually the case for “strong” environmental innovations. These innovations, and the high ecological performance expected from them (and the increase in the pace of technical progress that goes along with it), imply ambitious goals that go beyond the “normal” ability of the market to innovate. The search for suitable regulatory models plays an important role here.
- Ambitious structure of the policy mix: In addition to the environment-related infrastructure in research and development, the entire innovation process starting from market launch through to global distribution has to be stimulated. A hybrid regulatory model which combines general monetary incentives (e.g. by means of emissions trading) and product-specific regulation (e.g. dynamic energy efficiency standards) generally plays a key role here. Market-based and regulatory provisions, however, usually also require supporting instruments. Ambitious environmental policy targets are a basic prerequisite for everything.

– Eco-design of products and processes: Pushing product-related environmental innovations that also affect the production processes using the life cycle approach is practical in environmental policy terms and is particularly promising. In the interest of minimising the extent to which the government's capacities for action is used, product groups that have the greatest negative impact on the environment and the most beneficial potential for reducing environmental burdens have priority. It is not possible to achieve a significant, dynamic increase in eco-efficiency, however, via product regulations alone. Eco-efficiency innovates products and product classes as such but does not create any incentive to change to more environmentally friendly products or product classes (e.g. smaller cars). This incentive has to be created by monetary instruments (e.g. differentiated environmental taxes or emission trading).

Taking the limits of innovation-oriented environmental policy into consideration: The limits of innovation-oriented environmental policy are on the one hand the result of the fact that not all environmental problems can be solved by technology (e.g. biodiversity, land). These non-technical areas must not be neglected in the current euphoria surrounding innovation in environmental policy. On the other hand, it must be kept in mind that innovation processes are ambivalent and, as processes of "creative destruction", also produce "modernisation losers" whose resistance has to be expected. And finally, it is necessary to mention the limits of a policy-driven innovation strategy: for politicians, the key factor will be to keep in mind the difference between forcing industrial potential for innovation and excessive interventionism. Investment cycles in the economy have to be taken into account, the effects of overheating avoided, set timetables given to assistance measures, and competition boosted.

2.1 Introduction

59. The issue of "innovation-oriented environmental policy" making news today has a history that goes back more than thirty years. As early as 1974, the Japanese Ministry of International Trade and Industry (MITI) came up with an economic concept that ascribed great importance to knowledge-intensive, environmentally-compatible and resource-conserving production (MITI 1974). HAUFF and SCHARPF referred to this concept and, in 1975, recommended an innovation-oriented industrial policy that also keeps the "new market" for resource-conserving and environmentally compatible technologies in sight (HAUFF and SCHARPF 1975, p. 115 ff.; see also JÄNICKE 1978; 2008). At the same time, environmental economists emphasised that environmental policy ultimately needed to rely on technological change (KNEESE and SCHULTZE 1975). Ashford from the Massachusetts Institute of Technology (MIT) in the USA discovered as early as 1979 – long before his Harvard colleague, Porter (PORTER 1991; PORTER and van der LINDE 1995) – that government environmental regulations stimulate innovation (ASHFORD et al. 1985; ASHFORD 2005). In Germany, ideas for making technical progress "greener" have been developed since the 1980s (HUBER 1982; JÄNICKE 1984). The concept of ecological modernisation and the "greening of industry" formula characterise the continued debate about innovation, each with different semantics.

The new concepts that were created and what was seen as politically necessary and possible were reflected only very slowly in actual development. That this, however, could be a stable trend or a long-term economic cycle supported essentially by resource-conserving technologies more strongly aligned with ecological issues was realised as early as the beginning of the 1980s. Technologies that concentrated on environmental protection, recycling, efficient energy use and alternative energies were already considered the four most important technological drivers of long-term growth in the Prognos Euro Report 1983 (Prognos AG 1982; see also JÄNICKE 1985).

In the meantime, this prediction and its conceptual predecessor have largely proven accurate. Ecologically-efficient technologies feature unusually strong growth and are currently establishing a "mega-trend" in technological development. In the last few years, more and more industrialised countries – primarily in Europe – have set their sights on this development and have shifted to an environmental policy geared toward innovation. Stimulating environmental innovations has thus not just become a key category of environmental policy, it is also part of a strategic concept for stimulating growth and jobs.

60. The SRU addressed the issue of an innovation-oriented environmental strategy in detail in its Environmental Report 2002 (SRU 2002, Item 42 ff.). In this report, it emphatically stressed the considerable ecological as well as economic opportunities offered by an environmental policy based on technological progress and the political trailblazer role associated with it. It thus welcomes the initiatives undertaken by Germany and the EU in this direction. In environmental policy terms, however, it is less about environmental innovations in and of themselves that have long been the subject of discussions. The focus instead is an innovation process that effectively deals with environmental issues and fully exploits the considerable potential of this technology-based approach in the interest of vital solutions to problems in environmental policy. More has to be done to achieve this goal.

The first part of this chapter discusses the structure, growth and function of the "new environmental industry" (Chap. 2.2). Then thoughts as to how environmental policy could adequately capitalise on this enormous potential for growth (Chap. 2.3) are presented. From the SRU's point of view, the ecological efficiency of innovation processes should be the focus of targeted stimulation of environmental innovations (Section 2.3.1). This is followed by a discussion of the instrument structure of an innovation-orientated environmental policy geared toward ecological efficiency (Section 2.3.2). Product-specific environmental regulation is addressed separately (Section 2.3.3). The approaches to ecological industrial policy in Germany and in the EU are then described and assessed (Chap. 2.4) within the context of these considerations. Finally, the limits of innovation-oriented environmental policy are discussed (Chap. 2.5).

2.2 Rapid growth of the environmental industry

Structure of the environmental sector

61. According to Roland Berger, the environmental industry in Germany had sales totalling 4 % of the gross domestic product (GDP) in 2005 (BMU 2007a). According to the German Institute for Economic Research (DIW), the number of jobs in this sector made up a similar percentage in 2004 with 1.5 million (BMU 2006a, p. 13). An extensive study estimated sales for the EU-15 at € 214 bn for 2004. This represents 2.3 % of the GDP. Employment for the EU-25 is estimated at 3.4 million “full-time job equivalents”. Germany is the largest supplier of environmental goods and services in the EU, followed by France and the United Kingdom (Ernst & Young 2006). Special studies of the United Kingdom or Austria attest to the major importance of the environmental industry (DTI and DEFRA 2006; KÖPPL 2007).

The extensive scope of the “environmental industry” is still underestimated due to problems collecting data and establishing definitions. A British study thus calls it an “invisible industry” (DTI and DEFRA 2006). This underestimation is manifested in the influential study conducted by Ernst & Young (2006) for the EU: key areas are missing because they cannot be accurately documented by statistics. This applies to the “eco-construction” sector, whose size is estimated to be around € 40 bn in the EU, or to the expenditures for environment-related research and development (approx € 2.5 bn) or to monitoring (€ 1 bn). These sector totals are mentioned but not included in the overall total (as they are supposedly less reliable) (Ernst & Young 2006, p. 15). Also not included in the calculation are suppliers of eco-tourism, ecological financial services (KfW banking group, German Federal Foundation for the Environment *(Deutsche Bundesstiftung Umwelt – DBU)*, organic products or other specific environmentally friendly products (e.g. energy-efficient “top runners”). In this respect, the scope of the eco-industry indicated is a more conservative estimate. Even just including the estimates for “eco-construction” would increase the percentage this industry has in the GDP of the EU-15 to 2.7 %.

The EU study estimates that the environmental industry makes up 3 % of the GDP in Germany; Roland Berger calculates a figure of 4 % (Ernst & Young 2006; BMU 2007a). A study on the British environmental industry also arrives at a higher overall total (DTI and DEFRA 2006). In this respect, a percentage of 2.7 % for the EU-15 should be regarded as a lower limit. These discrepancies are also affected by differences in definitions (Table 2-1). Because theses ill-defined sectors often undergo particularly dynamic growth, the limitations made here are important.

Defining the environmental industry

The definition of environmental industry used here is based on a definition from Eurostat and OECD (Organisation for Economic Co-operation and Development) as the total of companies that manufacture goods or services both for conventional, downstream environmental protection (pollution management, end-of-pipe treatment) and for integrated environmental improvements (cleaner/clean technology, resource management) (Ernst & Young 2006).

In a study on the “environmental industry” for the European Commission, Ernst & Young (2006) make a distinction between two parts of the environmental industry:

– Pollution management: “[…] sectors that manage material streams from processes (the technosphere) to nature […] typically using ‘end-of-pipe’ technology” and

– Resource management: “sectors that take a more preventive approach to managing material streams from nature to technosphere”.

A problem of definition naturally occurs here with regard to the scope of the “preventive approach” and the respective efficiency increase. To solve this, sub-classes such as “renewable energies”, “recycling” or “eco-construction” are used. Regardless of this problem of definition, the dual distinction mentioned makes sense. However, unlike in the study and for Eurostat (DTI and DEFRA 2006), “clean(er) technology” should be assigned to the resource management sector because the term generally means technology that is more eco-efficient. This distinction also underscores the specifics of end-of-pipe environmental protection technology. This makes it clear that this additive environmental protection technology not only produces additional costs, it also uses additional resources (e.g. using lime for flue gas scrubbing or material for soundproofing walls). In the resource management sector, in contrast, more efficient resource use typically results in at least a relative cost saving. This opens up the option (which can also be observed in actual developments) of pursuing process or product innovations instead of more expensive environmental protection systems. This also explains why the demand for conventional environmental protection technology is falling in Germany but the resource management sector is booming. Innovations are also taking place in conventional environmental protection technology (clean-up technology) and they can considerably reduce selective environmental burdens as was the case with filter technology (KUEHR 2007). Environmental innovations with integrated solutions for processes and products (cleaner/clean technology) are, however, generally more efficient.

Growth dynamic of the environmental sector

62. The real growth in global demand of the environmental industry is estimated by Roland Berger – on the basis of a demand volume of €1,000 bn (2005) – at 5.4 % annually until 2020. Real growth of 8 % is projected for the German environmental sector until 2030 which would represent an increase in the percentage of GDP to 16 % (BMU 2007a). The European environmental industry also shows stable growth with high growth in the resource-conserving technology sector (Ernst & Young 2006). Growth of the environmental sector in the United Kingdom was estimated at £16 bn and 170,000 employees in 2001, and £25 bn and 400,000 employees for the year 2004 (DTI and DEFRA 2006). This type of disproportionately high growth is also expected for countries such as Austria (KÖPPL 2007).

A survey of 1,500 companies for the sector of eco-efficient technologies produced the following picture (the distinctive term “GreenTech” is largely the same as the term used above of efficient “resource management”):

The economic projections mentioned above may not be realistic in view of the slowed economic development that lasted until 2005. According to the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the German environmental sector grew by a total of 10 % between 2002 and 2004 (Federal Environment Ministry 2006a). On the other hand, caution should naturally be exercised when assessing the long-term outlook for growth of the environmental sector.

Causes of growth dynamic

63. The growth dynamic of the German and European environmental industry described above can be explained by the interaction of a number of drivers. They are the following:

– First, this growth cannot be explained without the active environmental policy in Germany and Europe to date (e.g. Ernst & Young 2006). Ambitious environmental regulation is one of the most important factors driving the innovation competition between developed industrial countries.

– The increase in energy prices and the costs of raw materials is the functional equivalent to an environmental policy that operates on the basis of the price mechanism. Here, one of the key factors is the exploding demand for raw materials from countries such as China, India or Brazil. The price increase reinforces learning processes that already led to a realignment of energy policy during the oil price crisis in countries such as Japan and the US.

– The foreseeable costs of damage caused by climate change or those that have already been incurred have also mobilised the public. This mobilisation is strengthened by current information about growth-driven environmental damage in emerging economies with high levels of industrial growth.

Table 2-1

Structure and dynamic of German "GreenTech"

	German share of global GreenTech market (%)	Annual growth in sales 2004-2006 (%)	Projected annual growth in sales 2007-2009 (%)
Environmentally friendly energy production	*30*	*30*	*27*
Energy efficiency	*10*	*21*	*22*
Raw material and material efficiency	*5*	*11*	*17*
Closed cycle management	*25*	*13*	*11*
Sustainable water management	*5*	*12*	*15*
Sustainable mobility	*20*	*29*	*20*

SRU/UG2008/Table 2-1; data source: BMU 2007a, p.2 and 14

Stated political goal of technology leadership
in climate-friendly technologies

- The European Commission's goal (2006) is "to become world leader in renewable energy" and "the world's most energy-efficient region".
- "[…] Norway shall be […] world leading (in) environmental friendly energy (Minister Enoksen, 2005)"
- A Finnish regulatory commission (2005) proclaimed its goal to establish Finland as "one of the most eco-efficient countries".
- Tony Blair (2004) declared his intention to establish Great Britain as a frontrunner in the area of climate-friendly technologies.
- Premier Ahern (2006) wants to make Ireland the "world leader […] in the areas of renewables […] and energy efficiency".
- Schwarzenegger (2006) wants to make California the "world leader" in climate policy.
- The Japan top-runner programme has the slogan "Developing the World's Best Energy-Efficient Appliances".

(own compilation based on ENDS Europe DAILY)

- Over the last few years, more and more industrialised countries have shifted to a more innovation-oriented alignment of their environmental policy. This has also influenced the international innovation competition and stimulated the respective political competition. In the meantime, a whole range of governments (Germany, Great Britain, Sweden, Norway, Finland, Japan, California, South Korea, Ireland) have stated that their goal is technological leadership in climate-friendly technologies (see box above).

– In environmentally intensive companies, the combination of climate change and higher energy prices increases their economic vulnerability and the uncertainty about future developments. Investment risks caused by environmental factors for companies have increased in a variety of ways (for the energy sector, see IEA 2003). For many companies, it has thus become more attractive when possible to go to the “safe side” with regard to environmental concerns. This stimulates demand for goods and services that contribute more specifically to environmental protection and more generally to eco-efficient resource use in particular. Companies that satisfy this demand form the new type of “environmental industry”. The latter is increasingly also discernible as a political actor (and lobbyist) (see box below). Interestingly enough, companies in the European environmental sector are calling for regulatory measures in particular (HENZELMANN et al. 2007, p. 9).

Pioneer companies call for environmental regulation

– EUCETSA (European Committee of Environmental Technology Suppliers Association, lobby organisation for environmental technology, 2006): “The reality is that regulation drives this industry”.
– SUN MICROSYSTEMS (2006): “We want standards and market opportunities for companies that meet them”.
– NOKIA (2006): “Better regulation […] provides incentives to front-runners”.
– HP (Hewlett-Packard, 2007): “We want standards to drive energy efficiency”.
– European Lamp Federation (2007): is calling for a political initiative to eliminate energy-inefficient lighting.

(own compilation based on ENDS Europe DAILY)

64. The high level of growth in the environmental industry can also be explained by its fundamental functional significance in the industrial growth process:

– The production of the environmental industry is necessary to keep the external cost of damage caused by environmental factors and declining standards of living brought about by industrial growth within tolerable limits. The objective significance of these limits become clear no later than when they are politically manifested in environmental crises and protests (Japan, USA, Eastern Europe, most recently China).
– Global industrial growth requires eco-efficiency at an ever higher level in light of the limited reductions and the scarcity of many resources. It is this dynamic that explains the

special significance and permanence of environmental innovations. The importance of this innovation process is comparable to the secular increase in work productivity.

– The “negative growth” requirement of ever increasing eco-efficiency ensures a potential demand for the respective innovations that is both long-term and global (“global environmental needs”). In addition to the negative requirement of averting harm, the environmental industry can also experience a “positive” stimulus for demand through the stated structural goals of the political and societal spheres. These societal standards also generally rise with higher levels of prosperity and education (see KUCKARTZ and RHEINGANS-HEINTZE 2006).

– Its own growth dynamic notwithstanding, the significance of the environmental industry and the specialised suppliers of environmental innovations lies in its modernisation function for the developed economies overall: they offer technological products and services for companies who come under pressure to make environmentally-related changes or who are striving to establish a reputation through additional environmental improvements. As a knowledge and innovation-intensive industry, the environmental sector appears to make a disproportionately high contribution to added value and increasing productivity in the economy (DTI and DEFRA 2006, p. 6).

The major significance of environmental innovations in global industrial growth makes it plausible that the environmental sector will experience stabile growth (JÄNICKE and JACOB 2006; see also DTI and DEFRA 2006). It also makes it clear why projections for global competition at the expense of environmental policy (race to the bottom) have not become a reality. In the meantime, however, it is no longer about whether industrial growth benefits environmental innovations but whether these innovations bring about the positive environmental impact required. The following sections address which type of environmental innovations should be sought and how they can be reached.

2.3 Governance of environmental innovations

65. Environmental innovations are motivated by a complex interaction of a number of factors both internal and external to a company (see SRU 2002, Item 51; BERNAUER et al. 2007; JAFFE et al. 2004). Political measures play a central role here. This is, in particular, owing to the fact that the products and processes developed generally lead to an improvement in environmental quality for which there is no direct market trade-off. But even when companies can expect benefits from adopting an environmental innovation, there are often internal obstacles hindering the implementation of the appropriate measures. These include, in particular, a lack of knowledge, time, capital and organisational responsibility (BRÜGGEMANN 2005).

Overall, this means that the emergence and spread of environmental innovations requires an active role on the part of the government. However, environmental innovations are not a goal in and of themselves but only justified as a means to attaining existing environmental quality goals. With this in mind, policy should concentrate on the ecological efficiency of innovation processes. The following section thus advises focusing on “strong” (as opposed to “weak”) environmental innovations (Section 2.3.1). This is followed by a discussion of the structure of instruments of this type of innovation-orientated environmental policy (Section 2.3.2). The approach of a product-specific environmental regulation is considered separately (Section 2.3.3).

2.3.2 Instruments for innovation-oriented environmental policy

69. When it comes to stimulating environmental innovations, a distinction is made between innovation policy instruments and environmental policy instruments. These instruments should affect the entire innovation cycle which, according to Schumpeter, can be broken down into the three phases of invention, innovation (market launch) and diffusion (see also Centre for European Economic Research and Environmental Policy Research Centre, ZEW and FFU 2007, p. 33 ff.). According to this breakdown, invention represents the idea of a new product that is turned into a marketable product through innovation, while diffusion describes the subsequent process of market penetration of the innovation.

Table 2-2 identifies a set of central starting points for how the innovation cycle can be influenced in its three phases using various innovation and environmental policy instruments. The section below explains the starting points for an innovation-oriented environmental policy in brief. The focus of this description is explicitly on the specific environmental policy instruments.

70. *Innovation policy* instruments are geared primarily toward the phases of invention and market launch (see Table 2-2). The most important innovation policy instrument in this context is direct (project) funding for research and development (R&D) and funding for market launch. Government research subsidies, particularly with regard to fostering radical environmental innovation, are indispensable given their initial distance from the market.

71. In contrast, *environmental policy* instruments should ensure that environmental innovations can compete with conventional products and processes. In the meantime, there is widespread consensus among researchers that the development and spread of ecological forward-looking technologies requires – in addition to calculable and ambitious targets – a mix of environmental political instruments (e.g. JÄNICKE 1996; KLEMMER et al. 1999; BLAZEJCZAK et al. 1999; EKINS and VENN 2006; BERNAUER et al. 2007; IPCC 2007). Consequently, the challenge lies not in selecting the individual instruments but in finding the best possible structure for the “policy mix”. With this in mind, the following section first discusses in brief the significance of the most important environmental policy instrument groups:

– Monetary instruments,

– Regulatory instruments,

– Supporting instruments.

Then, the opportunities presented by “smart regulation” by combining various instruments are addressed.

Table 2-2

Starting points for an innovation-oriented environmental policy

Instrument/phase	**INVENTION**	**MARKET LAUNCH**	**DIFFUSION**
Innovation policy instruments			
Direct project funding	Direct funding of research and development (R&D)	Direct funding of the market launch	
Environmental policy instruments			
Monetary instruments			
Taxes	General monetary incentives to influence the direction of technical progress		
Tradable use rights			
Subsidy-like funding	Specific monetary incentives to stimulate specific technologies		
Regulatory instruments			
Requirements, bans, limits	Product specific regulation beyond the current state of technology		Definition of standards based on the current state of technology
Supporting instruments			
Ecological procurement			Use of the government’s demand power
Environmental labels			Improving consumer information
Source: Centre for European Economic Research and Environmental Policy Research Centre, ZEW and FFU 2007, modified			

Monetary instruments

72. Monetary instruments include taxes and tradable emission rights on the one hand (economic instruments in a stricter sense) and subsidy-like funding on the other.

Taxes and tradable emission rights can potentially affect all three innovation phases (see Table 2-2) because they correct the structure of the relative prices of production factors in favour of the factor of the “environment” and thus improve the direction of technical progress. Their increased use is hence central and indispensable for an innovation-oriented environmental policy as a framework for guiding general trends. To be able, however, to achieve far-reaching innovation effects in the sense of “strong” environmental innovations, taxes and tradable emission rights have to be ambitiously structured (i.e. ambitious taxes and target quantities). Empirical studies on taxes (LINSCHEIDT 1999; GÖRLACH et al. 2005) and emissions trading systems in the USA (ASHFORD et al. 1985; GAGELMANN and FRONDEL 2005) show that less ambitiously structured instruments are associated with weaker innovation effects and at best result in the diffusion of available environmental technologies.

In addition to the increased use of ambitiously structured taxes and emission trading systems, it is common to stimulate specific environmental technologies by means of subsidy-like regulations which can also potentially influence all three phases of innovation (see Table 2-2). The latter is confirmed by empirical studies. Subsidy-like funding has been highly effective in influencing innovation in all three innovation phases: countries with feed-in payments (e.g. Germany, Denmark, Spain) have been especially successful in establishing an innovative industry for renewable energies (JACOB et al. 2005; ANDERSON et al. 2006). However, subsidy-like payments have to have, in principle, a limited timeframe so that they do not hinder the ongoing innovation process. The incentive structure has to facilitate the threshold of competitiveness being attained as quickly as possible.

Regulatory instruments

73. Regulatory law is traditionally seen critically in terms of innovation because innovations can only be stimulated within the framework of binding emission reductions. Regulatory requirements to date have usually been empirically oriented around the current state of technology because the government has evidence of technical feasibility when setting the standards. Regulatory law is thus often considered more an instrument to diffuse the current state of technology. This is confirmed by a set of empirical studies (e.g. KUNTZE et al. 1999; LEHR 1999; HILDEN et al. 2002; ROEDIGER-SCHLUGA 2004).

The potential for innovation that regulatory instruments have must nevertheless be seen with a much more differentiated view. ASHFORD (2000), for example, comes to the conclusion that regulatory law is managed with far more flexibility and with a greater focus on innovation in practice. Company reactions are also often more innovative than assumed. In numerous cost-benefit analyses of environmental policy measures, such as those impressively documented by newer, ex-post studies, costs are regularly put too high because the potential effect these measures have, particularly on innovation, has been ignored (OOSTERHUIS 2006a; ZEDDIES 2006; IEA 2007).

The potential for innovation also increases considerably when regulatory law is stimulated through “technology forcing”. This method has recently been seen with more frequency, albeit in various variants. “Technology Forcing” is the ambitious regulation in environmental protection that goes beyond the current state of technology, i.e. a requirement that cannot be met with existing technology and thus forces environmental innovations (BRYNER 1995; WEIDER 2007). It also stimulates innovations in the earlier phases of invention and market launch (see Table 2-2). It is assumed that this technology would not be developed or sold without government intervention. The American Clean Air Act (1970), for example, formulated ambitious reduction targets for HC, CO and NO_x beyond the current state of technology that forced a new (catalytic converter) technology to emerge – though this was first achieved in Japan. Later, the California Zero Emission Vehicles (ZEV) programme (1990) required the automotive industry to sell 10 % ZEVs on the Californian market by 2003. This obligation was later softened in response to pressure from the industry. Still, the programme "forced" a whole new series of technologies (HEKKERT and van den HOED 2006; JACOB et al. 2005; DTI and DEFRA 2006, p. 24). The European norms, as predictable, dynamic standards, are also a moderate variant of "technology forcing". In climate protection, the massive political pressure for carbon capture and sequestration (CCS) is another variant. Legal possibilities for transcending the current state of technology also exist, apart from nuclear legislation, in installation law (IPPC Directive Art. 10) but have not to date been brought to bear in innovation policy.

In the Japanese top runner approach with its dynamic tightening of standards (for a detailed description of the approach, see below), complete diffusion of the best available technology is the key focus (Swedish Environmental Protection Agency 2005; KUIK 2006; OOSTERHUIS 2006b). But the dynamic development of further standards forces innovations that go beyond the current state of technology. This becomes apparent in the second regulatory step (see Table 2-3): the second standard that goes one step further is no longer based on a market "top runner" but is already a product of the process. The top-runner approach is thus a radical variation of a forced technology development using dynamic standards.

Table 2-3

Selected goals and results of the top runner programme

PRODUCT:	**TARGET YEAR (base year)**	**ANTICIPATED SPECIFIC SAVINGS (weighted average)**
Computers:	2005 (1997) 2007 (2001)	*83% (reached 2001) 69%*
CD systems:	2005 (1997) 2007 (2001)	*78% (reached 2001) 71%*
Video recorders:	2003 (1997) 2008 (2003)	*59% (reached 74%) 22%*
A/C systems (cold/warm)	2004 (1997) 2010 (2005)	*66% (reached 68%) 22%*
Refrigerators:	2004 (1998) 2010 (2005)	*30% (reached 55%) 21%*
Cars (petrol):	2010 (1995) 2015	*23% (reached 2006) 29%*
Photocopiers:	2006	*30%*
TV sets:	2003 (1997)	*16% (reached 26%)*
Source: ECCJ 2006		

Overall, product-specific regulation – at least in the technology forcing variation – has become a key component of innovation-oriented environmental policy used to tap into specific potential for innovation. This is to be emphasised with regard to the recommended focus on stimulating “strong” environmental innovations. Still, product-specific regulation has its limits if it does not occur within the framework for guiding general economic trends via the pricing mechanism.

Supporting instruments

74. Supporting instruments such as an environmentally oriented procurement policy or the use of environmental labelling are a practical complement to market-based and regulatory solutions and thus an indispensable component of innovation-oriented environmental policy. Because these instruments are generally geared toward products already on the market, it is mainly the diffusion of environmental innovations that is stimulated (see Table 2-2).

Roughly 16 % of the GDP of the EU (European Commission 2007) and 13 % of the GDP in Germany (BMU 2006b) is made up by public procurement. If the government’s enormous demand power is exploited by a consistently ecologically oriented structure of the procurement of goods and services, the public sector can make a considerable contribution to diffusing environmental innovations.

Environmental labelling should provide the consumer with bundled information about environmentally friendly products and processes, thus increasing demand for ecologically beneficial products. This increased demand offers companies a direct incentive to improve the environmental balance sheet of their products and processes. The use of ambitious and dynamically structured environmental labelling therefore holds considerable potential in diffusing environmental innovations.

“Smart regulation” through policy mix

75. Overall, the intelligent combination of various instruments in particular holds a high potential for innovation. This type of policy mix has been called “smart regulation” in the literature (GUNNINGHAM and GRABOSKY 1998; Network of Heads of European Environment Protection Agencies 2005). Particularly striking in this context is how complementary regulatory and market-based instruments are. A forced exploitation – and increase – of innovation potential seems to be most successful if product-specific regulation (“regulatory core”) is combined with economic incentives to guide general trends. This “hybrid form” of binding rules and economic incentives is often supported by other supporting instruments.

The importance of these types of hybrid regulatory approaches is clarified by means of an example in a comparative study carried out by EKINS and VENN (2006) (see Table 2-4). In addition to the “policy mix”, the strictness of regulations is also significant here.

Table 2-4

Comparison of environmental innovations by regulation type

Sector	Study	Country	Innovation effect	Instrument			
				Market-based	**Regulation**	**Agreement**	**Information**
Fuel consumption/ CO2 emissions for cars	KUIK (2006) compares the voluntary agreements of the European *ACEA agreement, the US CAFE (Corporate Average Fuel Economy) programme and the Japanese top-runner approach to determine how they have affected innovation in fuel consumption/CO2 emissions for cars.	Europe	Medium			X	
		USA	Weak		X		
		Japan	Good	X	X		X
Energy efficiency of electrical appliances	OOSTERHUIS (2006b) examines the EU energy efficiency criteria for public tenders, the American energy efficiency programme and the Japanese law on ecological public procurement in connection with the top runner programme to determine how they have affected innovation in information and communication technologies (ICT).	Europe	Weak			X	
		USA	**Very good**	X	X		
		Japan	**Very good**	X	X		X
Photovoltaic technologies	ANDERSON et al. (2006) examine how public funding for photovoltaics has affected innovations in Germany, Japan and Great Britain.	Germany	Good	X	(X)		
		Japan	**Very good**	X	X		
		UK	Weak	X	X		
Emissions in paper and cellulose production	CHAPPIN et al. (2007) take a look at the Dutch regulatory attempts in the paper and cellulose industry to determine how they have affected innovation in waste water, waste and energy efficiency. A connection could only be established here between public intervention and environmental innovation in the private sector in the area of energy efficiency.	Netherlands	Unclear		X		
	SIMILÄ (2002) and HILDÉN etal. (2002) looked at the relationship between government regulation and environmental innovation in the private sector in the Finnish paper and cellulose industry. Both authors pointed out the connection between regulation and diffusion in particular.	Finland	Medium		X		
Replacing hazardous chemical substances	The study by OOSTERHUIS (2006c) looks at measures to replace hazardous substances using the example of handling chlorinated solvents (trichloroethylene) in Sweden, Denmark, the USA and Germany.	Denmark	Good	X			
		USA	Good		X		
		Germany	**Very good**		X		
*ACEA agreement = agreement with the European Automobile Manufacturers Association							
Source: EKINS and VENN 2006, p.34, revised							

2.3.3 Product-specific environmental regulations

76. An environmental strategy oriented around a specific product and its life cycle offers a range of regulatory advantages and thus deserves special attention in the context of an innovation-oriented environmental policy. It concerns the design phase where the concepts for the product properties and the process chains are developed. At this level, it can trigger competition to innovate, i.e. among the manufacturers of the end product. As consumers of intermediate products, these manufacturers potentially act as the “gatekeepers” of the material flows and as a controlling entity capable of spurring a “greening of the supply chain” (SARKIS 2006). The burden of the innovation process lies primarily with the manufacturers of intermediate products. This also eases, however, ambitious control activities in manufacturing companies and their purchasing departments.

Another advantage is the fact that only a few product groups make up the bulk of the negative environmental effects. During their life cycles, food, buildings (including their equipment) and road vehicles cause 70 to 80 % of the negative environmental effects among the 12 most important product groups (TUKKER et al. 2006). These three product groups are already subject to strict regulation. Notable here is also the fact that the negative environmental effects of these three product groups converge to a large extent in their life cycle – based on criteria such as impact on climate or water pollution (TUKKER et al. 2006). This makes it possible to maintain a pragmatic focus on priority products and priority, robust criteria (such as energy and material consumption or hazardous substances in the product). It would also suggest giving priority to products whose potential for improvement would be profitable.

77. Product-specific environmental regulations were initiated at the 2002 UN Summit in Johannesburg. They have spread rapidly around the world, particularly those pertaining to increasing energy efficiency. More than 50 countries, for instance, have at least introduced minimum energy performance standards (MEPS) for individual electrical appliances and a large number of other countries currently have plans to do so (STEENBLIK et al. 2006). The Japanese top runner programme mentioned above offers a more ambitious and comprehensive regulatory framework for 21 product groups (see box below). The European Ecodesign (EuP) Directive (2005) (EuP – Energy-using Products) expands this framework to include ecological criteria and the life cycle assessment (see IEA 2007; for details, see Section 2.4.2). For this reason, it is preferable to the top runner approach which has, however, proven to be more effective in the decision-making process and in the impact on innovation for device-specific energy saving.

As the core component of a product-specific innovation strategy, it is advisable to define binding and dynamic performance goals for products and processes. In the interests of minimising demands on the capacity of the controlling authorities, the focus here can be on the product groups mentioned with the greatest negative environmental impact.

The Japanese top runner programme (1999)

- Energy efficiency standards are defined for 21 product groups.
- The product-specific efficiency standard is based on the consumption values of the most energy-efficient products available on the market (top runners). It is set either at or above this top level taking into consideration the anticipated technical progress and the possibilities for diffusion.
- The standard has to be reached within a specific time period. It continues to change dynamically in the target year or if the target is reached earlier than planned. It is binding for domestic manufacturers and importers in the target year, and products that do not meet the efficiency value are banned.
- “Name and shame” are used to apply pressure prior to the target year.
- The top runner programme is supported by a Green Procurement Law (2001); cooperation with retail; an environmental car tax and annual prizes for products that outperform the efficiency of the top runner.
- Implementation was rated “very positive” (Swedish Environmental Protection Agency 2005): several products reach the standard before the target year (air-conditioners, cars, computers, VCRs).
- Most manufacturers attest to an increase in competitiveness.

2.4 “Ecological industrial policy” approaches in Germany and the EU

78. The following section outlines the most recent approaches in innovation-oriented policy in Germany and the EU keeping in mind governance for this type of strategy explained above. It is still too early to conduct an in-depth evaluation of the measures. However, several conclusions are made for current policies at the end.

2.4.1 “Ecological industrial policy” in Germany

79. In October 2006, Germany presented a memorandum for “Ecological industrial policy” (Federal Environment Ministry, BMU 2006a). The memorandum calls for a “third industrial revolution” to be brought about through improved energy and resource efficiency and the increased use of renewable raw materials. The goal is, on the one hand, to make a contribution to sustainable development. On the other hand, it aims to establish Germany as the “global environmental service provider” of the 21st century to accelerate new growth and job creation. The “Ecological Industrial Policy” includes a total of eight fields of action: energy generation and storage, energy efficiency, raw material and material efficiency, sustainable mobility, closed-loop processes, waste and recycling, sustainable water management and biotechnology and nanotechnology, two areas that are somewhat controversial in terms of environmental policy.

The goal is to bring about “revolutionary technology advances” in these fields of action. To achieve this goal, a number of general principles are formulated whose aims include:

– Development of an intelligent regulatory framework for ecological industrial policy
– Improved exploitation of export potential
– Accelerated market launch of innovative technologies
– Improved financing for company innovation
– Creation of lead markets
– Setting up institutional structures for innovation (in the form of an industry cabinet)

80. The concrete instruments for the German “ecological industrial policy” approach are still in their infancy. It must be kept in mind here that key aspects of this type of policy can only be decided at European level. It is thus a welcome step that the German Federal Government submitted a number of proposals to put its concept into concrete terms at European level during its European Council presidency in 2007 (Federal Environment Ministry 2007b).

81. Without a doubt, the overall approach of the memorandum for “ecological industrial policy” makes an important contribution to the discussion. It emphasises the economic and environmental potential of improved environmental technologies and views forcing of these technologies as a cross-departmental opportunity and responsibility. However, it does not go far enough, to the extent that the standard is not based on the ecological efficiency of environmental innovations which aim to largely disassociate economic growth and environmental consumption. Instead, the goal is a “vigorous growth spurt” with “higher than normal growth rates” that is the “basis for the new ecological industrial revolution”. Nanotechnology is also identified as a forward-looking technology although its potential environmental and health risks have not been adequately clarified to date.

The instruments are the following:

– *Direct project funding:* A study conducted by the Centre for European Economic Research and Environmental Policy Research Centre (ZEW and FFU 2007, p. 37 ff.) comes to the conclusion that direct project funding from the Federal Government, apart from targeting useful projects such as “renewable energies”, hardly considers the areas of “sustainable mobility” and “biotechnology”. In addition, a lot of money continues to be invested in technologies that are questionable in terms of the stated goal of ecologically effective innovations. This includes funding for nuclear technology.

- *The use of monetary instruments*: Even though one aim of "ecological industrial policy" is to optimise the "market economy framework", stronger reliance on monetary instruments – for instance, by further developing the "ecological tax reform" – has not been evident to date. Without the increased use of ambitiously structured economic instruments that act as general incentives, achieving the goal of "revolutionary technological advances" will hardly be possible.
- *Promoting specific technologies*: With its Renewable Energies Act (EEG) which gives precedence to renewable energies, Germany has been particularly successful in establishing an innovative industry for renewable energies. This technologically-specific assistance model is undergoing major expansion within the framework of the Federal Government's "integrated energy and climate programme" which includes the revision of the Heat-Power Cogeneration Act *(Kraft-Wärme-Kopplungsgesetz – KWK-Gesetz)*, an update of the Renewable Energies Act, the Renewable Energy for Heat Act *(Erneuerbare-Energien-Wärmegesetz)* and the expansion of the biofuels quota. This last item has been criticised by the SRU because it is not certain that biofuels reduce greenhouse gases (SRU 2007).
- *Public procurement*: The potential offered by public procurement has only been exploited insufficiently in Germany to date (e.g. GÜNTHER and KLAUKE 2004). Some of the key obstacles include the higher costs of "green" products, uncertainty about the legal validity and a lack of information (Federal Environment Ministry, BMU 2006b; BOUWER et al. 2006). A basic improvement has been made in the area of "energy and climate" where the Federal Government plans to develop guiding principles for procuring energy-efficient products and services on the basis of the life cycle cost principle. Concrete targets would be absolutely essential here, however (e.g. a dynamic minimum quota for procuring eco-efficient products).

Overall, adequate "ecological industrial policy" instruments have only been seen so far in the area of "energy and climate". In this area, however, Germany broke new ground with its instruments (such as in the Renewable Energy Act) which have gained considerable attention internationally as well.

2.4.2 Promoting environmental innovations in the EU

82. The key role environmental innovations play is also emphasised at EU level. Promoting them is considered a "key to success" for environmentally compatible growth as part of the renewed Lisbon strategy (2005) (European Commission 2005, p. 28). The European Council has also repeatedly underscored the key significance of environmental technology (European Council 2005; 2006; 2007). The Environmental Technologies Action

Plan (ETAP), which was launched in 2004, provides an overarching framework, but so far progress in implementation has been slow. The European Commission (2007) thus sees a need for "systematic and coordinated measures on the demand side" in its most recent progress report (European Commission 2007). These measures include encouraging environmentally-oriented procurement, mobilising financial investments, creating systems for technology testing and performance targets, building on promising practices of member states and concentrating on areas with lots of opportunities for gain (building, food, transport, recycling and waste water). New stimuli can also be expected from the European Council's call to the Commission to "present proposals for an integrated strategy to promote eco-innovations by the beginning of 2008" (European Council 2007, marginal note 17).

83. The following instruments are in place in Europe:

– *Direct project funding:* Some progress has been seen in the EU in direct project funding for environmental innovations (HERTIN et al. 2006). Promoting environmental technologies within the framework of the EU's Seventh Framework Programme is thus assigned an important role and supported with a considerably higher budget. The complementary "Competitiveness and Innovation Framework Programme" (CIP), which applies to the downstream innovation phases, also takes into account environmental innovations in a separate budget. Compared, however, to the research budget for nuclear and fusion research, the funding for environmental innovations is still low in both programmes.

– *Monetary instruments*: For a long time, the EU relied on financial subsidies for its environmental protection aims (see HOLZINGER et al. 2006). A European-wide ecological tax reform is targeted in the 2006 EU sustainability strategy but it has failed so far as a result of the member states' veto right in tax matters. With the introduction of emissions trading in climate protection, a market-based instrument was introduced with a high potential for innovation. This instrument, however, hardly had any effect in the first trading period due to the excessive number of certificates allocated free of charge and the numerous exceptions (see SRU 2006). The goal of future trading periods thus has to be ambitious development of emission trading as a central instrument of an innovation-oriented environmental policy. Positive developments have been seen at European level as a result of the revision of the Emissions Trading Directive (for details, see Item 165). Of particular importance to ensure that the instrument stimulates innovation are defining an ambitious, EU-wide quantity cap with complete auction-based allocation and long-term trading periods with calculable targets.

– *Environmental regulations*: "Technology forcing" has not been previously practised in Europe. However, in some sub-segments, standard setting has been dynamic, for example, European norms that go beyond the technology currently available. In addition, the complete implementation of EU laws such as the Integrated Pollution Prevention and

Control directive (IPPC Directive), the Waste Electrical and Electronic Equipment Directive (WEEE Directive) and the Directive on Restriction of certain Hazardous Substances (RoHS Directive) could advance eco-innovations more in the future.

– *Product-specific innovation approach*: The EU's integrated product policy (IPP) has stayed unproductively on the sidelines for quite some time (see SCHEER and RUBIK 2006). In contrast, the EuP Directive (Eco-design Directive) creates the opportunity for a far-reaching, product-specific innovation approach (see box). It is notable that the EuP Directive – unlike the Japanese top runner programme – is not based on how much energy products consume, it also includes other environmental impacts of the products as defined in a life cycle assessment (e.g. reducing quantities of waste, preventing hazardous substances). Now, however, strict and dynamic minimum standards have to be developed for the 20 product groups. The top runner mechanism could be incorporated into the Eco-design Directive in such a way that the focus initially lies on improving energy efficiency, thus speeding up the pace of the long-winded Eco-design Directive process. Dynamic standards (and the associated product labelling) then make it possible in principle to incorporate the improvement in material efficiency and the substitution of toxic substances into the product assessment in later innovation phases beyond energy efficiency. This would make it possible to form a practical link between the two most far-reaching product regulations.

– *Ecological procurement:* While the new allocation directives of the EU have strengthened the legal basis for allowing ecological procurement, practical implementation has been largely insufficient until now. Priority measures to improve implementation are setting binding targets and creating guiding principles for indicators and benchmarking (see European Commission 2007, p. 11). The new EU sustainability strategy provides orientation with the goal of raising the ecological public procurement system to the level of the best member state by 2010.

The EuP Directive (2005/32/EC)

- The EuP Directive defines a framework for the environmentally compatible design of a total of 19 energy-using product groups (including boilers and combi-boilers, computers, televisions, office and street lighting, air-conditioning, refrigerators and freezers, dishwashers and washing machines, electric motors, laundry driers, domestic lighting).
- Selection criteria for the product groups included are market volume (200,000 units per year and higher), environmental impact and potential for improvement.
- Life cycle assessment starting with material selection through to final disposal, (least) life cycle costs, BAT (Best Available Technique), also incorporation of prototypes and international best standards.
- Harmonised, EU-wide approval standards based on “generic eco-design requirements” (GERs) for health, safety and environment, 19 impact categories.
- The institutional responsibility lies with the Commission and a Regulatory Committee, advised by a Consultation Forum.
- Provisions have been made for binding standards or voluntary agreements under controlled conditions, member states are responsible for monitoring.
- Commission + Regulatory Committee + pluralist Consultation Forum.
- One of the objectives is also to create competitive advantages for the EU.

2.5 The limits of innovation-oriented environmental policy

84. In conclusion, it is important to note the inherent limits of innovation-oriented environmental policy that have to be kept in mind.

These limits first arise from the fact that not all environmental problems can be solved by technology. This applies in particular to the fields of action of biodiversity and soil conservation, where technical solutions are only possible to a limited extent. Even though there are “win-win solutions” beneficial to the environment that are also capable of further development (such as the relationship between nature conservation and tourism), these are seldom based on marketable technical solutions. On an international comparison, biodiversity and land/soil, as non-technical fields of action, are much less important than the highly visible technical fields of air quality control and water conservation as the economic development level of a country rises (ESTY et al. 2006). This trend could intensify now that environmental policy is more “fixated” on innovation. With this in mind, it must be ensured that the non-technical areas of environmental policy are not neglected.

Environmental innovations can also fail to fulfil their potential due to structural rigidity on the part of established manufacturers. Innovations are associated with “creative destruction” and always produce “modernisation losers” – a conflict that is easy to ignore in the euphoria surrounding innovation. How these types of conflicts can be solved constructively and not destructively has by no means been adequately clarified in scientific terms. Innovation-oriented environmental policy also ultimately requires a structural policy that helps “modernisation losers” make the transformation and breaks down resistance from influential veto groups.

Finally, we also have to point out the limits of a policy-driven innovation strategy. It will be essential for policy to keep in mind the difference between forcing industrial potential for innovation and excessive interventionism. Investment cycles in the economy have to be taken into account, the effects of overheating avoided, set timetables given to assistance measures and competition boosted. A close network for dialogue made up of the government, private sector, researchers and representatives of environmental issues is a key prerequisite for ensuring that the innovation process moves forward with enough transparency and that undesirable developments are recognised early on.

2.6 Conclusion

85. Contrary to pessimistic attitudes in the business community, the SRU feels validated in its assessment that an ambitious environmental policy has important potential for growth and modernisation and that it makes sense for Germany to play a leading role (SRU 2002). Environmental technologies now play a central role in the innovation competition between highly developed countries: the German environmental industry is particularly successful in this sector. It is already extremely significant to the national economy and has an exceptional potential for growth. To a slightly lesser degree, this also applies to the European environmental sector. This development cannot be explained without the active environmental policy pursued in Germany and Europe until now.

The strong growth in environmentally friendly technologies and services can essentially be explained – in addition to more recent developments in resource costs, climate research or public opinion – by the important role of eco-innovations in the process of global industrial growth. If the external damage it causes stays within limits that are both economically and politically acceptable, it will be necessary to steadily increase eco-efficiency to an ever higher level. This is an objective tendency to the extent that essential ecological requirements always become apparent through environmental crises and political protest or are made an issue through preventive policy and implemented in measures. This creates a special kind of dynamic development in innovation with specific global and long-term market opportunities and a specific function for modernising the national economies. One of its unique features is the close correlation between politics and technology.

The Federal Government has assigned primary importance to environmental innovations both through a programme-based "ecological modernisation" in 1998 and with the concept of an "ecological industrial policy" when the government changed in 2005. Welcome progress has also been made in this direction in the "ecologicalisation" of the EU's Lisbon strategy, due among other things to the innovation-oriented focus during Germany's presidency of the European Council. Translating this approach into concrete instruments remains a political challenge, however.

86. After more than thirty years of dealing with this issue, today the focus is no longer on environmental innovations in and of themselves, but on an ecologically effective innovation process that is measured in terms of its contribution to largely decoupling industrial growth and environmental consumption. The prerequisite here is an ambitiously structured, innovation-oriented environmental policy. The approaches below should be pursued more vigorously:

– *Focus on "strong" environmental innovations*: Innovation-oriented environmental policy should concentrate on innovations that, on the one hand, aim to do more that just make incremental improvements and, on the other, achieve a high level of market penetration (internationally as well). Even the most radical improvement in environmental technology will not help reduce environmental burdens if it does not meet with widespread acceptance.

– *An active role for the government*: Incremental innovations or those limited to niche markets can usually be left to the innate dynamics of the market. This is not usually the case for "strong" environmental innovations. The high standard of ecological performance associated with them (and the corresponding acceleration of technical progress) also implies ambitious goals that go beyond the "normal" power of the market to innovate. The search for suitable regulatory models plays an important role here.

– *General monetary incentives plus specific product regulations plus supporting instruments*: In addition to the environment-related infrastructure in research and development, it is also important to stimulate the entire innovation process starting with market launch through to global distribution. A hybrid regulatory model which combines general monetary incentives (e.g. by means of emissions trading) and product specific regulation (e.g. dynamic energy efficiency standards) generally plays a key role here. Market-based and regulatory provisions, however, also usually require supporting instruments. Important items here are an improved ecological procurement policy and a more ambitious structure for environmental labelling (giving an indication of life cycle costs). Ambitious targets are the basic prerequisite for all of this.

– *"Technology forcing"*: "Strong" environmental innovations require ambitious product specific regulation that systematically deals with the technology-specific potential for innovation or innovation obstacles. Forcing technological improvements that go beyond the best available technology has gained in importance in the meantime. When it comes to setting dynamic standards, the spectrum ranges from the mild variant of the European norms all the way to the radical variant of the Japanese top runner approach. Still, even radical standards only achieve selective improvements that can also result in “rebound effects”. Consequently, general economic incentives that make use of the pricing mechanism are absolutely necessary in the broad quest for better technology.

– *Eco-design of products and processes:* Forcing product-related environmental innovations that also affect the production processes via the life cycle approach is practical in environmental policy terms and particularly promising. In the interest of minimising the extent to which the government’s capacities for action is used, product groups that have the greatest negative impact on the environment and the most beneficial potential for reducing environmental burdens have priority. It is not possible to achieve a significant, dynamic increase in eco-efficiency, however, solely via product regulations. Innovations are made for products and product classes as such, but no incentive to switch to more environmentally friendly products or product classes is created (e.g. smaller cars). This incentive has to be created by monetary instruments (e.g. differentiated environmental taxes or emission trading).

– *The limits of innovation-oriented environmental policy:* The limits of innovation-oriented environmental policy are the result, on the one hand, of the fact that not all environmental problems can be solved by technology (e.g. biodiversity, land). These non-technical areas must not be neglected in the current euphoria surrounding innovation in environmental policy. On the other hand, it must be kept in mind that innovation processes are ambivalent and, as processes of “creative destruction”, also produce “modernisation losers” whose resistance must be anticipated.

And finally, we also have to point out the limits of a policy-driven innovation strategy: it will be essential for politicians to keep in mind the difference between forcing industrial potential for innovation and excessive interventionism. Investment cycles in the economy have to be taken into account, the effects of overheating avoided, set timetables given to assistance measures and competition boosted. A close network for dialogue made up of the government, private sector, researchers and representatives of environmental issues is a key prerequisite for ensuring that the innovation process moves forward with enough transparency and that undesirable developments are recognised early on.

3 Climate Protection

Messages

The 4th Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) presented alarming new findings. The reductions in greenhouse gases (greenhouse gas – GHG) found necessary in this report go far beyond what has previously been discussed. A global GHG reduction requirement of 50 to 85 % by 2050 (compared with 2000) to limit the temperature increase to 2° C is mentioned several times. For the industrialised countries, the report specifies an emissions reduction of between 25 and 40 % from 1990 levels by 2020 and considers a GHG reduction of 80 to 95 % necessary by 2050. The German Advisory Council on the Environment (SRU) recommends incorporating these more ambitious targets and the justifications for them into the ongoing process of setting objectives. This is justifiable because these more ambitious targets are accompanied by new dynamism in innovation and growth for climate-relevant technologies that offers increased room for action.

The approach of Germany and the EU in advancing climate protection so that other countries will follow is right and has also proven successful from an economic point of view. However, this policy is only credible if the set goals are also reached. The cabinet resolutions on climate change from 5 December 2007 are generally to be considered a welcome step. However, in some sub-areas, such as saving electricity or further tax concessions for high-consumption company cars, concessions were made which were not justifiable from an objective standpoint.

Increasing energy efficiency has a special role to play. In view of the high level of potential profit such measures could bring about and in light of the great importance of energy prices and innovation competition in this area, the SRU feels that more ambitious measures are not only possible but would also be useful in terms of the pace of climate change. The implementation of ambitious, calculable targets should generally be pursued with an overall monetary incentive that is supplemented by product specific regulation (e.g. dynamic consumption standards). The efficiency strategy focuses on buildings, energy-using devices and transport. These areas have a lot of untapped economic potential.

In the residential real estate sector, the passive house standard for new houses should be targeted beyond current planning in line with the climate policy of the EU by 2015. However, achieving the structural and use-related energy savings often fails because overall incentives have not been adjusted. The assistance programmes justified for this reason should make adequate allowances for the efficiency of funding deployment and actual energy savings.

For energy-using devices, orientation around the market “top runner” plays an important role in the discussion. Making standards dynamic has encouraged innovations that have further increased the technical potential of energy saving. The European Eco-design Directive for Energy-Using Products which expands this approach with ecological criteria should be implemented more quickly, with more ambitious goals and with an initial focus on energy efficiency.

The Voluntary Agreement of the European automotive industry to limit the CO_2 consumption of passenger cars has failed. As an alternative, the SRU recommends a standard limit value for all passenger cars that made more flexible by options which allow manufacturers to compensate internally or to trade with other manufacturers. The target value should be reduced further to 80 to 95 g/km by 2012. This standard should be accompanied by economic instruments that affect buying behaviour when it comes to cars and annual mileage. The weight-driven limit value curve proposed by the European Commission with fines and greater flexibility makes concessions to the German horsepower-intensive automotive industry that does not satisfy either the technical potential or the requirements for climate protection.

Capturing and storing CO_2 (Carbon Capture and Storage – CCS) is in principle feasible from a technical standpoint but is still facing unsolved technical and economic problems. The investments costs of a power station with CCS are almost double those of one without. Considerably higher than this are the additional costs of retrofitting an existing power station. If and when CSS is ready for the market and meets with sufficient public acceptance for storage is still completely open – also in the light of recent problems in plants in Norway and the USA. If the technology does not meet the set expectations and/or if retrofitting of power plants does not prove to be profitable, the climate protection targets must not on any account be called into question. In view of drastic climate changes, massively expanding coal-fired power plants cannot be justified on the basis of uncertain expectations of future technologies. This is why public criticism of building new coal-fired power plants is understandable. European emissions trading will ultimately decide whether CCS will make a contribution to reducing emissions in the German energy mix. The key factor is credible insistence by politicians on compliance with the emission budget so that the business risk does not turn into an overall (climate) risk for society. To prevent misguided investments, the privileged position of coal-generated electricity in emissions trading (until 2012) should be lifted unequivocally at the right time. The SRU, however, considers further research in CCS technology sensible.

The Commission’s proposal to revise the Emissions Trading Directive with the standard emission budget calculable over the long-term and the long-range plan for complete certificate allocation by auction is just as welcome as the other targeted simplifications. In coming up with a transitional industry arrangement, even though a harmonised system would be better than rules in individual states, the additional complexity that would be introduced to the system needs to be weighed against the supposed benefit. The same applies to the planned exceptions for industries supposedly affected by business relocations which, accordingly, should be handled in a restrictive fashion. Emissions trading should be established at the level of the primary trading phase, resource extraction or imports over the long-term. The key advantage of this upstream model is that the energy-induced emissions of all sectors are recorded. Additional measures to mobilise special potential for innovation – ranging from dynamic maximum consumption standards to product labelling – continue to be possible in this type of system.

Land use compatible with nature conservation lowers the sensitivity (vulnerability) of land use and, at the same time, reduces greenhouse gas emissions. It should also make landscapes permeable for the migration of species brought about by climate change. Measures to increase soil carbon stocks do not just contribute to boosting the carbon storage capacity and maintaining biodiversity, they also improve the water balance and nutrient cycles of terrestrial ecosystems. Revitalising natural regions thus equally promotes climate protection, adaptation to climate change and the nature conservation goals.

3.1 Introduction

87. In 2006 and 2007, the focus of environmental policy shifted to climate policy. The shift cannot only be explained by new experiences with extreme weather events (such as Hurricane Katrina in the USA or severe forest fires in Southern Europe), but also by new scientific findings about climate change and the damage it causes, published in such reports as the Fourth IPCC Assessment Report (AR4) and the Stern Review. A sense of alarm, which is at times considerable, is perceptible in the general public and in European and international politics. This alarm became evident at the UN General Assembly dedicated for the first time to the issue of climate in the autumn of 2007. At the same time, innovation and growth in climate-relevant technologies is undergoing a new kind of dynamism that reveals new flexibility for action.

The SRU dealt extensively with climate protection policy in the 2002 and 2004 Environmental Reports. The increase since then in the number of signs that climate change is speeding up (for instance, in the Arctic) makes a critical interpretation of the Fourth IPCC Assessment Report necessary.

The greenhouse gas concentrations of the gases covered by the Kyoto Protocol today reach 430 ppm (parts per million) CO_2-eq (CO_2 equivalents) (STERN 2006, p. 3). This means that the maximum greenhouse gas concentration of 450 ppm CO_2-eq which is still considered tolerable has almost been reached. Moreover, according to IPCC calculations, this concentration has only a 50 % probability of satisfying the widely recognised goal of limiting global warming to no more than 2° C. The now unavoidable global temperature increase of less than 2° C over pre-industrial values (1750) already poses incalculable risks. This suggests setting stricter targets and taking faster action.

Consequently, the previous European greenhouse gas reduction targets of 30 % (by 2020) and 60 to 80 % (by 2050) (40 and 80 % respectively for Germany) over 1990 values are to be scrutinised critically in the light of new findings and bearing in mind the precautionary principle. This applies to the long-term targets and the structure of emission trading, to the increase of efficiency in energy conversion (heat-and-power generation) and to end-use energy consumption (particularly for buildings, cars and products). The primary focus will be to record sectors that have been privileged up to now, such as, in particular, horsepower-intensive cars and electricity generated from coal, and to ensure more ambitious and effective regulation of the important field of existing buildings. Higher targets can be reached in renewable energies as a result of the growth in this sector, which is stronger than anticipated.

3.2 Scientific basis

3.2.1 Methods and classification of the reports of the Intergovernmental Panel on Climate Change

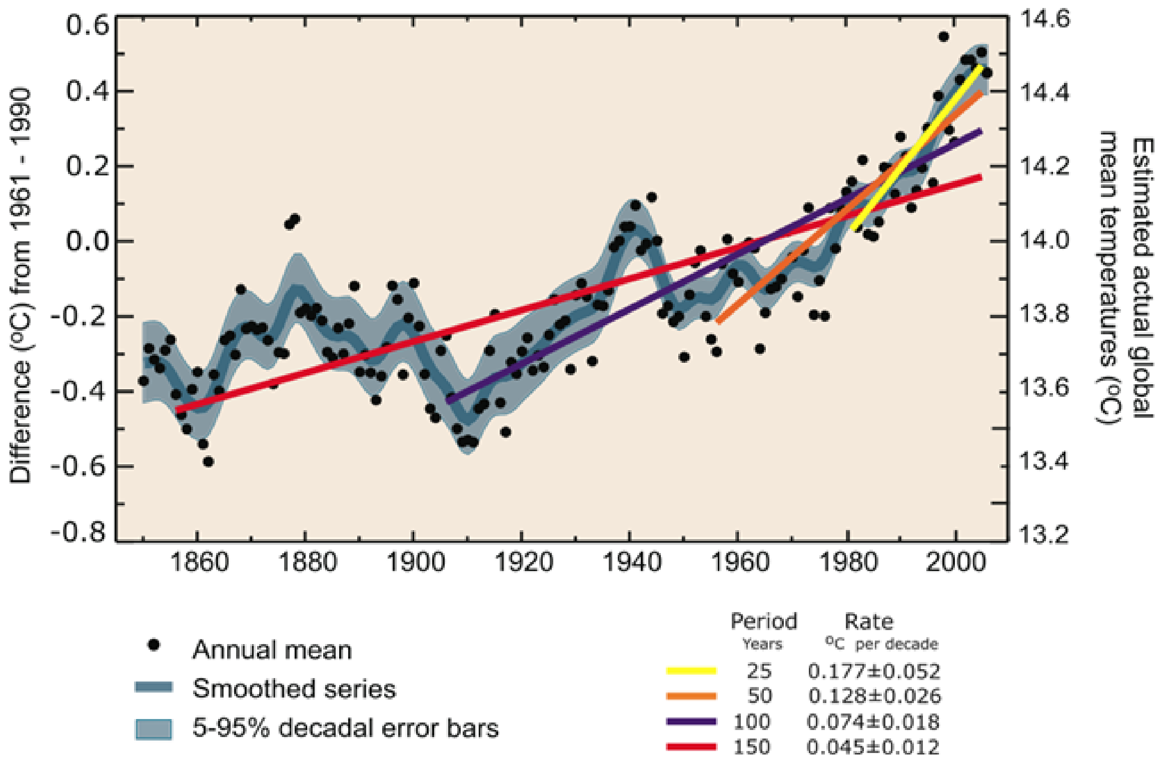
88. Every few years, the Intergovernmental Panel on Climate Change (IPCC) analyses the most recent climate research and summarises it in an assessment report. The fourth assessment report was published in 2007. It is broken down by Working Group (WG). WG-I is responsible for the scientific basis (IPCC 2007c), WG-II for the impact of climate change (IPCC 2007a) and WG-III for technology development, adaptation strategies and preventive measures (IPCC 2007b). In the spring of 2007, the Summaries for Policymakers (SPM) of these Working Groups were presented to the public (IPCC 2007e; IPCC 2007d; IPCC 2007f). The formulation of these summaries, unlike the long versions, is negotiated at a political level prior to publication. This generally results in statements being toned down. We would therefore like to point out that, in some cases, much more critical statements are made in the actual reports and in the Technical Summaries (TS).

3.2.2 The 4th Assessment Report of the Intergovernmental Panel on Climate Change

89. Overall, the AR4 not only confirms the picture of the climate risks found in earlier IPCC reports, it even reports more drastic findings in key points. In none of the key areas is the risk diminished compared to previous assessment reports. This applies to rising sea levels, extreme weather conditions such as heat waves with adverse health effects, negative impact on biodiversity, etc. It is no longer possible to seriously doubt anthropogenic climate change. All in all, the certainty and reliability of existing knowledge has grown over the last 15 years. The IPCC recognises significant progress in the knowledge base, although many factors that affect the climate system are still not fully understood (clouds, aerosols, dynamics of the cryosphere (ice-covered surfaces of the earth), oceans, changes in land use). The interaction between direct and indirect measurements (proxies) and theories and models produces a coherent picture of an even more obvious and intensifying global warming process (see Fig. 3-1) that has been caused by human activities in the past and will be in the future. The global warming trend over the last 50 years is nearly twice as high as the linear average between 1906 and 2005. It was the highest during the last decade (1995 to 2006) (SOLOMON et al. 2007, p. 36). Eleven of the last 12 years were the warmest since temperatures started being recorded in 1850.

Figure 3-1

Global temperature Trends



Source: SOLOMON et al. 2007, p. 37

This acceleration is cause for alarm because until now, the average global temperature has increased only slightly from pre-industrial times by 0.76° C. There is no guarantee that this trend will continue in the long-run but, in conjunction with other findings on the feedback effects of climate change, it is easy to explain: the climate system is probably more dynamic than previously thought due to positive feedback and non-linear changes (see also WBGU 2007, p. 77 ff.). The hypothesis that the global climate system with all of its systems of ocean circulation, the cryosphere, the biosphere, etc. is an inert system is currently being revised. The IPCC repeatedly emphasises the positive feedback in the global climate system. For example, the increase in the temperature and acidity of the ocean (see also the Federal Government's Advisory Council on Global Environmental Change, WBGU 2006) and the melting of the permafrost regions can bring about positive feedback effects by releasing methane deposits in the ocean floor and in boglands. Even though, in the short-term, it is unlikely that larger quantities of methane hydrate will be released, there is a risk of methane release in the long run due to the rising temperature of the oceans. The release of methane from thawing boglands could occur more quickly in comparison but a lot of uncertainty exists about the scale of this process (DENMAN et al. 2007, p. 543). Another feedback effect is that changes in the cryosphere result in changes to the albedo (reflection of the sun's radiation from the Earth's surface). The ability of terrestrial ecosystems (forests, soil, etc.) to absorb CO_2 could gradually weaken if global warming is rapid, and could even reverse if there is a sharp rise in temperature. This feedback alone could contribute up to 1° C to global warming (BARKER et al. 2007b, p. 77, 89).

90. In the most recent climate research, special attention has been given to non-linear changes when thresholds are exceeded – otherwise known as tipping points. These non-linear changes can have far-reaching and, in some cases, global consequences. Important tipping points in the global climate system include the Northeast Atlantic with its important role in the circulation of the Atlantic Ocean (Gulf Stream), the Amazon basin, the monsoon regions of the Indian subcontinent, the glacier regions of Pamir and Himalaya, the permafrost regions of Siberia, and the change in wind patterns in the South Pacific (El Niño). According to the IPCC, the consequences of large-scale ecological transformations in these areas can no longer be predicted (BARKER et al. 2007b). If, in keeping with the precautionary principle and Article 2 of the Framework Convention on Climate Change (Item 97–99), the potential feedback effects and changes in tipping points are categorised as serious and dangerous, the stabilisation targets have to be adjusted and made stricter.

The IPCC's best estimate on climate sensitivity is approx. 3° C. This figure relates to the probable increase in the global mean temperature if the concentration of GHGs doubles from pre-industrial values. In the Third Assessment Report (TAR) of the IPCC, climate sensitivity was estimated in a range of 1.5° to 4.5° C. It is now considered very unlikely that climate sensitivity will be lower than 1.5° C. The possibility of values above 4.5° C, on the other hand, cannot be ruled out according to the AR4 (SOLOMON et al. 2007, p. 65).

91. None of the emission scenarios developed by the IPCC (Special Report on Emission Scenarios – SRES) ensures likely compliance with the 2° C target repeatedly mentioned – also by the EU – (IPCC 2000b; IPCC 2000a; see Items 97, 100). Even though the 2° C target lies in the most positive scenario family, the B-1 family, still within the estimated probable range of 1.6 to 3.4° C compared with 1990, the best estimate here is only 2.3° C compared with 1990. The representation is misleading, particularly in the SPM of the WG-I. For instance, it specifies the often quoted changes in sea level of 18 to 59 cm by the end of the century, but these changes only affect the thermal increase in sea level and if anything do not factor in the more dramatic rise caused by melting processes. In addition, the time period from 1980 to 1990 is used as a base value and it already assumes an increase.

The temperature changes of the scenarios also relate here to the time period from 1980 to 1990 instead of using the pre-industrial values as is standard practice. Only a footnote in the TS II (i.e. a different document) points out that this requires an addition of 0.5° C. Then, the B-1 scenario is also above the target value at 2.3° C (IPCC 2007e, p. 13; ADGER et al. 2007, p. 11 fn. 8). In all other scenarios, the risk that the targets will not be met is even higher. These SRES scenarios, however, were modelled without explicit climate policies and only represent possible development paths (storylines). The assessment, which concludes that only the B-1 scenario is realistic and has to be additionally supplemented by an ambitious climate protection policy (OTT et al. 2004), gains additional plausibility in the light of the AR4. According to the IPCC's assessment, even a modest GHG concentration value of 445 to 490 ppm CO_2-eq (with a temperature increase of at least 2 to 2.4° C) by 2050 requires a global reduction in emissions of 50 to 85 % compared with 2000. For the industrialised countries, a reduction of 80 to 95 % from 1990 values is seen as necessary (BARKER et al. 2007b, p. 39; FISHER et al. 2007, p. 198; GUPTA et al. 2007, p. 776). These values are considerably higher than what has been discussed to date.

The Swedish Scientific Council on Climate Issues underscores the IPCC statement that only a concentration value of 400 ppm CO_2-eq would make it sufficiently feasible (66 %) to reach the 2° C target. For the EU, it considers a GHG reduction of 75 to 90 % – instead of 60 to 80 % – necessary by the year 2050 (Scientific Council on Climate Issues 2007). In the light of the CO_2 concentrations of 380 ppm today (representing approx. 420 ppm CO_2-eq), it is necessary to push forward in a new direction.

In this respect, it is a welcome step that the climate summit in Bali (December 2007) not only called for "stronger reductions in global emissions", but also suggested a GHG reduction target of 25 to 40 % over 1990 values by 2020 for industrialised countries – even if only in a footnote to the action plan – and at least expressly cited the more ambitious reduction scenarios of the AR4 (Item 98).

92. A "soft landing", i.e. keeping climate change moderate using energy mitigation and intelligent adaptation strategies is still within reach of responsible climate policy action. However, if there is an unchecked increase in the average global temperature, successfully dealing with climate change will become more unlikely because the capacities of ecological and social systems to adapt will be overextended. Consequently, the relationship between avoidance (mitigation) and adaptation is such that mitigation is an essential condition for successful adaptation because we only appear capable of successfully tackling moderate climate change (see Chapter 3.7).

93. Over the last few years, global emissions have steadily risen to a level of 7.2 (±0.3) Gt carbon (C) per year between 2000 and 2005. The possibility that this trend will reverse in the short-term can be ruled out as emissions in industrial countries are almost unchanged or have increased (USA since 1990) and emissions in emerging nations have risen sharply.

The trend scenario of the International Energy Agency (IEA) even predicts a CO_2 increase of 57 % by 2030 (IEA 2007d, p. 13). The overall conditions for a change in course have nevertheless improved as we will show in this chapter. The IPCC is right when it says that the required technologies for successfully dealing with the climate problem are available. Additional innovation effects can also be expected from a decisive climate policy which can boost the potential for solving problems.

94. The reference in the Stern Review to the critically high costs of damage brought about by failing to protect the climate (STERN 2006; 2007) are then also plausible in principle even if there are objections to its methods. The SRU has also already pointed out that economic optimisation models can be used to represent almost every climate policy as “efficient” or “optimal”, starting from a “wait and see” approach through to energy emission reduction. This is due to the key “variables” of economic models such as the discount rate, the energy prices, the function of damage, the statistical evaluation of human life, learning curve effects, endogenous or exogenous modelling of technological progress, the quantification of damage resulting from extreme events, translating ecological changes into monetary terms, etc. The extremely high damage costs calculated in the Stern Review are also to be viewed in this context (SRU 2002a, Items 15, 522; CLINE 2005; MATSCHOSS 2004; OTT 2003; HAMPICKE 2003; PARFIT 1983; LIND and SCHULER 1998).

In climate economics, people now believe that the short-term opportunity costs of emission mitigation were overestimated (by far) and the long-term benefits underestimated (by far) in the older calculations (NORDHAUS 1994; NORDHAUS and YANG 1996). The majority of the economic studies analysed by the IPCC show additional costs through climate protection. But even for concentration targets of approximately 450 ppm CO_2-eq, the costs, expressed in cumulative gross domestic product losses (GDP losses), are under 3 % in 2030 and under 5.5 % in 2050 in most models (FISHER et al. 2007, p. 205 f.). However, specifying technical progress is a central factor in the cost estimates of the long-term models. If it is taken into account that climate policy itself speeds up investment in and use of efficient technologies (what is known as endogenous technical progress), the cost estimates can – as also emphasised by the IPCC – turn out to be even less. The precise extent to which costs can be reduced depends on the type of modelling and varies considerably in some cases. In the endogenous case, early reductions pay off because they reduce the costs of later, more far-reaching reductions as a result of technological learning (BARKER et al. 2007a, Section 11.5; FISHER et al. 2007, Section 3.4.3.2). The Federal Environment Ministry calculates savings as high as 5 billion in a cost estimate of the German climate programme (Federal Environment Ministry, BMU 2008, p. IV). This is also consistent with newer ex-post evaluations of cost-benefit calculations which say that ignoring the effects of innovation as a result of an ambitious environmental policy leads to the systematic overestimation of costs (OOSTERHUIS 2006; ZEDDIES 2006; ELLIS 2007). It should also be kept in mind that the costs consist of growth losses of GDP which are frequently converted to absolute monetary amounts or – as above – stated as cumulative values and then appear “enormous” or “gigantic”. If, on the other hand, the cumulative growth losses mentioned above of (below) 3 or 5.5 % are expressed in annual growth delays, a much more moderate picture emerges with 0.12 % in both cases (FISHER et al. 2007, p. 205 f.; SRU 2005a, Item 3-6).

95. Burden sharing is of key importance for post-Kyoto pursuit of climate policy. In terms of fairness, there is no justification for wealthy countries, who were largely responsible for causing the problem with past CO_2 emissions and who have per capita emissions far higher than the developing and emerging nations, to expose the poorest and most vulnerable parts of the world’s population to great dangers. There is also no moral reason why one citizen of the earth has a greater right to use the atmosphere (known as “global common pool good”) than another. The normative concept of contraction and convergence related to this (SRU 2002a, Item 539; OTT 2007) has met with widespread acceptance in the meantime. It is a welcome development that the Federal Chancellor took up this concept and embedded it in a proposal for the UN Climate Conference in December 2007.

3.2.3 Conclusion

96. Scientific scepticism about global warming being largely caused by humans has been dispelled. Compared to earlier reports, the IPCC’s AR4 does not only give no “all-clear” – its findings are even more dramatic in key points. In addition to speeding up change, the significance of threshold values is emphasised. Exceeding these values can lead to non-linear changes in the climate system with large-scale ecological transformations that can no longer be predicted. The IPCC’s best estimate on climate sensitivity is approx. 3° C. Based on this figure, none of the SRES scenarios guarantees likely compliance with the 2° C target which is also being pursued by the EU. This requires more rapid and farther-reaching emission reductions of between 80 and 95 % compared with 1990 for industrialised countries. Burden sharing is of key importance for post-Kyoto pursuit of climate policy. The basic normative concept of contraction and convergence has met with widespread acceptance in the meantime.

3.3 German climate policy in the international context

3.3.1 The International regime

97. In the United Nations Framework Convention on Climate Change (UNFCCC) that was ratified in 1992 and went into force in 1994, and which has its origins in the Conference for Environment and Development in Rio in 1992, the 190 signatory nations made a commitment to “stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (Art. 2 UNFCCC). In the meantime, it is widely accepted that, to achieve this goal, it is necessary to limit the global temperature increase to 2° C above pre-industrial levels (i.e. compared to 1750) (SRU 2004, Item 24; Federal Government's Advisory Council on Global Environmental Change, SRU 2003, p. 9; OTT et al. 2004; SCHRÖDER et al. 2002, Chapter 1.4; LUMER 2002). In the Kyoto Protocol that was ratified in 1997 and did not come into force until 2005, the western industrialised nations and the Eastern bloc states at that time (Annex-I countries) committed themselves to lowering their emissions over the entire time period from 2008 to 2012 by a total of 5 % compared to 1990. Reduction commitments range from – 8 % for the countries in the European Union (some as a shared commitment, Item 100 f.) to + 10 % for Iceland (Art. 3 and Annex B, Kyoto Protocol). This commitment is not adequate to satisfy Article 2 UNFCCC. More stringent targets are required in a follow-up agreement. The fact that developing countries have been exempted to date allows for the principle of "common but differentiated responsibilities" (Art. 3 UNFCCC) that gives the Annex-I countries a leadership role (IISD 2006; MATSCHOSS 2004; SRU 2004; UNFCCC 2007a; GRUBB et al. 1999; OBERTHÜR and OTT 1999).

The most important task in further structuring international regulations is defining further reduction commitments for a smooth transition after the Kyoto Protocol expires at the end of 2012. The latter can only represent a first step on the path to stabilisation because:

– The reductions agreed to date are fully inadequate for the reduction requirements provided above.

– The Annex-I countries alone cannot reach the 2° C target and thus developing countries, and large emerging nations such as China and India in particular, will have to enter into reduction commitments.

– The refusal of the USA, the Annex-I country which produces the most emissions worldwide with the highest per capita emissions, to sign the Kyoto Protocol has damaged the credibility of the postulated principle of differentiated responsibilities.

98. The effectiveness of a future regime will depend, in particular, on whether the USA, on the one hand, and China and India, on the other, can be successfully included in regulations to reduce GHGs. This is because these countries, together with the EU, Canada, Russia and Japan, are responsible for 75 % of global GHG emissions (European Commission 2005b). It is therefore a welcome development that climate protection – since the consultations in Gleneagles in 2005 – has become a focal issue for the Group of Eight (G8) and that the emerging nations of Brazil, China, India, Mexico and South Africa have been included in the consultation under the German presidency ("G8+5") (Federal Government, Bundesregierung 2006). A concrete reduction commitment by the G8 countries was not expected. However, the G8 made a commitment to a follow-up regulation for the Kyoto Protocol as part of the UN climate process (Bundesregierung 2007b). This was an important prerequisite for the resolutions of the 13th Conference of the Parties (COP 13) in

Bali in December 2007. In the Bali Action Plan, “nationally appropriate mitigation commitments” are targeted for the developing countries (UNFCCC 2007b; IISD 2007).

Even though the Bali resolutions do not lay down any quantitative goals, they indicate a potential reduction target for the industrial countries in a footnote (25 to 40 % by 2020). The same footnote references a global GHG reduction target of 50 to 85 % by 2050 (compared with 2000) (UNFCCC 2007b). The IPCC table cited in the Bali Action Plan envisions an emission reduction of 80 to 95 % over 1990 values for the rest of the industrialised countries (BARKER et al. 2007b, p. 39, 90; GUPTA et al. 2007, p. 776). The SRU recommends incorporating this more ambitious target and the justification for it into the continued process of goal formulation. This is also justifiable because these more ambitious targets seen as necessary by the IPCC are accompanied by new dynamism in innovation and growth for climate-relevant technologies that has increased room for action (see Item 94; Chap. 2). It is not only the requirements of climate policy that have undergone dynamic changes, it is also the potential for action.

99. A set of proposals exists on how to structure the regime after 2012. They range from relatively complicated models that, like the Kyoto Protocol, explicitly take into consideration the situation and development level of the individual countries, to simple models oriented around a small number of principles (GUPTA et al. 2007, Section 13.3.3). A comparison shows that the allocations of emission rights to individual countries vary more in the stringency of the global reduction target than in the choice of the model. A key factor in achieving ambitious reduction goals is that, in addition to the Annex-I countries, as many non-Annex-I countries as possible – in particular the +5 countries with their high emissions – enter into reduction commitments quickly enough (HÖHNE 2006; HÖHNE et al. 2006; HÖHNE et al. 2005; GUPTA et al. 2007). Apart from Germany, a number of countries have now entered into more far-reaching reduction commitments (including the United Kingdom, France and Sweden). Even though the US Senate rejected draft legislation for nationwide emissions trading in the USA in 2003 (in the McCain-Liebermann Climate Stewardship Act) (PEW Center, publication date unknown; PIZER and KOPP 2003), no fewer that twelve different bills have in the meantime been submitted to the US Congress (RFF 2008; KOPP 2007). In addition, there are already regional initiatives, such as the GHG initiative of the North-Eastern States that starts in 2009 and a reduction commitment signed into law in California (ARIMURA et al. 2007; KNIGGE and BAUSCH 2006).

3.3.2 The European climate strategy

100. The Council of the European Union set a target of limiting the increase in the average global temperature to 2° C for the first time in 1996 and has affirmed this figure several times since then (European Commission 2007b). The European Commission thus made the 2° C target the core of its climate protection strategy and explicitly stressed the pioneering role of the EU, but at the same time, the necessity of participation by the non-Annex-I countries. The European Council adopted large parts of an overall concept for an integrated climate and energy policy presented by the European Commission at the spring conference in 2007. The core of the concept is a unilateral reduction target of at least 20 % compared with 1990 which is to be increased to 30 % “as long as other industrial countries commit to comparable emission reductions and the more economically advanced developing countries commit to a contribution appropriate to their responsibilities and respective capabilities” (European Council 2007, Para. 31-2; European Commission 2005b; 2007b; 2007d). In the light of the difficult negotiations for the period after 2012, the unilateral target will make an important contribution to ending the blockade between Annex-I and non-Annex-I countries. Measured against the long-term reduction requirements, it is still inadequate. Instead, a resolution for a unilateral reduction of at least 30 % or a multilateral reduction of at least 40 % would be necessary.

In January 2008, the European Commission presented a second energy package designed to ensure that the reduction targets are reached by 2020. In addition to proposals for directives to promote renewable energies and CCS, the package contains proposals to revise and contribute to emissions trading (see Section 3.5.4) and burden sharing between the member states (now called effort sharing). According to this, the GHG emissions are to be reduced by a total of 14 % over 2005 emissions (this represents a reduction of 20 % over 1990 emissions). It prescribes a reduction of 21 % for the emissions trading sector and 10 % for the other sectors. An EU-wide emissions budget applies to emissions trading. For the other sectors, the reduction commitments of the EU-27 range from – 20 % (Denmark, Ireland, Luxembourg) to + 20 % (Bulgaria). The target for Germany is – 14 % (compared with 2005). If the reduction targets are changed as mentioned to 30 % of 1990 values, the country and sector targets will be adjusted proportionally (WENNING and TOSTMANN 2008; European Commission 2008c; 2008e).

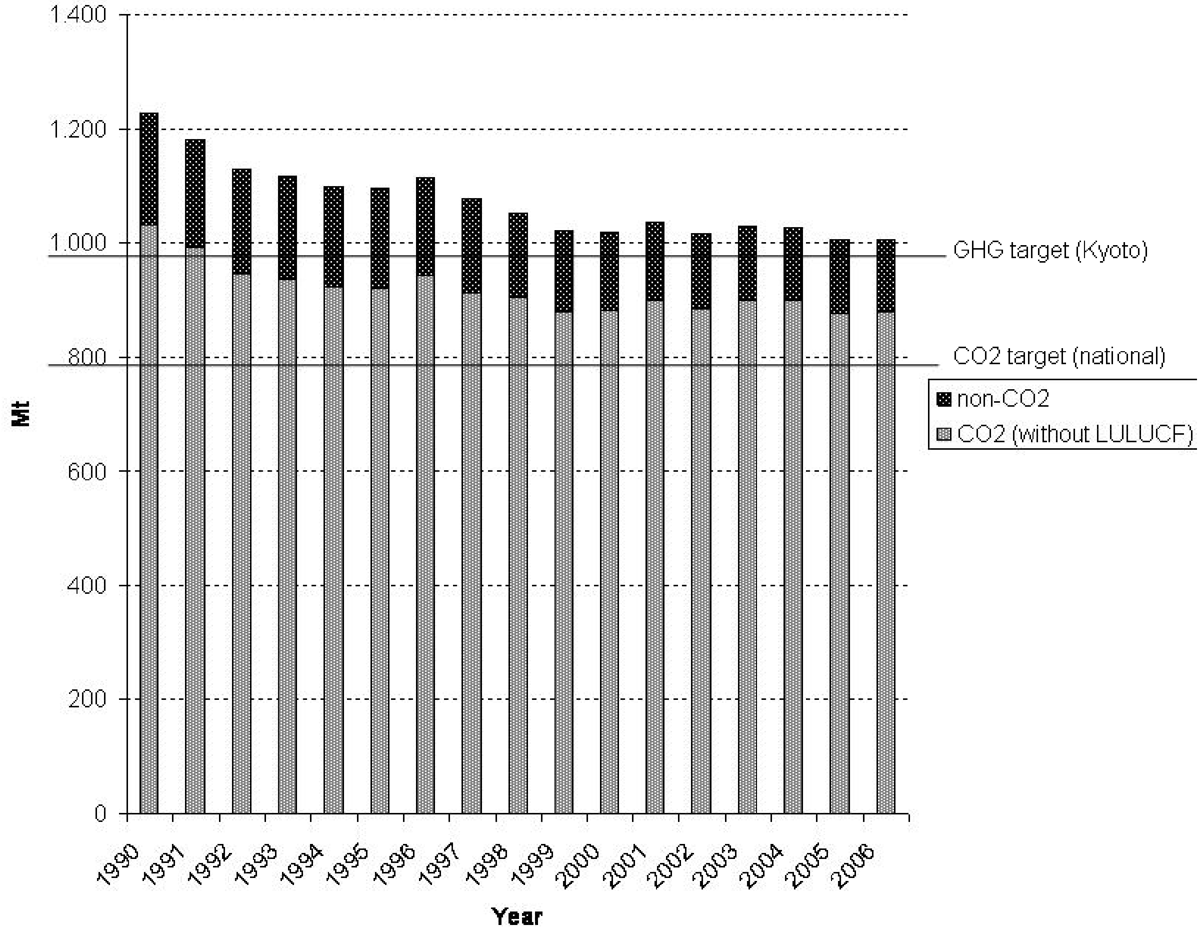
101. Reaching the reduction targets of the Kyoto Protocol is a key factor in the European Union’s credibility in the upcoming negotiation process and in the pioneer role it has claimed. However, whether the targets will be reached is still currently uncertain because the previous reduction of the EU-27 can be primarily attributed to the economic slump in the accession and transformation states in the 1990s. The GHG emissions of the EU-15, in contrast, fell only 1.6% by 2006. The (almost exclusively energy-induced) CO2 emissions even rose in the EU-15 by 4.1% (ZIESING 2007b). In the light of the fact that this target is already inadequate, this development is absolutely unacceptable even if a slightly more favourable picture emerges when flexible mechanisms are incorporated (EEA 2007c).

3.3.3 Previous reduction targets and emission developments in Germany

102. Figure 3-2 shows the development of GHG emissions in Germany. The other five gases covered by the Kyoto Protocol, CH_4, N_2O, HFCs, PFCs and SF_6, are combined in the non-CO_2 category. The dominant CO_2 portion (87.1 %), which is almost exclusively energy-induced, is typical for highly developed industrial countries. Land use, land use change and forestry (LULUCF) are presently absorbing more GHG than they are releasing, i.e. they still currently act as a counterbalance (Federal Environmental Agency, UBA 2007b). The national target of reducing CO_2 emissions by 25 % by 2005, which had bipartisan representation for quite some time (shown by the lower horizontal line), was not reached (SRU 2004, Item 22). Within the scope of EU-internal burden sharing set forth in the Kyoto Protocol, Germany committed itself to reducing all GHGs by 21 % over the entire time period between 2008 and 2012 (shown by the upper horizontal line). Even though the target had largely been reached with a reduction of 18 % by 2006, emissions rose again slightly compared with 2005 (ZIESING 2007a). In 2007, there was a further decline in energy consumption and emissions, but this was primarily the result of weather conditions and other factors and thus cannot be seen as unconditional affirmation of the trend. On the contrary, the percentage of electricity generated from hard coal and lignite has further increased (ZIESING 2008; AGEB 2008; Federal Environment Agency press release of 10 March 2008). There is thus no guarantee that the Kyoto target will be reached, even though the European Environmental Agency's projections are more optimistic (EEA 2007c). That the European Commission prevented over-allocation in the second phase of emission trading and allocated one part of the measures of the inadequate climate protection programme from 2005 (Deutscher Bundestag 2005) to the emissions trading sector (Item 203) is at least a sign that it is working towards the set targets.

Figure 3-2

Green House Gas emissions in Germany according to the type [CO_2 equivalent]

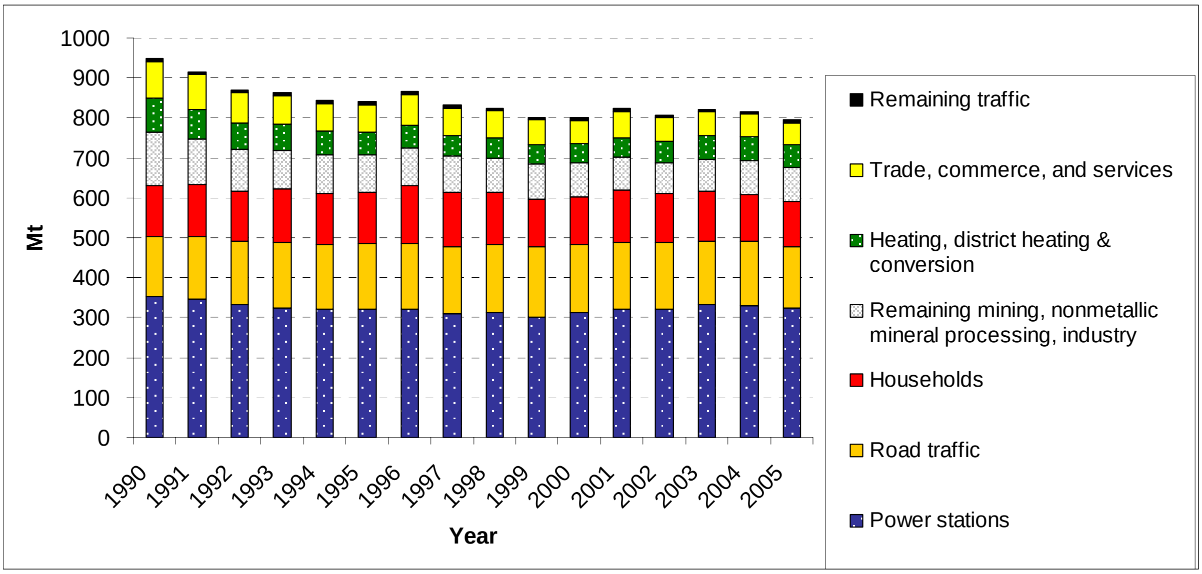


SRU/UG 2008/Abb. 3-2; Source: UBA 2007b; UBA 2008a

103. Figure 3-3 shows the development of energy-induced CO_2 emissions broken down by sector. The largest proportional reductions have been achieved to date in the less important sectors of trade, commerce, and services, heating and mining which together made up 23 % in 2005. The CO_2 emissions of road traffic (2005: 19 %) have been decreasing since 1999 but are still above the 1990 level. Even though the absolute decline in the largest sub-sector of power stations (2005: 41 %) is the largest overall, this sector rose again steeply after 1999 – primarily through the use of lignite (SRU 2004, Item 22; SRU 2005a, Item 17) – so that the proportional reduction is one of the lowest. It can be clearly seen from the power station emissions that – similar to changes in emissions in the accession countries of the EU – the greatest reductions are due to the collapse of the former East German economy.

Figure 3-3

Development of energy-induced CO_2 emissions by sector



SRU/UG 2008/Abb. 3-3; Source: ZIESING 2007a; 26 August 2007

3.3.4 The integrated energy and climate programme

104. The current government has committed itself to taking on a leadership role in climate protection just as its two predecessors did (Bundesregierung 2007b). In a government statement issued on 26 April 2007, it undertook to reduce emissions by 40 % compared with 1990 by 2020, or 270 Mt CO_2 compared with 2006. This represents a reduction of 26.4 % from 2005 (the new base year of the European Commission). Eight fields of action are identified with their respective contributions. Cornerstones of a new climate protection programme to meet this target were adopted at the Cabinet meeting on 24 August 2007 in Meseberg. The first part of a relevant legislation package was passed by the Cabinet in December 2007, the second part is scheduled to follow in May 2008 (Federal Environment Ministry press releases, 24 August 2007 and 5 December 2007; BMU 2007g). The measures for energy-induced CO_2 emissions are mainly based on a study conducted by the Federal Environment Agency (Umweltbundesamt – UBA) which, however, rated several areas more critically (combined heat and power generation and renewable energies for heat and power) but instead specified other additional measures. Overall, the study arrived at a reduction of 224 Mt/a in energy-induced CO_2 emissions by 2020 (Federal Environment Agency, UBA 2007a). Table 3-1 shows the measures included in the government statement and their reduction targets as well as an estimate of the effectiveness of the resolutions drafted in Meseberg.

105. The impact analysis of the Meseberg resolutions yields a GHG reduction of only 219.4 Mt and not 270 Mt. This represents a reduction of around 36 % compared with 1990. The package of measures thus misses the reduction target of 40 % by one-tenth. The assumption has to be that these emission reductions are still being overestimated. Even though the difference is explained by the definitions used compared with existing measures, other studies arrive at much more critical conclusions. A rough analysis of an earlier programme draft calculated – with a more generous interpretation of the text – a reduction of 215 Mt GHG, of which 35 Mt GHG were considered uncertain. This would create a shortfall of 85 Mt GHG or 7 % (ECOFYS 2007) in 2020. The rough analysis corresponded to a version of the programme that was more comprehensive and stringent than the most recent compromise passed by the Cabinet. Cuts were made by the Cabinet which lower the expected emission reductions. Several measures were thrown out such as the mandatory energy consultation in exchange for an exemption from the ecological tax or the HGV toll for vehicles under 12 t. The ban on night-storage heating systems was initially conceived with long transition periods but it is now being pushed through. The de facto tax privileges for high-powered company cars and contracting in the rented homes sector were only commissioned for review. Several financial pledges for assistance programmes are slated for cancellation (Frankfurter Rundschau, 16 and 20 August 2007; Handelsblatt, 16 August 2007; Die Zeit, 23 August 2007). Against this background, another calculation using the actual Meseberg resolutions only arrives at a reduction in emissions of 160 Mt GHG by 2020. This would be a serious shortfall on the original targets. The greatest differences are found in electricity generation, smaller differences exist in building remediation and reducing the other GHGs (EUtech 2007). Overall resistance appears particularly strong in the key areas of energy efficiency and electricity savings. This corresponds to the deficits in the national action programme for energy efficiency (see Item 128).

Table 3-1

Germany's Integrated Energy and Climate Programme (IECP)

Measure	GHG reduction in Mt CO_2-eq	
	Govt statement	Impact analysis
Reduction of electricity consumption by 11 %: – Stricter consumption standards for energy-using devices – Mandatory energy audit in companies (coupled with ecological tax exemption) – Consideration of energy efficiency in public procurement – Energy efficiency funds: advisory services and low-interest loans for small and medium-sized companies and households	40	25.5
Consumption reduction in buildings and production processes: – Phased tightening of the Energy Saving Ordinance (Energieeinsparverordnung – EnEV): 30 % by 2008/2009, up to 30 % again by 2012 (synonymous with 3-litre standard, heating oil/m^2) for new buildings, taking night-storage heating systems out of operation – Rental apartments: amendment to the Heating Costs Ordinance (increase in the portion of variable costs for more incentive to save energy), assess possibilities for contracting – Further development of the CO_2 building remediation programme	41	31

– Subsidies for remediation of the social infrastructures of *Länder* and municipalities (schools, etc.) by the Federal Government – Continuation of the programme for remediation of federal buildings		
Increase in the percentage of renewable energies in electricity generation to more than 27 % (25 to 30 %): – Amendment to the Renewable Energies Act (Erneuerbare-Energien-Gesetz): increased compensation rates for offshore wind, biomass and geothermal energy, improved incentives for repowering – Grid integration: accelerated expansion of the electricity grid (Power Grid Expansion Act (Energieleitungsausbaugesetz) with requirements plan, sample guidelines for plan approval, shortening of the legal process, bundling of plan approval for offshore connection, etc.) – Offshore wind energy: better integration in regional planning (designation of priority areas) – Repowering wind energy: replacement of old facilities and removal of scattered systems through better integration in physical development planning (concentration zones in land use plans) and regional planning (designation of suitable areas).	55	54.4
– Increase in the percentage of renewable energies in the heating sector to 14 %: – Renewable Energy for Heat Act (Erneuerbare-Energien Wärmegesetz – EEWärmeG) with proportional mandatory use of renewable energies – Stepped up market incentive programme – Electricity feed-in regulation for biogas in natural gas networks with priority rules for and minimum percentages of biogas.	14	9.2
– Upgrading power plants: – Research funding for CCS – Establishment of a legal framework for CCS – Efficiency increases – Mandatory use of the latest technologies (Best Available Technique – BAT), stricter limit values	30	15
– Doubling of combined heat-and-power generation (CHP) to 25 %: – Appeal to private sector to implement CHP agreement – Amendment to the CHP law (incl. funding for local and district heating networks)	20	14.3
– Efficiency increase in transport and increase in the percentage of bio fuels to 17 %: – Emissions standards and consumer labelling in accordance with EU strategy – Vehicle road tax: revenue-neutral change to CO_2 basis – HGV toll (12t and higher): more rate differentiation by emissions class – Increase in the biofuels quota to twenty volume percent by 2020 – Increase in the competitiveness of the rail system – Development of a master plan for goods transport and logistics – Inclusion of air and sea traffic in the European emissions trading scheme	30	33.6
– Reduction of fluorinated greenhouse gases (non-CO_2): – Enactment of a climate protection ordinance for chemicals – Development and market launch of refrigeration systems with natural refrigerants	40	36.4
– Reduction overall	270	219.4
SRU/2008Environmental Report/Table 3-1; data source: BMU 2007f; BMU 2007a; BMU 2008; UBA 2008b; Federal Ministry of Economics and Technology and Federal Environment Ministry, BMWi and BMU 2007		

106. The restrictions laid down by the Meseberg resolutions are also difficult to justify in terms of cost. According to a study for the Federal Environment Agency, the energy and climate programme of the German government entails annual investment costs of 24 bn euros compared with annual energy savings of 29 bn euros (DOLL et al. 2008). As expected, a study for the Federation of German Industries (Bundesverband der Deutschen Industrie e.V. – BDI) (McKinsey & Company 2007) arrives at a much more critical conclusion. The study says at least that the savings brought about by the emissions reduction of 127 Mt GHG (= 25 % emissions reduction by 2020 over 1990) make the investment profitable. A GHG reduction of 44 % (with CCS) is considered possible by 2030 – even if nuclear energy is still phased out – of which just under two-thirds is regarded as profitable. This result would be much more positive if several parameters were changed in a plausible way. For example, even though the assumed price of crude oil (2020: USD 52 per barrel) corresponds to current forecasts, higher prices, as is the current reality, would expand the range of worthwhile measures. What is primarily lacking though, is consideration for the effects of innovation (also recently discussed by the IPCC) brought about by an ambitious climate policy which usually lead to a drop in costs for climate protection measures (IPCC 2007b; SRU 2002a). These effects are explicitly taken into account in the study conducted by DOLL et al. (2008). Interestingly enough, the wide range of costs between the individual measures is evident in both studies: the lowest costs for further reductions are generated by the measures for saving energy while GHG prevention using biofuels represents the most expensive bundle of measures by far (see also SRU 2007).

107. With the government statement dated 26 April 2007, the adjustment of the reduction targets supported by the two previous administrations in keeping with an EU-wide reduction target of 30 % was abandoned (CDU et al. 2005; SRU 2004, Item 27). Similar to the unilateral target of the EU, the German government makes a welcome contribution to further developing international climate regulations with this basis decision. The targets effectively reached, however, play a critical role in the credibility of this ambitious policy. Being able to foresee that the self-imposed target will not be reached from the outset contradicts this. It also deserves criticism because it dispenses with key innovation incentives, for example, encouraging the use of more fuel-efficient company cars or rewarding a mandatory energy consultation with a tax break, a programme that has met with great success in Great Britain. The programme’s weakness in promoting energy efficiency is serious because, on the one hand, it is highly profitable and, on the other, it is ultimately a condition for the success of other measures.

3.3.5 Conclusion

108. In the present critical phase of international climate regulation, the goal is to create a follow-up agreement with reduction targets that are sufficiently strict to ensure a smooth transition to the period after 2012. It is of critical importance that the USA and the large emerging nations are included. The unilateral reduction targets of the EU and Germany make an important contribution to ending the blockade between the Annex-I and non-Annex-I countries. For the sake of credibility, however, it is necessary to actually reach the targets, something that has not appeared certain at either EU or national level so far. The measures of the German integrated energy and climate programme are to be considered a welcome development overall, but concessions have been made in sub-sections that could prevent the targets from being reached. These concessions are particularly high in the areas of energy efficiency and electricity savings, which have been shown by various studies to have the greatest potential with the lowest costs.

3.4 Emission reduction through energy efficiency

3.4.1 Significance and role of energy efficiency

3.4.1.1 Climate protection and energy efficiency in the energy policy target triangle

Definitions

109. Due to the central importance of energy efficiency described, the possibilities for increasing efficiency will be looked at here in more detail. This is preceded by a brief explanation of several terms.

Energy intensity measures the energy consumption per activity (e.g. GDP, km) while energy efficiency represents the reciprocal value (IEA 2004, p. 21; AZAR and DOWLATABADI 1999, p. 520). The definition of the term efficiency potential is reached by cascading downward from the definitions of other terms. The highest is theoretical potential followed by the technical potential, finally arriving at the economic potential, which describes the portion of potential with macroeconomic benefits in the existing economic framework. While economic potential assumes functioning markets, the market or expectation potential ultimately takes into account the portion that can be reached despite market imperfections (SCHMID et al. 2003, p. 6-7; THOMAS 2006, 7 f.; Deutscher Bundestag 1994, p. 130). It is argued that what is known as the rebound effect exists where one portion of the costs saved by an increase in energy efficiency can be used to boost demand for energy services. Increasing energy efficiency can also be obscured and overcompensated for by other developments (general economic growth, technological change) (GELLER and ATTALI 2005, p. 5 ff., 31 ff.). This means, on the one hand, that direct efficiency policies (e.g. dynamic device standards) have to be sufficiently ambitious and, on the other, that supporting measures for establishing a framework (limiting/pricing of energy or CO_2) continue to be necessary.

Significance for climate policy and security of supply

110. To achieve the necessary reduction in emissions without lowering living standards, it is necessary to increase CO_2 efficiency at all levels of the energy system. The necessary scale of emission reductions requires an almost complete shift to CO_2-free, or renewable, energy sources over the long run. To achieve this, it is also necessary to drastically reduce overall primary energy requirements which are fundamentally characterised by conversion losses and extremely inefficient end energy use. Currently only approx. 10 % of the primary energy used is converted to actual energy services. The conversion losses alone that occur when producing energy suitable for consumption make up two-thirds of the primary energy (BLOK et al. 2001, p. iv; WAGNER 2006; NAKICENOVIC 2007).

Lowering the energy intensity of end-use consumption is thus a decisive factor in lowering primary energy requirements and energy-induced emissions. Between 1973 and 1998, for example, 75 % of the reduction in CO_2 intensity was attributed to the reduction in the energy intensity of end-use consumption in eleven OECD countries. Without this reduction, the absolute energy consumption would have been 50 % higher during this period (IEA 2004, p. 54, 192; SRU 2005a, p. 7 f.; ZIESING 2006a; 2006b).

111. Energy policy goals form a triangle made up of security of supply, competitiveness and environmental compatibility. Interpretations of these goals are often one-sided in the public debate. For instance, an outdated view of supply security is played off against environmental and climate protection. In this case, a national, coal-based energy base is advocated and an increase in the percentage of natural gas is represented as a supply risk. This view is short-sighted, whereby a distinction has to be made between physical (availability of energy/resources) and economic security of supply (protection against price fluctuations).

In physical terms, it is not a national energy base that is important but a diversification of energy sources enabling access to global energy markets and transport channels. No physical bottlenecks are anticipated for coal in the foreseeable future. The uneven global distribution of oil means that, in the integrated global market, physical supply bottlenecks occur, for example, when individual supply routes are blocked because oil is supplied by ship. This also applies – with restrictions – to gas whereby a strong reliance on liquefied natural gas is necessary. The prerequisite is also sufficient investments in infrastructure (YERGIN 2005; Federal Ministry of Economics and Technology 2006, p. 2 ff.; IEA 2007d, p. 159–164, 181; IEA 2006c, p. 88 ff.). The risks are thus primarily economic in nature. But also when seen in terms of vulnerability to high price fluctuations, a national energy base does not really offer a solution as a result of the integrated global energy markets. This is because even in the – unrealistic – event that the national or European energy markets became independent of the global energy markets, opportunity costs would arise from the higher value of the energy (YERGIN 2005, p. 55; IEA 2007d, p. 164). The key lies instead in systematically reducing the energy intensity of the national economy so that a smaller portion of factor costs is accounted for by energy costs – as is already the case today in contrast to the situation during the oil price shock in the 1970s. Increasing energy efficiency is the key to dealing reliably with rising and volatile energy prices.

112. Overall, increasing energy efficiency thus has a particularly important role to play both in the security of supply and in climate protection. This insight is nothing new (SRU 1981, p. 77). What is new is the increased recognition of supply risks associated with the sharp rise in energy prices and an increased environmental awareness due to weather anomalies which are interpreted as the first signs of climate change. As a result, synergies often exist between policies for reducing CO_2 emission and increasing energy efficiency. The overall concept mentioned above for the EU's integrated climate and energy policy (Section 3.3.2) tries to capitalise on these synergies and the advantages offered by this type of innovation strategy. Important components of this new energy policy are the unilateral reduction target mentioned and an action plan for energy efficiency (to be published ahead of time). The conscious integration of the various energy and climate policy sub-sectors into a coherent overall concept is a welcome step.

3.4.1.2 Efficiency targets and developments

Development to date

113. Despite their extreme relevance, the annual rates for improving energy intensity have fallen considerably in the OECD, the EU and Germany since the beginning of the 1990s. As a result of economic upheaval, more progress was made in the new member states than in the EU-15. The low average rate over the last few years has largely been caused by weak economic growth (MANTZOS and CAPROS 2006c, p. 40; communication by the European Commission, 16 January 2006). Following a period during the 1990s when the German rates of intensity improvement were well above the EU-15 average as a result of reunification, they have stagnated since 2000. In absolute terms, the German energy intensity figure is, however, far below the average of the EU-25 and EU-15. Only Denmark, Ireland and Austria are lower (Eurostat 2006; ZIESING 2006a). An analysis of energy productivity produces a similar picture: the rates of increase continuously fell in Germany every year by 2.1 % in the first half of the 1990s to 0.9 % every year in the first half of this decade (ZIESING and WITTKE 2006, p. 119). In the period from 2006 to 2007, however, the rate – partly due to the increase in energy prices – jumped to 7.7 %, adjusted for temperature and inventories to 5.1 % (AGEB 2008).

The European efficiency strategy

114. The Action Plan on Energy Efficiency published in 2006 by the European Commission and ratified at the spring summit in 2007 pursues the goal of energy savings of 20 % from the baseline scenario. They aim to achieve 50 % of this target by implementing measures that have already been adopted and the other 50 % through additional measures.

Overall, this is intended to double the previous rates of the annual intensity improvements to – 3.3 % in the EU-25, with – 0.7 % anticipated from the Energy Services Directive that has already been adopted (Item 123) and – 0.8 % from the new measures of the Green Book and the Action Plan (European Commission 2005a, p. 42; 2006a, p. 7 f.; MANTZOS and CAPROS 2006c, p. 6, 16; communication by the European Commission, 16 January 2006).

The projected rates are based on internal studies conducted by the European Commission, the Wuppertal Institute and the IEA which assume moderate oil prices. In all scenarios, the increase in energy efficiency of end-use consumption makes the greatest contribution to reducing emissions. In the Wuppertal scenario, this contribution amounts to half and even reaches two-thirds in the IEA's scenario with additional measures (alternative policy scenario). In one of the IEA's long-term studies on energy technologies, the percentage of energy efficiency increase is between 40 and 53 % in five of six scenarios (MANTZOS and CAPROS 2006a, p. 6, 17–18, 20, 55; 2006b, p. 49; MANTZOS et al. 2003; LECHTENBÖHMER et al. 2005, p. 17; IEA 2006c, p. 190; IEA 2006b, p. 51).

115. Overall, the European Action Plan to increase energy efficiency can be considered ambitious in the sense that it envisions a considerably faster pace than previous trends and lies above the projected rates of the future scenarios. The formulation of a potential economic saving of 20 % is based on several studies (DUSCHA et al. 2006; LECHTENBÖHMER et al. 2005; LECHTENBÖHMER et al. 2001; SCHMID et al. 2003). On the other hand, the quantitative results of the studies depend on the assumptions used in the models. For example, the Commission studies set the impact of directives (efficiency scenario) higher than the impact of energy price increases (high price scenario). The models also do not represent all of the measures of the Action Plan, and none of the European Commission studies combines the (not unlikely) high price scenario with the efficiency scenario. With this in mind, the stated goal of the Action Plan should be seen as more moderate.

The German context

116. The German government has also set the goal of doubling energy efficiency and productivity from 1990 values by 2020 which is also intended to result in energy savings of 20 % compared with the trend. The Action Plan on Energy Efficiency presented at the second Energy Summit (2006) recognises that, to achieve this goal, it is necessary to triple previous energy efficiency increases to 3 % per year (CDU et al. 2005; UBA 2006; BMU 2006). The efficiency increase over the last year of 7.7 % (adjusted 5.1 %) has shown that this is by no means unrealistic (Item 113).

117. A report commissioned by the Federal Government for the third energy summit illustrates the significance of energy efficiency and the secondary role of nuclear energy. Table 3-2 shows the results of the "Coalition Agreement" scenario (CA scenario), "Stronger

Expansion of Renewable Energy" (RE scenario), "Longer Service Lifetimes of Nuclear Power Plants" (LSL scenario), and a variant of the CA scenario with a lower efficiency increase. The results show that the impact of a variation of the annual efficiency improvement of just one percent by 2020 (if all other assumptions are the same) is twice as great on the GHG reduction and even three times as great on lowering the primary energy requirements than the effect of extending the service lives of nuclear power plants by 20 years (Prognos AG and EWI 2007). What will determine the success of the German climate policy is not extending the service lives of nuclear power plants, as repeatedly called for, but capitalising of the existing potential of energy efficiency.

Table 3-2

Energy scenarios for the 2007 Energy Summit: changes by 2020

Scenario	LSL	RE	CA	CA (2%)
Efficiency increase per year	3 %	3 %	3 %	2 %
Emissions compared with 1990	45 %	41 %	39 %	28 %
Primary energy consumption compared with 2005	13 %	16 %	17 %	6 %
– Percentage of nuclear energy	14 %	4 %	4 %	4 %
Gross electricity generation compared with 2005	9 %	11 %	13 %	+4 %
– Percentage of nuclear energy	29 %	8 %	9 %	7 %
Import quota (2003: 75%)	72 %	66 %	69 %	73 %

SRU/2008 Environmental Report/Table 3-2; data source: Prognos AG and EWI 2007

In addition to the assumptions about energy productivity, other decisive factors in reducing GHGs are the assumed energy prices and the resulting price relationships of the individual energy sources to one another, particularly the "spread" (price differential between gas and coal). In the phase-out scenarios, part of the capacity of decommissioned nuclear power plants is compensated for by lower demand due to the increase in energy efficiency – electricity efficiency in particular. The remaining gap is covered by the additional electricity produced from other energy sources (and electricity imports). The extent to which coal or gas is used to generate electricity depends on the spread and on the price for emission rights. If the spread increases, more coal is used; a rising price for emission rights counteracts this trend. The CO_2 emissions are influenced by the respective combination. Here, the high price of oil due to the oil price indexing of natural gas causes the spread to widen and more coal to be used (VIELLE and VIGUIER 2007; MANTZOS and CAPROS 2006b, p. 28).

118. It is also energy efficiency and not nuclear energy that plays the crucial role in the security of supply. Although it is not the import quota but unhindered access to the global energy markets that is the decisive factor (Item 111), the role of nuclear energy is continuously highlighted in the security of supply. In actual fact, the import dependence is highest in the LSL scenario because 100 % of all uranium is imported (Prognos AG and EWI 2007; NEA and IAEA 2006). Instead, the renewable energies make up larger percentages of primary energy and electricity consumption over time because this falls with the increase in energy efficiency (with the exception of the CA variant (2 %) in which the fossil fuels have to compensate for the slower increase in efficiency). The prerequisite, however, is the assumption that the renewable energies are produced domestically, which is not a given for biomass due to the current expansion targets (see SRU 2007).

Also for natural gas requirements, which are considered a sensitive area, the efficiency increase has a much greater effect than nuclear energy: in the LSL scenario, the requirement is only 6 % points less than the CA scenario. In the CA scenario (2 %), on the other hand, it is 18 % points higher. It is thus important to compensate for the additional demand for electricity production by savings in the building sector which currently makes up approx. 90 % of natural gas requirements (UBA 2007a, p. 26).

3.4.1.3 Key areas for efficiency strategies

119. To determine the efficiency potential, it is necessary to capture the entire energy flow from the primary energy through the various conversion phases all the way to end-use energy consumption. This makes it possible to assess the impact of various energy use paths on the amount and structure of the primary energy requirements, taking into account their respective conversion losses. Table 3-3 shows the primary energy requirements that can be attributed to the various sectors in 2004 taking into account conversion losses in the individual use paths (electricity and “fuels” aggregate).

Table 3-3

Sectoral primary energy requirements for electricity and fuels in 2004 in Germany as percentages

	Electricity	Fuels	Total
Households	9.1	20.7	29.8
Industry	15.1	10.6	25.7
Transport	1.0	20.3	21.4
Trade/commerce/services	7.4	4.7	12.1
Non-energy		8.3	8.3
Agriculture	0.5	0.6	1.2
Not specified		1.7	1.7
Total	33.2	66.8	100.0
Differences possible due to rounding			

SRU/2008 Environmental Report/Table 3-3; data source: IEA 2006a, p. II.71

Electricity consumption is of special significance here due to its high conversion losses during generation. Although electricity only made up 17.5 % of end-use energy consumption in Germany in 2004, it represented 33.2 % of primary energy consumption. This is why lowering electricity consumption – in addition to lowering conversion losses – has strategic significance. In 2004, just under half of German electricity consumption (end-use energy) was accounted for by the households and trade/commerce/services sectors (49.7 %), on the one hand and the industry sector (45.5 %) on the other. Taking into consideration the percentages of end-use energy consumption in the respective sectors yields the percentages of 16.5 % and 15.1 % for total primary energy requirements provided in Table 3-3.

In a sectoral analysis, the greatest portion – with just fewer than 30 % of the primary energy requirements – is accounted for by households, followed by industry with a good quarter and the transport sector with a good fifth. If the sectors of households and trade/commerce/services are combined due to their similar use of energy, they represent the largest consumer group with just fewer than 42 % of primary energy requirements. The distinction between electrical and non-electrical fuel applications makes it evident that the greatest primary energy requirements are made up of fuel applications in the household and transport sectors, each with one-fifth, followed by electrical and non-electrical applications in industry with 15 % and just under 11 % respectively and electrical applications in households with a good 9 %. If the household and trade/commerce/services sectors are added together again, they again represent the largest consumer group with 17.5 % in the electrical and 25.3 % in the non-electrical applications. Table 3-4 breaks down the primary energy requirements in the household, trade/commerce/services and industry sectors further into the various end-use energy applications for 2003.

Table 3-4

Sectoral primary energy requirement for end-use energy applications in the key areas for electricity and fuels in 2003 in Germany as percentages

	Households		Trade/Commerce/ Services		Industry		Total
	Electricity	Fuel	Electricity	Fuel	Electricity	Fuel	
Space heating	1.7	17.2	0.4	3.1	0.2	1.4	24.0
Hot water	1.2	2.1	0.2	0.4	0.2	0.1	4.2
Process heat		0.1		0.8	3.9	8.7	13.6
Light and ventilation	0.8		3.2		3.1		7.2
Power	0.5		1.2		6.4		8.1
Major domestic appliances and entertainment electronics	5.2		2.6		0.6		8.4
Total	9.4	19.4	7.7	4.4	14.4	10.2	65.5
Differences possible due to rounding							
SRU/UG 2008 /Table 3-4; data source: IEA 2006a, p.II.70; BARTHEL et al. 2006, p.5-8							

If the similarity of certain energy applications is taken into account, the following strategic key areas – some of which overlap – emerge from Tables 3-3 and 3-4. These areas represent the starting points for an efficiency strategy (see also TUKKER et al. 2006):

– Fuel and electricity use for buildings and building infrastructure (49.2 %);
– Electricity use for energy-using appliances in households, trade/commerce/services and industry (29.9 %);
– Fuel use in transport (20.3 %).

Heat applications in buildings alone account for almost 40 % of the primary energy. The key areas overlap in the energy-using devices that are part of building infrastructure (around 15 %) because here, both appliance efficiency and structural measures play a role. The primary energy requirements of the transport sector are mainly accounted for by road traffic (SRU 2005b, Item 61-63; ZIESING 2006a).

3.4.2 Energy market liberalisation, cross-sectoral instruments and mainstreaming

3.4.2.1 End-use energy efficiency and energy market liberalisation

120. Even though a basic incentive for energy efficiency exists in liberalised energy markets, energy prices are still far from the “ecological truth” needed, because external effects continue to be insufficiently internalised (von WEIZSÄCKER 1992). In addition, the unused economic potential of increasing energy efficiency is evidence that the market players do not respond adequately to scarcity indicators. The existing market imperfections are largely associated with a lack of information on the demand side. The consumer, for example, only has inadequate information about the electricity consumed by households and office equipment and the tenant/buyer does not know the energy-related quality of apartments/offices upfront. This is called the investor/user dilemma in which the producer/seller/landlord is not the one who pays the energy costs later on. This is why adequate information is necessary – particularly in liberalised energy markets – (VINE et al. 2003), and labelling of buildings and products plays an important role. In energy-using devices in residential and non-residential buildings and in the industry sector, a gap is created between economic and realised potential that is often, for example, the result of the mass effects of scattered, smaller potential for which the relevant information is available in principle but the individual feels that the expenditures appear too high in relation to the (expected) cost savings (THOMAS et al. 2002, p. 12 f.). Here, additional regulations such as consumer standards in product policy may be necessary to achieve the necessary market penetration with energy-saving devices and products as quickly and completely as possible.

121. Energy supply companies have an inherent interest in selling energy and not in their customers saving energy. Until now, they have also mostly been successful at compensating for policy-driven savings in sub-sectors by expanding in other areas. The question thus arises as to which overall conditions or incentive structures could also change the interests of the energy supply company in this direction. If it is only possible to earn profits by selling energy, the energy supply companies will be the “structural losers” of an efficiency strategy because lower demand will result in sales losses. An incentive to sell less energy only exists if the sales loss results in lower costs than creating additional products and services, i.e. if demand side management (DSM) is cheaper than building up additional production and network capacities. More far-reaching efficiency increases on the demand side are only in the energy supply company’s interest if they benefit from the efficiency gains, and these benefits exceed the sales losses or at least compensate for them (DIDDEN and D'HAESELEER 2003; THOMAS 2006; THOMAS et al. 2002).

122. The idea of DSM (also called Integrated Resource Planning – IRP or least-cost-planning – LCP) refers to the overall optimisation of the entire value added chain from production through distribution all the way to consumption. In the concept of energy services, energy is only an intermediate product which this service provides by means of a conversion technology (incandescent lamp, refrigerator, heating). This integrated analysis focuses on the useful effect of energy and minimises the total costs from end-use energy and conversion technology (THOMAS 2006, p. 118 ff.; THOMAS et al. 2002, p. 17 ff.; LEEM 1997, p. 34 f.). New regulations to increase energy efficiency are necessary with the liberalisation of the energy markets because the value added chain becomes unbundled when production and distribution are completely separated. So far, the focus of liberalisation has continued to be on providing energy affordably and not on competition for the cheapest energy services which makes more sense in terms of climate and energy policy. The energy supply companies thus need an incentive to transform themselves from energy supply companies into energy service companies. On this view, it would be the task of regulation to force this structural change by establishing the appropriate framework (THOMAS et al. 2000; THOMAS et al. 2002; PERRELS et al. 2006; VINE et al. 2003).

But even in liberalised energy markets, there can be a supply side incentive to offer not only energy but energy services despite of unbundling. A central instrument in the building sector is contracting. In this case, an additional actor (contractor or energy service company – ESCO), who optimises energy supply and taps into potential efficiency, acts as an intermediary between the energy supply company and the end customer. Both the owner/tenant and the contractor benefit from this business model because the efficiency gain (energy costs saved) is distributed. Saving energy thus becomes marketable, and the contractor has an ongoing incentive to save energy because this increases profit (DENA 2007; WESTLING 2004). The greatest potential of contracting lies in high and unspecific energy applications (building heating in large properties) with a high potential for savings at low transaction costs. From this arises, for example, the key application field of public properties (BACHOR 2006; SORRELL 2007; WESTLING 2004, p. 5). There are thus incentives for energy supply companies to offer energy services even in liberalised markets as long as they generate higher profits than they do just selling energy. A central prerequisite is that free grid access for third-parties is guaranteed to ensure more competition in this sector.

3.4.2.2 Cross-sectoral instruments and mainstreaming

Energy Services Directive

123. The 2006/32/EG directive of 5 April 2006 on end-use energy efficiency and energy services (Energy Services Directive) aims to stimulate competition for energy efficiency in the context of liberalised energy markets. This requires cross-sectoral and specific measures in the key areas mentioned above (Item 119). The Energy Services Directive brings together measures that serve to (i) remove information deficits (ii) emphasise the exemplary role of the public sector and (iii) improve the functioning of markets for energy efficiency and services (mainstreaming). The Energy Services Directive also prescribes a general efficiency target of 9 % in nine years and a harmonised system of measurement. It requires the member states to present an Action Plan which describes the goals to be achieved every three years.

In addition to the general call for the provision of more information (Art. 7) and energy audits (Art. 12), the “traditional” actors in the energy sector, in particular, are also required to provide this information to a sufficient extent (Art. 6). A particular highlight is the provision to convert metering and billing systems (smart metering) which is a prerequisite for DSM (Art. 13). Instead of the flat-rate payments on account that are prevalent, actual energy consumption is to be recorded as a function of the period of use. The meters required to do this are more expensive than conventional meters but the price is expected to drop (further) – particularly when introduced across the board – and they also offer other benefits for the energy suppliers such as automation of customer administration, better grid troubleshooting and much less internal consumption (FRANZ et al. 2006, p. 114 ff.; IRASTORZA 2005).

The Energy Services Directive justifiably calls on the public sector in the member states to set an example in procurement as it can play a key role in introducing energy-efficient products to the market. For example, the member states have to select at least two requirements from a list (Annex VI) of energy efficient public procurement measures, e.g. procurement of vehicles, equipment, purchase of energy services or conducting energy audits. A higher savings target for the public sector (1.5 % per year), was not, however, pushed through.

To generally stimulate energy services, the Energy Services Directive calls on the member states to remove legal obstacles to financing energy services (Art. 9). This concerns, for example, impediments in tenancy laws and means another step closer to a standard European framework. This is also important in eliminating tariffs that stimulate consumption (Art. 10) particularly, for example, by banning volume discounts. In this context, it is important to note that individual OECD countries (e.g. Japan) also have experience with progressive electricity tariffs. It could prove valuable to review them in more detail (FOLJANTY-JOST 1995, p. 98).

Efficiency funds and savings certificates

124. If price signals and the elimination of market obstacles cannot be implemented through policy, or only inadequately, the actors either have to be given subsidies to achieve more end-use energy efficiency or forced to do so through regulations. To subsidise energy efficiency, the member states are “free” to establish funds and financial instruments to promote energy efficiency programmes (Art. 11). These types of assistance programmes already exist in Germany at the federal, state and local levels (BMU 2007c). The Wuppertal Institute (2006) proposes a central fund with a portfolio made up of twelve energy efficiency programmes (THOMAS et al. 2002; THOMAS 2006; DUSCHA et al. 2006). One possibility for a requirement to achieve greater energy efficiency is the standard mentioned above, which is described below in more detail for energy-using devices in product policy (see Section 3.4.5). Another option for requiring efficiency is what are known as tradable white certificates (white certificates – WhC; tradable white certificates – TWC) that have to first be reviewed at European level (Art. 4 (5) Energy Services Directive) (European Commission 2006a, p. 13). These types of regulations have been and will be introduced (in different forms) in several European countries and are considered a success, for example, in the United Kingdom (see Item 125).

Based on the idea of emissions trading, a group of market players (ESCO or energy distributors) is required to reach a certain level of energy efficiency on the demand side. In contrast to emissions trading, the rights traded – similar to the project-based mechanism of the Kyoto Protocol, the Clean Development Mechanism (CDM) and Joint Implementation (JI) – are generated in projects (baseline-and-credit). Here, the principle of additionality vis-à-vis the baseline plays an important role in preventing windfall-profit effects. Ex-ante standardisation of projects and reductions lowers the time and effort needed for monitoring, but means an inherent conflict between documenting more affordable potential for prevention and lower transaction costs (OIKONOMOU et al. 2004; FARINELLI et al. 2005, p. 10–23; GAUDIOSO 2006, p. 3; MUNDACA and NEIJ 2006, p. 22). WhCs, through interactions with emissions trading via the electricity market, also do not lead to emission reductions per se. If the WhCs are seen as an independent climate protection instrument, the energy savings achieved have to be converted to emissions and deducted from the emissions budget. There is also always a conflict that emerges here between accuracy and practicability (HARRISON et al. 2005, p. 147, 165, 199).

125. Some of the EU member states, on the other hand, have developed specially designed WhC systems or are in the process of setting them up. One interesting variant is the British Energy Efficiency Commitment (EEC). It is more a flexible standard, however, than a fully-fledged trading system. Introduced in 2002, the third phase began in April 2008. British energy suppliers can choose the measures they want to use to reach the specified savings for end customers, i.e. in existing buildings, from a standardised catalogue with accredited measures and reductions. The target level and scope of the system increase in every phase. The annual reduction target for 2010 is 7 Mt CO_2 (1.9 Mt C). The target of the third phase alone – which only has a CO_2 target and was renamed to the Carbon Emission Reduction Target (CERT) – is 4 Mt CO_2 (1.1 Mt C), which represents a decline in demand of 3 % over the baseline (DTI 2007, p. 59; Defra 2007, p. 5). The programme is considered a success because the target of the first phase was exceeded by far and 93 % had already been achieved in the second phase after just two years. The costs of preventive measures per energy unit were also below the energy costs, i.e. net profits were generated (Ofgem 2007; IEA 2007a, p. 38 ff.; IEA 2007c). Half of the savings were achieved through building insulation. This is an area that is traditionally weak in Great Britain.

The Italian system, in contrast, provides for an actual trading exchange and works with a standardised list of measures. It aims to reduce all end-use energy sources. The first commitment period runs from 2005 to 2009 with savings targets that nearly double every year. The CO_2 reduction was higher than in the British system as early as the first year. During the Kyoto period, trade is to contribute approx. 8 % to the Kyoto target (BÜRGER and WIEGMANN 2007, p. 32 ff.). The first period of the French system runs from 2006 to 2009 and aims to achieve annual reductions of 0.5 to 1.5 Mt CO_2. It sets itself apart with a large number of standard measures (TABET 2007; BÜRGER and WIEGMANN 2007, p. 37).

A proposed system for Germany involves a reduction target for all end-use energies of companies subject to the Energy Taxation Act (Energiesteuergesetz) and the Electricity Tax Act (Stromsteuergesetz). These companies are the importers for heating oil and liquid gas producers and the classic ESCOs for natural gas and electricity. As in the British and Italian models, it is up to the regulator to stipulate standardised measures. With respect to interaction with other instruments, reducing the emission trading budget by the WhC-targeted CO_2 savings has been proposed. The calculation should include only those measures that are not prescribed by the Energy Saving Ordinance (BÜRGER and WIEGMANN 2007).

126. The introduction of white certificates has to be assessed with a differentiated approach depending on the structure. Seen against the unexploited potential for economic efficiency, it is evident that the markets for energy efficiency have only been functioning inadequately until now. The purpose, for example, of funds or WhCs can easily be justified by the existence of market imperfections that emission trading has not yet been able to overcome. White certificates offer an extra incentive to transcend market imperfections without, however, having to worry about getting rid of them. This can be considered the actual task of efficiency policy (creating a better framework). WhCs then generate an efficiency benefit for the entire national economy if they tap into additional potential for efficiency (on the demand side) and are not (over)compensated for by the transaction costs of the instrument. In this case, this type of system can make a meaningful contribution to lowering the costs of climate protection. The United Kingdom seems to have found a better solution for the problem of transaction costs – at least until now – than Italy. We should wait and see; however, what other experience is reported (IEA 2007a, p. 47). It is, in any case, too early to integrate these systems into a European-wide standardised system.

3.4.3 The German Action Plan on Energy Efficiency

127. At the end of September 2007, the Federal Ministry of Economics and Technology presented the national Energy Efficiency Action Plan (EEAP) called for in the Energy Services Directive (Item 123) and integrated it into the energy summit process and the Meseberg resolutions (Federal Ministry of Economics and Technology, BMWi 2007b). The Action Plan shows how the savings target of 9 % set forth in the directive to be reached in nine years (2008 to 2016). Based on a background study, the Action Plan indicates a technical potential of 15.5 % and an economic potential of 13.2 % for this period with the greatest economic potential found in the public sector with 17.5 % (Federal Ministry of Economics and Technology, BMWi 2007b; SEEFELD et al. 2007). The report rightly identifies information deficits in almost all sectors as obstacles to the full expoitation of the economic potential: landlord/tenant or user/investor dilemmas in the household and trade/commerce/services sectors, and the low relative importance of energy costs and competing investments in the core business in the manufacturing sector and the trade/commerce/services sector. In keeping with the Energy Services Directive, a series of cross-sectoral measures is thus planned to create markets for energy efficiency (Item 123). To overcome information deficits and similar problems, provisions have been made for the following:

– Improved consultations with households on-site and in consumer centres

– Continued advancement of the energy efficiency initiative in all sectors

– The development of intelligent energy systems and smart metering

– More training and education

– The introduction of the energy pass for buildings

Contracting is to be stimulated through a series of initiatives. A range of measures aims – again under the scope of the Energy Services Directive – at enhancing the exemplary function of the public sector. This includes the energy-saving remediation and improved operational monitoring – also through contracting – of federal properties, the remediation of schools and kindergartens, of street lighting and traffic lights.

The EEAP also focuses on the key areas of buildings, energy-using devices and transport (Item 119). The KfW programmes to remediate existing buildings and for new passive and energy saving houses are to be expanded. There are also plans to tighten up the provisions of the Energy Saving Ordinance. A European top runner strategy is also planned for energy-using devices for all sectors. Savings in the transport sector are to be achieved through:

- Optimising drive systems for passenger cars and HGVs.
- A CO_2-based vehicle road tax.
- Voluntary measures to help promote communications and logistics.
- Driver training and motivation.
- Expanding the cycle path network.

The assistance measure of the special energy efficiency fund for small and medium-sized companies is new. It is intended to finance consultation and investment grants for trade/commerce/services and industry.

128. The Action Plan aims, on the one hand, for “over-fulfilment” because the assumption is that not every measure will be implemented in its entirety. However, under the directive measures from as early as 1995 on can be included in the calculation, some even as early as 1991. Based on this definition, Germany would have already satisfied the ordinance target by 45 % (Federal Ministry of Economics and Technology 2007b, p. 18). The fact that many of the trend measures were represented as new policies was already evident in the impact analysis of the Meseberg resolutions, where substantial shortfalls are expected, particularly in the areas of electricity saving and building remediation (Item 105). In the light of the strategic importance of energy efficiency – for all the entire energy policy target triangle – and the tripling of the improvement rates of energy intensity necessary (Item 116), this skewed prioritisation is unacceptable despite its positive approaches and has already been criticised by the European Commission (European Commission 2008b).

3.4.4 Key area: Buildings

3.4.4.1 Sectoral energy consumption structure

129. Despite the progress made over the last few years in heat remediation for buildings, existing potential has only been exploited to a small extent. The percentage of end-use energy consumption for generating space heating and hot water in existing buildings was reduced by almost 16 % between 1996 and 2005, but heat consumption still contributes

32 % to end-energy use and hot water consumption a good 5 %. In comparison, end-use energy consumption for other process heat, mechanical energy and lighting increased by almost 3 %. During this period the decline in end-use energy consumption is accounted for solely by the savings in the heat supply for buildings.

The greatest heat consumers by far are private households (68.7 %) and the trade/commerce/services sector (24.4 %). The industry percentage is 6.8 %. Between 1996 and 2005, the greatest savings in end-use energy on the heating front were achieved in the industry sector with – 22.3 % and the trade/commerce/services sector (– 22.4 %). In contrast, savings of only 12 % were achieved in private households (Federal Ministry of Economics and Technology, BMWi 2007a). Even though the potential has nowhere near been exhausted in the commercial sector, there is a particular need for action in private households.

Table 3-5

Changes in space heating consumption broken down by energy source (for industry, trade/commerce/services, private households) from 1996 to 2005

Energy source structure of space heating production	1996		2005		1996-2005
	in PJ	in %	in PJ	in %	in %
Oil	1,339.4	38.2	847.0	30.0	36.8
Gas	1,474.2	42.1	1,348.2	47.8	8.5
Electricity	149.5	4.3	120.2	4.3	19.6
District heating	307.7	8.8	252.0	8.9	18.1
Coal	134.8	3.8	55.7	2.0	58.7
Other	96.7	2.8	199.3	7.1	106.1
Total	3,502.3	100.0	2,822.4	100.0	19.4
Of which fossil fuels	2,948.4	84.2	2,250.9	79.8	23.7

SRU/2008 Environmental Report/Table 3-5; data source: BMWi 2007a

130. Fossil fuels continue to be the main energy source for supplying space heating to buildings (79.8 %). The most important energy source is gas followed by heating oil, renewable energy sources and coal. District heating and electricity, as secondary heat energy sources in the building sector make up an unchanged percentage of 13.4 %. Renewables, the only energy source to experience an increase in consumption, now account for 7.1 % of the heat supplied to buildings (Table 3-5).

3.4.4.2 Energy consumption in existing residential buildings

131. Potential for saving energy in private households can be found in both new buildings and existing buildings. Progress has already been made recently in the construction of new buildings. Some 35 % of all new buildings already satisfy the standard for low-energy houses with a heat energy requirement of less than 70 kWh/m^2. Because construction of new housing will result first and foremost in an increase in space heating consumption due to the steady growth in per capita living space in Germany (1990 to 2005: + 15 % to 41.2 m^2), the most important potential for saving energy lies in reducing the heat requirement in older buildings which make up three-quarters of all residential units (built before 1978) (IFS 2006). The annual area-specific heat consumption in all existing buildings was approx. 165 kWh/m^2 in 2005. While the average heating energy indicator for centrally heated buildings is approx. 160 kWh/m^2 per year in the former West German *Länder*, the figure in the former East German *Länder* is still approx. 200 kWh/m^2 per year (KRÉMER et al. 2005).

132. Regional climate differences also affect how much heat energy is consumed. A regional degree day adjustment of the heating energy consumption for buildings heated with heating oil in 126 West German municipalities shows that it is not only the age of the building and the heating systems that affect the range of worthwhile investments in energy efficiency, it is also the regional climate conditions (Techem AG 2006).

3.4.4.3 Potential for saving energy in existing residential buildings

133. A majority of buildings in Germany do not come close to reaching the energy-saving quality standard that would be necessary to meet long-term climate protection targets. This quality standard could be reached through modernisation of the buildings and heating equipment (HERTLE et al. 2005).

In reality, however, the technical potential for saving energy has to be measured on the basis of its profitability. In view of increasing energy prices, many energy saving measures have already paid off and contribute to saving heat energy costs (Table 3-6). Additional costs of only 8 % were specified for the construction of new residences that meet the passive house standard (Federal Environment Ministry 2007e, p. 61).

Table 3-6

Profitability of standardised energy savings measure bundles for modernised residences

	Buildings left as is	Energy Saving Ordinance – existing buildings	Energy Saving Ordinance – new buildings	Passive house components
Measures	Maintenance with heating optimisation	Energy Saving Ordinance retrofitting requirements	Heat insulation 12 cm; condensing boiler	Heat insulation 20 cm; controlled ventilation; solar energy system if applicable
Typical heat requirement (kWh/m2a)	120 – 180	80 – 120	60 – 80	25 – 50
Specific additional investments (€/m2)	10 – 20	40 – 80	100 – 150	180 – 500
Equivalent energy price (€/kWh)*	0,04 – 0,08	0,10 – 0,12	0,10 – 0,20	0,10 – 0,40
Payback period	Up to 5a	Up to 10a	Up to 20a	Up to 40a
*Equivalent energy price = ratio between the annuity costs of the measure and the energy saved annually, makes it possible to compare the financial relief brought about by the energy saving measure with the costs of alternative energy supply.				
Source: WOLFF 2007a				

Table 3-7

Profitability of individual measures for energy saving

Measure	Energy savings (kWh/m^2a)	Investment (€/m^2)	Equivalent energy price (€/kWh)*
Insulation (roof, cellar ceiling, outside wall)	50 – 150	50 – 250	0,02 – 0,20
Windows	20 – 50	30 – 150	0,06 – 0,30
Boiler replacement	20 – 120	20 – 80	0,02 – 0,20
Heat recovery ventilation system	10 – 25	20 – 70	0,08 – 0,25
Solar drinking water systems	5 – 20	35 – 50	0,10 – 0,40
Solar drinking water systems plus heating support	10 – 25	50 – 80	0,10 – 0,40
Hydraulic calibration and heating optimisation after structural modernisation	10 – 20	1 – 6	0,02 – 0,04
*Equivalent energy price = ratio between the annuity costs of the measure and the energy saved annually, makes it possible to compare the financial relief brought about by the energy savings measure with the costs of purchasing alternative energy.			
Source: WOLFF 2007a			

Many energy savings measures only pay off when coupled with a structural measure that is carried out for the appropriate economic use of the property (KAH and FEIST 2005, p. 10 ff.).

Some measures, in contrast, cannot be implemented cost-effectively at present. In addition, the existing potential for energy savings affects climate protection efficiency differently.

134. Despite the additional public funding, many basic economic measures are currently not being implemented. For example, the "Heinze Marktforschung 2002" study based on a survey of 10,000 building owners, landlords and tenants about measures to modernise the most important building components and heating systems relevant for energy consumption shows that the actual annual remediation rate is only 52 % of the remediation rate that would be expected based on the age structure of existing buildings (KLEEMANN and HANSEN 2005, p. 60 f.). Modernisation investments in the housing industry have lagged far behind investments in the construction of new buildings for many years so that the additional energy consumed by newly built residences offsets the decreases in energy consumption in modernised residences. Between 2002 and 2005, for example, an average of just less than 28 million m^2 of additional new housing was built every year while only roughly 4 million m^2 of living space was made up of modernised residences. Given these unfavourable conditions, the risk of offsetting the energy savings in modernised buildings by the additional consumption in new buildings will be virtually impossible to prevent (see Table 3-8). The overall assessment would be even worse if the best energy consumption standards were not reached in the course of implementing the building measures. Until the requirements stipulated by the new Energy Saving Ordinance 2007 go into effect for modernisations, for new building construction and for replacing or changing components and systems, building use will cause additional greenhouse gas emissions because the measures that have to be implemented anyway are not profitable.

Table 3-8

Estimated additional energy consumption and energy savings through construction of new residences and modernisation

		2002	2003	2004	2005	Mean
New housing	million m^2	29.1	27.4	29.2	25.3	27.8
Additional energy consumption – at 25 kWh/m^2a	million kWh	728.3	686.3	729.2	632.4	694.0
– at 50 kWh/m^2a	million kWh	1,456.6	1,372.6	1,458.4	1,264.8	1,388.1
Modernisation	million m^2	4.4	4.1	4.2	3.9	4.2
Energy savings – at 50 kWh/m^2a*	million kWh	703.1	662.7	664.5	624.2	663.6
– at 80 kWh/m^2a*	million kWh	571.2	538.5	539.9	507.1	539.2

*Comparison value before modernisation 210 kWh/m2a

SRU/2008 Environmental Report/Table 3-8; data source: Federal Statistical Office 2007a; WOLFF 2007a

Inadequate implementation of energy saving measures during modernisation of existing buildings is a regular occurrence. In addition, the theoretical savings are not always reached due to the heterogeneous usage patterns. Despite full energy-based remediation of a residential building to meet low-energy house standards, the heating energy consumed by the users still varies up to 50 kWh/m^2 per year, and if there is no ventilation system, this figure can be as high as 80 kWh/m^2 per year (LOGA et al. 2003, p. 48). An analysis of consumption data over several years using a representative sample of existing German buildings broken down by building type and construction year revealed that the ratio between actual and target consumption was only 59 % for 1999, which was the last year (standard consumption according to the Heat Insulation Ordinance). Because the requirements of the Energy Saving Ordinance 2004 were not actually changed vis-à-vis the standards at that time and because it can be assumed that standard implementation is better only when modernisation measures are subsidised, little will have changed in this ratio according to experts with practical experience (KLEEMANN and HANSEN 2005, p. 61 f.).

3.4.4.4 Climate policy instrument mix in the building and housing sector

135. The Federal Government’s efforts to implement climate policy targets in the building and housing sector are based on a wide range of environmental instruments.

The most important measure for improving energy efficiency in the building sector is the Energy Saving Ordinance. Tightened and expanded several times, it brings together all of the energy-relevant regulations in the building sector. The most recent revision of the Energy Saving Ordinance in 2007 distinguishes itself from previous regulations as it has more stringent standards for the primary energy requirements of new and existing buildings and it gives separate consideration to residential and non-residential buildings. For the first time, it contains conditional requirements for the use of renewable energy sources in larger buildings and will gradually introduce a requirement to present a statement of energy requirements and consumption starting in 2008.

The Heating Cost Ordinance is designed to ensure that the costs of heating and hot water costs from central heating and water supply systems in residential buildings are recorded and distributed for each user. Other than requiring heat and hot water consumption to be recorded per user, the Heating Cost Ordinance regulates the allocation of total costs to the users of a residential building. A minimum of 50 % and a maximum of 70 % of the operating costs of the central heating systems may be charged based on the recorded heat consumption. The other costs are to be allocated to the individual users based on the individual living space or area in use. Only that portion of heating costs which the user has control over is to be billed based on consumption. The chimney cleaning costs, which are independent of energy consumption, and the maintenance and energy costs are billed in proportion to floor space.

136. These regulatory specifications are supported by a series of federal and state (*Länder*) assistance measures. Financial support for additional energy savings measures is granted both for the construction of new buildings and for modernising existing buildings.

Finally, the petroleum excise duty on heating fuels represents an instrument for reducing energy consumption. The ecological tax rates on solid and liquid heating fuels last raised in 2003, in particular, were explicitly introduced as an incentive tax (see SRU 2004, Section 2.2.4.2).

137. The Federal Government has high expectations of this combination of instruments. The implementation of these goals within the framework of the energy and climate programme will gain emphasis with future revisions to laws and ordinances and expansions of measures in funding policy (Bundesregierung 2007a). The regulatory specifications aim to maintain a minimum heat insulation level and technical energy consumption limits. The assistance programmes are designed to complement these specifications by creating incentives for improving enforcement of the standards and increasing the dynamic development of environmental protection that has only been brought about in part by regulatory law. The assistance programme promises to ease the economic problems associated with adjustment and the distributive burdens of implementing the standard. It will also help users adjust to the tax burden of heating fuels which is intended to enhance the political feasibility of the climate policy instrument. Secondary goals include promoting business activity and employment in the building sector.

3.4.4.5 Energy savings law and funding policy as instruments to limit the user-investor dilemma

138. There are many reasons for failure to take sufficient advantage of the existing potential for saving energy. In addition to inadequate expertise and insufficient coordination among the participating actors, incentives to boost energy efficiency are also lacking. Because building owners can largely “pass on” the costs of energy consumption to tenants, they have few financial incentives to keep the energy consumption of their buildings low by investing in them. If, on the other hand, they invest in measures to save energy, the tenant’s operating costs are lowered but the landlord does not necessarily get more rent. This lack of incentive is often referred to as the user-investor dilemma (Item 120, 127).

139. To help solve the user-investor dilemma, the Energy Saving Act and the Energy Saving Ordinance based on it lay down regulatory requirements for saving energy in the building sector. These regulations, however, have had limited impact and are not sufficient to bring about the necessary reduction in energy consumption in the building sector. First, they are primarily relevant for newly constructed buildings and energy supply systems still to be installed (see Section 4 (3) Energy Saving Act). Second, the law stipulates that the energy saving requirements be economically justifiable (Section 5 (1) Energy Saving Act). This "profitability principle" is even stricter when existing buildings are undergoing modernisation (Section 4 (3) sentence 1 Energy Savings Act). Justifiable investments are defined as those which generate earnings from the resulting savings within the remaining or anticipated service life of the building. This regulation ignores the external costs of energy consumption. Laws, including various options for structuring rent law, should work more toward internalising costs in the future (Item 140) (KEYHANIAN 2008). Third, it is evident that, due to the profitability principle, the Energy Saving Ordinance does not even mobilise profitable modernisation investments. These requirements are often at the lower end of what is economically justifiable (THORWARTH 1997, p. 198; BEAUCAMP and BEAUCAMP 2002, p. 326). In view of the intensifying climate problems, some of the Energy Saving Ordinance standards can no longer be used as benchmarks for setting energy saving targets in the building sector. For example, in terms of the permissible annual primary energy requirements, the Hamburg Climate Protection Ordinance of 11 December 2007 lays down requirements for new residential buildings that are at least 30 % more stringent than those in the Energy Saving Ordinance (Section 2 (2) 1 of the Ordinance). According to reports obtained by the city of Hamburg, the higher requirements to be met for building substances and building technology generally pay off in 10 to 20 years (rationale of Hamburg climate protection Ordinance, p. 4 f.). In its integrated energy and climate programme, the Federal Government has also argued in favour of tightening the requirements for primary energy in the short-term by 30 % starting in 2009 (Table 3-1).

140. It will only be possible for the Energy Saving Ordinance to be implemented consistently if its impact is not counteracted by economic incentives to the contrary. The Heating Cost Ordinance, which is oriented around the principle of cost, requires that heating and hot water costs be billed based on consumption and only gives the tenant, as the user, certain incentives to save energy. The landlord, on the other hand, really does not have much direct interest in energy-saving modernisation because the heating costs are fully transferred to the tenant. Rental law thus opens up the possibility of passing on the costs of energy-saving modernisation measures to the tenant by allowing the base rent to be raised. In addition to a rental increase by providing sample rents for comparable properties in the same location (Article 558 of the Civil Code), the landlord is entitled to charge a modernisation fee in these cases under Article 559 of the Civil Code. Rental law thus allows for more flexibility than regulatory law: in contrast to the Energy Saving Act, modernisations that go beyond the profitability principle are also permitted following a Supreme Court ruling. It is only the rental law hardship clauses that set limits here (Federal Constitutional Court, ruling of 3 March 2004, judgement VIII ZR 149/ 03, NJW 2004, 1738 ff.). The core of this ruling can be attributed to the fact that the power to increase the rent following energy-saving modernisations ultimately serves the common good (SÄCKER and RIXCKER 2008, Section 559, marginal note 3). The law, however, limits the extent to which costs can be passed on by only allowing the annual rent to be increased by a maximum of 11 % of the costs associated with modernisation. The possibility that this amount is too low in single cases to compensate for a lack of incentive cannot be ruled out.

141. The landlord-tenant dilemma can also be attributed to the disparity between the information available to the person renting out a home and the person looking for a home. The complexity of structural and technical building parameters makes it more difficult for tenants or buyers to assess the parameters of the living space relevant to energy consumption. Due to a lack of information, housing demand has largely only been oriented around the quality average of the building until now, so that the resulting market price does not allow for a supply of homes that are more energy efficient than average. With the introduction of the requirement to provide a statement of energy requirements and consumption, the first binding steps have been taken toward more transparency in assessing the energy-related quality of buildings.

142. Assistance programmes can compensate for the effects of investor caution brought about by the market and regulation. General investment subsidies in housing construction, on the other hand, pose the risk that some of the financial relief will be undone due to a comparably slow response by the building sector to offer construction services resulting in short-term price increases. Sufficient production capacities can only be established and increase the market supply in the medium and long term. Real additional savings effects can thus only be expected from assistance programmes if they are paid continuously over a long period of time. The effects of assistance measures have to be taken into account across all segments of the housing market. For example, there is a risk that one-sided subsidies in the new building sector will tie up limited building capacities in the short-term, cause building price increases and reduce the profitability of investments in existing buildings. The construction of large amounts of new housing also increases the housing supply and lowers the rent differential of existing housing between the various quality segments (what is known as ‘filtering up’ the households). The profitability of investments in maintenance and modernisation in existing buildings falls, however, because rents have dropped or levelled off on the entire housing market (EEKHOFF 2006).

When assistance criteria for energy saving programmes are too narrowly defined, investors primarily carry out energy-saving investments with narrowly predefined packages of measures eligible for subsidies and not based on minimising costs (WOLFF 2007b, p. 71). Subsidies are not granted for individual measures, which can lead to investors postponing building maintenance or optimisations that would be profitable now so that they can receive subsidies for a complete package of measures later on. The energy savings and emission reductions actually brought about by the subsidised measures are not monitored.

Consequently, the subsidies can only create incentives for optimum system coordination between building, systems technology and use to a limited extent.

Other effects of the existing assistance programmes which are counterproductive from an environmental standpoint are, if anything, underestimated. Table 3-7 shows that the savings triggered by additional investments are steadily falling. Accordingly, the assistance programmes will need to provide more financing if they are still to be able to create investment incentives as the energy saving standard rises. This means, however, that much higher savings would be achieved with the available public budget if the money was primarily invested in measures with comparatively low costs and high energy savings and emissions reductions.

3.4.4.6 Modernisation incentives through more market transparency, price incentives and more efficiency in subsidies

143. Climate protection on the housing market combines the instruments of consumption standards and positive economic incentives (subsidies) as well as negative ones (ecological tax). The stricter efficiency standards targeted in the new climate programme are useful even though they remain below the indicative specifications of the European Commission (towards the goal of the passive house standard by 2015). The economic instruments, however, take on special importance due to the problems associated with implementing ambitious standards. If price-based incentives are inadequate and these price signals are not transmitted between the sides of the market as a regular occurrence, climate protection will remain inefficient and far below its potential on the housing market.

The ecological tax on fossil fuels for heating was an important first step toward greater incentives for reducing energy consumption. Other moderate but continuous increases in the prices of energy sources would offer savings incentives over the medium and long-term and, at the same time, make an economically sustainable adjustment possible. This incentive can continue to be developed with the emissions trading based on the first trading phase as favoured by the SRU (Section 3.5.5). With respect to their steering effect, direct price signals have the advantage that they give the actors involved an incentive to choose the most cost-effective energy savings measure taking into account all of the general conditions relevant to individual energy consumption. These range from reducing room temperature in the short-term to long-term investments in energy saving technology and switching to renewable energy.

144. The steering effect of energy prices could be enhanced by making it easier for the relevant actors to perceive the price signals and respond appropriately. Market obstacles would need to be rigorously eliminated to achieve this. Rental law and the Heating Cost Ordinance should be restructured in such a way that both tenants and landlords directly feel the economic consequences of the increasing energy prices and can respond appropriately.

However, the increase in the consumption-dependent portion of the heating charges described in the Federal Government's climate and energy programme is insufficient to achieve this goal (Table 3-1). The distribution of heating costs should not only guarantee that tenants have adequate cost incentives to heat efficiently, it should also make it possible for the landlord to influence the heating behaviour of his tenants through financial incentives to improve the overall profitability of the rented property. Options for contractual deviations in heating cost allocation, which is regulated by the Heating Cost Ordinance, could serve the purpose here. For example, leases that included heating costs could be considered where the landlord pays part of the operating costs of heating. Heat energy consumption would thus again be included in the landlord's profitability calculation. This would also pave the way for heat contracting in the building sector. In this scenario, building owners would be able to farm out all energy supply for office and residential buildings to specialised energy service providers (BARTHEL et al. 2006). They would in turn carry out the contracted services more cost-effectively and undertake appropriate measures in buildings and heating systems and conclude incentive-compatible service agreements with individual users (see Item 122).

The most recent proposals for a conditional transfer of heating costs tied to structural energy saving measures seek to create additional short-term modernisation incentives and encourage implementation of the Energy Saving Ordinance (BAAKE et al. 2007). However, we should not lose sight of the potential long-term negative consequences. On the one hand, these approaches do not make a distinction between preventable structural and consumption-side energy consumption. On the other hand, these types of measures could, from the landlord's point of view, result in unprofitable investments given the current energy prices and housing market conditions.

145. Requiring landlords to provide an energy requirements statement to prove energy consumption could make a substantial contribution to increasing market transparency for housing consumers. For landlords with properties for rent, this transparency will provide more incentive to take energy efficiency into account as a feature representing the quality of their property. Much transparency can already be gained from disclosing energy consumption with what is known as energy consumption-based energy pass. A consumption-based energy pass is also much more cost-effective than a pass that revolves around energy requirements. The advantage of the latter is primarily that the potential energy saving is determined when the requirements are calculated. Practical tests show, however, that information about energy requirements still fluctuates in a wide range due to the lack of a uniform assessment process for buildings (GdW 2006). The format of the specified energy indicators of the building and the respective comparison data from the region under review could turn out to be even more important than this assessment basis. The energy requirements and energy consumption data should allow for conclusions based on the variability of the indicators of individual housing units and the effects of weather. As a comparison standard for evaluation, it is necessary to consistently introduce publications that detail current average property rental prices. These publications would also provide information on the energy condition of the existing buildings on the housing market and how much heat they use. Local heating levels, as they have been published now for several years for a number of cities in Germany, can be used for orientation here.

146. More incentives should also be created within funding policy to concentrate on maintenance and modernisation measures that are as cost-efficient as possible. Because, when seen from the standpoint of climate policy, the goal is primarily to make investments with very high potential savings, subsidies that ease the financial burden of property modernisations offer advantages over technology-oriented subsidies. Stronger incentives for optimum implementation of energy saving investments and the optimum use of heating systems could be created with the credit variant of the KfW CO_2 building remediation programme if the repayment allowance granted in several subsidy models were not applied based on the standard of energy savings calculated ex-ante, but using the successes that can actually be measured.

The SRU recommends establishing the passive house standard for new buildings by 2015 in regard to e.g. the positive development in passive houses, the profitability of the saving, and the rapid technical progress in insulation technology or heating pumps. A similar proposal can be found in the European Commission’s efficiency programme. Germany has attained a leadership position in passive and low-energy houses in Europe with scope for expansion.

3.4.5 Key area: Energy-using devices

147. In 2003, major domestic appliances and entertainment electronics and the rapidly growing area of IT and telecommunications technologies accounted for 55 % of electricity use in private households and 34 % in the trade/commerce/service sector. Rapidly increasing electricity consumption for major appliances and entertainment electronics can be seen in almost all industrialised countries with a particularly steep increase in the portion stemming from the electricity consumed by entertainment electronics and stand-by losses. Potential economic savings can be realised in particular through greater market penetration of more energy-efficient appliances and a lower level of stand-by losses (LECHTENBÖHMER et al. 2001; BARTHEL et al. 2006; DUSCHA et al. 2006; IEA 2003, p. 30).

148. Product-specific measures in energy saving policy are, unlike a general policy incentive by way of prices, a type of detailed incentive that also tackles the additional specific savings potential for energy-intensive products. Several of these individual measures were already undertaken in the 1970s in various OECD countries with a focus on consumer labelling. The electricity consumption of washing machines has, for example, steadily been reduced by more than half since 1970. The EU has also been active in this area since the

1990s primarily with “soft” instruments including consumer labelling and voluntary agreements.

These efforts have not, however, achieved any noteworthy effects on total end-use energy consumption to date. This has encouraged a trend toward binding efficiency standards – also in the light of higher energy prices and stricter requirements for climate protection. Currently, close to 80 countries have introduced minimum energy performance standards (MEPS) for individual electrical appliances or have plans to do so (STEENBLIK et al. 2006). The Japanese efficiency strategy for energy-using products, in particular, triggered a certain dynamic development in regulation after 1998 that gained significance as a result of higher energy prices. The European Directive 2005/32/EC of 6 July 2005 to create a framework for defining requirements for an environmentally-compatible structure of energy-using products (known as the Eco-design or EuP Directive) was influenced by the Japanese efficiency strategy as was China’s new product policy.

The Japanese top runner programme adopted in 1999 is an ambitious form of what is known as “technology forcing” where the pace of technical progress is systematically increased and the more energy-efficient technology is guaranteed total market penetration (JÄNICKE and JAKOB 2006). At the same time, this approach is applied to such a wide range of energy-using products (from computers to small buses) that end-use energy consumption of the whole country is expected to be affected. The top runner for 21 products on the market becomes the energy efficiency standard for a binding efficiency standard that goes into force in stages. Before the top runner standard becomes binding, a soft incentive system is created for future innovations (prizes awarded for innovations that go one step further). There are also a number of supporting regulations: defined public procurement based on top runner products (Japanese procurement law from 2001), competition incentives for retail, consumer labelling or an environment-related car tax. In surveys, most companies felt that the programme offered them an international competitive advantage (SEPA 2005; ECCJ 2006). Some of the increases in efficiency so far have been surprising (see Chapter 2, Table 2-3).

149. The EuP Directive influenced by the Japanese model is part of the European Commission’s efficiency strategy (see Table 3-9). It has since been put into concrete terms for 19 products. What is noteworthy about this directive is that – unlike the top runner programme – it also incorporates life cycle assessment and generally includes other environmental effects of the products. This EU directive also follows the specifications at UN level for a sustainable structure of production and consumption (UNDSD 2002). Prototypes and efficient products of foreign suppliers should also be taken into consideration when defining efficiency standards. A dynamic system of product labelling is planned. In contrast to Japan, no public procurement has yet been stipulated for eco-design products.

Table 3-9

Top runner and EuP standard

	Top runner standard	EuP standard
Regulated products	21 (including cars)	14+6 (without cars)
Integrated approach	No (energy efficiency)	Yes, IPP
Life cycle costs (LCC)	No	Yes
Price mechanism ("hybrid" instruments)	Weak	Moderate (ETS, ecological taxes)
Strictness	High	Still pending
Effectiveness	Very high in places (> 90%)	Pending
Effect on innovation	Strong, technology forcing	Pending
Competitive strength	High	Pending
Political process	Fast pace	Slow so far
Participating actors	Limited number	Complex combination
Transaction costs	Medium	Probably higher

SRU/2008 Environmental Report/Table 3-9

Assessment

150. A product-specific energy efficiency strategy can only be understood as a specific incentive within the scope of a comprehensive general incentive that pertains, in particular, to the economic incentive system. Both approaches are sensibly combined in the policy mix. Price signals are vital but often not massive enough or cannot be clearly discerned due to limited information and other restrictions (Item 120-122). Product-related measures for saving energy, for example, are often easily neutralised by rebound effects without any respective price signals. This is particularly important with respect to the fact that efficiency standards can usually only be defined for different product classes. Efficiency standards do not offer an incentive to give up more energy-intensive product classes (e.g. sport utility vehicles, SUVs). They thus need to be supplemented, particularly by economic incentives. Regardless of this, each product-related measure to boost energy efficiency is only effective for climate policy if it is seen dynamically, is based on more than just incremental innovations and does not remain limited to niche markets (JÄNICKE 2008).

This type of complementary, product-specific energy saving policy has the specific advantage that it can stimulate the competition for innovation for more eco-efficient products at the product design level. Empirical evidence shows that this competition – which also extends to regulations – has already gained considerable importance. One political advantage is that government measures can rely here on concrete interests of suppliers who increasingly push for political initiatives. Government procurement rules can (as in Japan) contribute to the market penetration of eco-efficient innovations.

To make price signals more discernible, improved and dynamic product labelling is essential for stimulating competition for energy-efficient products. The current labelling is static and does not contain much information. The breakdown of energy efficiency classes stems from the 1990s, and key indicators are lacking which the customer can use to compare the energy costs saved with a lower efficiency class (EEAC 2007, p. 5 f.; MATSCHOSS 2007, p. 11 f.). The revision announced in the European Action Plan on Energy Efficiency is thus a welcome development in combination with the EuP Directive (European Commission 2006a, p. 11 f.).

Another advantage of a product-specific energy efficiency strategy is the fact that only a small number of product groups make up the bulk of the negative environmental effects. According to more recent studies, food, houses (including their technical equipment) and road vehicles cause 70 to 80 % of the adverse environmental effects of products during their life cycles (TUKKER et al. 2006). The emissions in these three product groups are also highest throughout their life cycle. And they are areas subject to heavy regulation. The life cycle assessment of these types of priority products can also be a key incentive in pushing the energy productivity of processes more into the spotlight.

Recent studies by the IEA show that the increases in product prices usually expected does not necessarily occur. On the contrary, a normal trend toward falling prices often continues for more efficient products (ELLIS 2007).

One fundamental problem still remains with the interests of energy suppliers who, when possible, compensate for market losses through efficiency measures, meaning they counteract the effects of energy saving policy. Fundamental changes are required to shift these interests and create profitable conditions for selling what are known as “negawatts”, i.e. units of saved energy, (Item 121 f.).

Recommendations

151. Product-specific improvements in energy efficiency that capitalise on specific potential for saving energy make sense if they concentrate, as is the aim of the European Commission, on devices with a particularly high and particularly profitable potential for saving energy. The standards have to be sufficiently strict (Items 66 to 68, 83) to limit the rebound effect (Item 109). On the other hand, a product-specific efficiency strategy always has to be supported by general incentives by way of energy prices.

The EuP Directive goes beyond the ambitious Japanese top runner approach by incorporating environmental concerns (Integrated Product Policy – IPP) and generally including the costs across all production stages (life cycle costs – LCC). This ambitious goal, however, also involves a very difficult and drawn-out process which also threatens to result in less ambitious efficiency standards. Consequently, when setting at least the first standard, – in a dynamic process – we recommend focusing on energy efficiency in the interest of speeding up the process. Other criteria found in the integrated product policy can then be included step-by-step in later standardisation stages. Priority should be given to developing dynamic labels for the life cycle costs of energy-intensive products.

3.4.6 Key area: Motor vehicles

3.4.6.1 Changing the CO_2 emissions of passenger cars

152. The energy efficiency of passenger cars has only increased slightly in the last few years. If the increase in energy efficiency is examined based on the changes in CO_2 emissions that correlate directly to fuel consumption, the following picture emerges for the last few years: average CO_2 emissions of new cars on the road in Germany fell from 194.3 g CO_2/km in 1995 to 173 g CO_2/km in 2006 and, according to the latest information from the German Automobile Manufacturers Association *(Verband der Automobilindustrie – VDA)* to approx. 170 g CO_2/km in 2007 (European Commission 2002; German Federal Motor Transport Authority 2006; German Automobile Manufacturers Association press release, 6 February 2008). Average CO_2 emissions of new cars have fallen only slightly, however, by 3 g CO_2/km since 2001. At European level (EU-15), average CO_2 emissions from new cars on the road declined steadily by 12.4 % from 186 g CO_2/km in 1995 to 160 g CO_2/km in 2006 (European Commission 2006e; T & E 2007, p. 5). This means that since 2006, if not before, it has been clear that the self-imposed target value set by the European automotive industry of reaching an average fleet consumption of the 140 g CO_2/km by 2008 will not be met. The voluntary undertaking has thus failed as an instrument without the power to impose sanctions.

153. The most important reason that consumption has only fallen slightly is the increase in weight, engine power and capacity. While the increase in weight is connected to safety, the enormous increase in engine power is by no means a technical necessity. In 2006, the average engine power of cars in the new fleet was 84 kW Europe-wide, and as high as 93 kW in Germany. This represents an increase of 17 % from 1995 figures in Germany and 27 % in Europe (European Commission 2006f, p. 12). This means that the increases in efficiency that are technically feasible for lowering consumption are thus only partially exploited and are offset by the increase in weight and engine power.

3.4.6.2 European targets for CO_2 reduction

154. In June 2006, the Council of the European Union confirmed the target already set by various automobile manufacturers in the 1990s that the average new vehicle fleet should reach CO_2 emissions values of 140 g CO_2/km by 2008 (European Automobile Manufacturers Association – ACEA) and 2009 (Japan Automobile Manufacturers Association – JAMA; Korea Automobile Manufacturers Association – KAMA), and 120 g CO_2/km by 2012 (Council of the European Union 2006). In a communication dated February 2007, the European

Commission announced proposing a legal solution instead of a voluntary undertaking, and in return lowering the target level. Newly sold vehicles only have to comply with an average of 130 g CO_2/km through improved vehicle engine technology while a further reduction of 10 g CO_2/km or its equivalent is to be achieved through other technical improvements and an increased use of biofuels (European Commission 2007e; 2007c). An international comparison of standards for limiting vehicle CO_2 emissions concludes that the EU stands to lose its international leadership position to Japan after 2012 as a result of this move. Japan wants to reach the 120 g target by 2015 through vehicle-related standards (ICCT 2007).

The European Commission failed to announce more ambitious targets up to 2020 which would have been particularly important for the dynamic development of innovation in the medium-term. The European Parliament proposed a target of 95 g CO_2/km by 2020 and a medium-term target of 80 g CO_2/km in a report (DAVIES 2007). As long as three years ago, the SRU asserted the technical feasibility of an average fleet consumption of 100 g CO_2/km by 2012 (SRU 2005b, Item 299 ff.). Mid-size cars whose consumption is considerably below 100 g CO_2/km are already on the market or in development. In regard to the high oil prices that can be expected, customers will also have more flexibility to compensate for the steep rise in vehicle prices by savings in fuel costs. There is thus potential for further increasing efficiency that is justifiable in economic terms.

3.4.6.3 Solutions for achieving the targets

155. In advance of the Commission proposal presented in December 2007, alternative instruments for reaching the goals were discussed (European Commission 2007 f.; SMOKERS et al. 2006; European Commission 2007a). The Commission's proposal for a regulation to reduce CO_2 emissions for passenger cars is to be evaluated with this debate in mind. In general, the following instruments could be considered:

– A limit value, possibly with a fine when exceeded,

– A charge-based solution,

– The introduction of an emissions trading system.

Combination models are proposed in many cases.

Limit value with/without fine

156. Defining a standard limit value (g CO_2/km) that each newly registered car has to comply with by 2012 is one of the most exacting instruments for reducing fuel consumption. This instrument is based on acceptance of the idea that vehicles which do not comply with the limit value may not register. Compared with this controversial standard solution, a milder variant would also be possible which involves linking the limit value to a limit value curve. Instead of keeping the cars off the market all together, a (sufficiently high) fine is used to achieve compliance with the limit value. A limit value curve links the CO_2 emissions of a vehicle with other vehicle attributes (e.g. track x wheelbase, weight, and capacity) and allows larger or heavier cars to have higher CO_2 emissions.

A limit value curve makes things easier for manufacturers of heavier vehicles with more engine power. This strategy also has disadvantages, particularly if it undermines the incentive to achieve savings through a vehicle fleet that is overall lighter and has a lower engine capacity. Incentives to downsize the vehicle fleet are undermined particularly if the limit value curve is weight-dependent. Linking the CO_2 emissions to other vehicle attributes prevents the technical potential for reducing CO_2 emissions from fully unfolding. One economic disadvantage is that CO_2 reduction is cheaper for high-consumption and emission-intensive vehicles than for small vehicles. A report commissioned by the European Commission lists the projected costs of CO_2-reducing technologies agreed with the industry (ZIEROCK et al. 2007; TNO et al. 2006). The costs of preventing CO_2 emissions in diesel vehicles are much higher than for petrol-fuelled cars. In addition, CO_2 reduction is generally more expensive for small cars than for large ones. The table below shows these correlations in more detail.

These figures show that favouring larger or heavier vehicles by introducing a weight or size-dependent limit value curve considerably increases the costs to the national economy. The introduction of a limit value curve can also only ensure compliance with the average limit value (130 g CO_2/km) across the entire vehicle fleet with prohibitively high fines for exceeding it that are much higher than the avoidance costs. These problems can be somewhat alleviated but not solved through compensation solutions which allow manufacturers to compensate internally or work together with other manufacturers.

Introduction of a charge-based solution

157. A charge-based solution can be applied for both the vehicle manufacturer and the vehicle owner. At the level of the vehicle manufacturer, a charge can be imposed if a previously set limit value or reference value is exceeded. This instrument is very similar to the limit value with fine described above. If the parameters of the limit value, the amount of the charge or the fine are identical, the way the instruments work is the same. In the fine-based approach, however, the fine has to be set so high that it prevents activities which would violate the standard. The limit value-based approach with charges is more flexible here.

The charge-based solution only creates incentives to innovate below the limit value curve when a manufacturer is allowed to balance out his fleet, i.e. a manufacturer is given the incentive to build very efficient vehicles to compensate for the sale of his consumption-intensive vehicles. Incentives to innovate and reach targets that lower costs could be enhanced if it were possible to offset between manufacturers. This more flexible model is similar to the emissions trading models at the level of vehicle manufacturers (see Item 158 f.). This instrument is only effective if the charge is high enough to create a considerable incentive to build fuel-saving vehicle models.

Table 3-10

Increase in manufacturer costs in euros per vehicle through a reduction of 30 g CO_2/km, calculated on the basis of the TNO cost curves

Increase in manufacturer costs in euros per vehicle					
Petrol			Diesel		
Small	Medium	Large	Small	Medium	Large
759	590	463	1 494	987	582

SRU/2008 Environmental Report/Table 3-10; data source: ZIEROCK et al. 2007, p. 16; TNO et al. 2006

Charges – whether they are imposed on the manufacturer or the buyer – do not guarantee that a preset average emissions target will be reached. The charge rates for achieving the target can only be determined in a long and complex process of trial and error. A limit value curve with charge-based rates that would result in the target value for the vehicle fleet was modelled for the Federal Environment Ministry (ZIEROCK et al. 2007). However, the curve is, at best, a plausible approximation to the set target methodologically speaking, but cannot be used to actually reach the target.

A charge for vehicles with high CO_2 emissions can also be imposed on the car buyer. This type of charge can be structured as a registration tax, as already introduced in some member states, or an annual CO_2 tax (on the lines of the CO_2-based vehicle road tax). A charge whose amount is based on CO_2 emissions has an independent steering potential that goes beyond the steering effect of pure taxes on consumption (see SRU 2005b, Item 341 ff.). The problem, however, is that this type of charge is imposed in the individual member states, thus excluding the possibility of an EU-wide solution. The worry is that the target value defined at European level will be difficult for the entire European vehicle fleet to reach by adding up the individual member states, each with a different tax rate.

Introduction of an emissions trading system

158. Compared to the charge-based solution described above, the advantage of emissions trading is that it guarantees that a previously set limit value is reached. In the emissions trading model, the market performs the complex and necessary process of adjusting the amount of the charge as the price for the CO_2 emissions. The time-consuming process of subsequently adjusting the charge rates is thus avoided and the focus of political efforts is now on the ambitious target. A distinction has to be made between emissions trading with absolute and relative emission caps.

The trading variation that goes the farthest with absolute emission limits (caps) is the emissions trading scheme based on the first trading phase endorsed by the SRU (see

Section 3.5.5). Because it was uncertain whether this model could be implemented in the short-term, the SRU (2005b, Item 324 ff.) proposed an emissions trading model at manufacturer level which allocates a total CO_2 budget to the individual manufacturers. This budget is calculated by multiplying the preset specific emission limit value with the estimated total mileage of the new vehicles sold. This now makes it technically possible to link it to the emissions trading model that had already been introduced, which only included the major stationary emitters. This link would have aligned the CO_2 avoidance costs for the automobile manufacturers to those of the industry with the consequence that a large majority of the required avoidance activities would be physically performed outside of the transport sector because it would be more affordable. The European Commission has largely moved away from this type of open emissions trading as an instrument because it would only be possible to implement from a legal standpoint with the next commitment period starting in 2013. Second, the easing of the car manufacturers' burden to be expected from their own innovation efforts to reduce fuel consumption met with misgivings in terms of the goal of a secure energy supply (see Item 111 f.).

159. An emission trading model was recently proposed (DUDENHÖFER 2007) that pursues compliance with a relative emissions goal measured in g CO_2/km. Every car manufacturer has to comply with the target value of, for example, an average of 130 g CO_2/km across its entire fleet of new cars sold. If a manufacturer goes below the fleet emission standard, an appropriate number of emissions rights are allocated to him. If he exceeds it, he has to purchase emissions rights accordingly. Every manufacturer who cannot comply with the target value despite purchasing additional emissions rights faces a fine. By passing on the costs of the emissions rights, more fuel efficient vehicles become cheaper and less fuel efficient vehicles more expensive (DUDENHÖFER 2007). This model promises the most efficient way to reach a sectoral fleet consumption target for passenger cars which is confirmed by the European Commission's impact assessment. Table 3-11 shows that a standard limit value with emissions trading has the lowest limit avoidance costs and hence the lowest costs for the national economy (on the basis of Net Present Values – NPV).

The SRU does not share concerns about the limited function of emissions trading based on the oligopolistic structure of the actors (European Commission 2007a, p. 39). A total of more than 20 car manufacturers are organised in the ACEA, JAMA and KAMA associations. They would be the manufacturers participating in the emissions trading system which would replace the Voluntary Agreement. There are also other manufacturers who are not members of the associations mentioned.

Table 3-11

Costs of various options for reducing CO_2 emissions of passenger cars

	Cost effectiveness (€/t CO_2)	Total economic costs 2006-2020, (net present value, million €)	GHG prevention 2006-2020 (Mt)	€/t CO_2
Option 1	Standard limit value with trading	9,746	624	15.6
Option 2	40 % increase in surface area	22,159	638	34.7
	80 % increase in surface area	21,008	634	33.1
	40 % increase in mass	21,674	638	34.0
	80 % increase in mass	20,523	634	32.4
Option 3	% reduction per manufacturer	17,922	626	28.6

Source: European Commission 2007a, p.35

The automotive industry has successfully discredited this model as a distortion of competition. Several experts for the Federal Environment Ministry and an impact assessment of the European Commission even believe that competition is distorted if payments between competitors are required (ZIEROCK et al. 2007, p. 9 f.; European Commission 2007a, p. 37). This view is not valid because it is based on the same false understanding of competition that exists in the discussion about the European emissions trading scheme, which says, for example, that the generation of electricity from coal has to be “protected”. In this case, competition is not protected; it is inhibited to function in favour of climate protection goals. Competition is generally only distorted if vehicles with the same attributes (such as, e.g. CO_2 emissions per kilometre) but from different manufacturers were treated differently. However, this is not the case for emission trading (see Item 170). The industry demand for “competitive neutrality” serves to protect an industry segment from climate policy requirements, slows down structural change toward smaller, lighter and more efficient vehicles and thus makes it unnecessarily expensive to reach the fleet consumption target stipulated by policy.

Supporting measures

160. Each type of product standard should – in keeping with an innovation-oriented strategy – be accompanied by supporting instruments that aim, in particular, to prevent a rebound effect (see Item 109). In this case, it would be conceivable to adjust the ecological tax to the average efficiency gains for the vehicles or to the wholesale-level emissions trading scheme sought by the SRU in the long term, which would only result in a moderate increase in fuel prices even if certificate prices were high (SRU 2005b, Item 324 ff.).

In addition, climate-relevant incentives that have contributed to excessive engine power of the vehicle fleet in Germany are to be corrected in the German tax system. A large proportion of newly registered passenger cars are company cars that benefit from tax write-offs which are proportional to the purchase costs. This systematically favours a vehicle fleet whose weight and engine power – and hence also the price – lie above the equilibrium level of an undistorted market. The adjustment discussed to correct this deficiency has been shelved in the Federal Government's climate programme (Item 105). This is just as regrettable as the stubborn rejection of European-wide speed limits on German highways: even though the limits would only result in a comparatively low direct reduction in emissions (without stricter speed checks), the signal this would send to the automotive industry cannot be underestimated.

3.4.6.4 The European Commission's proposal

161. In December 2007, the European Commission presented draft legislation containing the instrument structure for achieving the 130 g target and the impact assessment mentioned above (European Commission 2007f; 2007a). The proposal consists of:

- A weight-dependent limit value curve,
- A fine for exceeding the limit values that drastically increases over time,
- More flexibility through options allowing manufacturers to compensate internally or work together with other manufacturers.

Each manufacturer has to reach a fleet consumption that is calculated based on the sum of the weight-dependent limit values of all newly registered vehicles. The underlying limit value curve is weight-dependent. A kilogram above the current average vehicle weight of the European fleet allows the limit value to increase by 0.457 g CO_2/km above the average value of 130 g CO_2/km. On this basis, a vehicle weighing 1 t has to comply with a limit value of 117 g CO_2/km and a vehicle weighing 2 t with a limit value of 162.5 g CO_2/km. This way, all vehicles are required to make a contribution to reductions. The proposed increase in the limit value curve has, in the meantime, led to arguments about distribution. The Federal Government, which thinks that the curve is too flat, feels that the heavy-duty "premium vehicles" are discriminated against, while France and Italy think that the curve is too steep and criticise the fact that heavier vehicles are protected at the expense of small and mid-sized cars.

Fines are envisioned if the limit value curve is not complied with. In 2012, the fine for each gram of CO_2 above the set limit value curve will be 20 euro per vehicle. In 2013, this fine will increase to 35 euro, finally reaching 95 euro in 2015. The fines of 20 euro for each additional gram of CO_2 for 2012 only create a minor incentive to comply with the limit value because the additional costs of emission reduction are similar to the amount of the fines. With this in mind, compliance with the specified limit values and actual emissions reductions should only be anticipated for 2014 and 2015. The effective implementation of the 130 g target has thus been pushed back two years.

It is possible for manufacturers to compensate internally so that only the average fleet consumption is used to calculate the fine. Article 5 of the Commission proposal also makes it possible for different manufacturers to form a pool. They can merge together and be treated as a single manufacturer. They have to uphold EC competition law when doing so. They have to ensure that participation in the pool is “open, transparent and free of discrimination […] under economically appropriate conditions”. This pool solution lets producers of high-consumption vehicles avoid paying fines by cooperating with manufacturers of very efficient fleets. This can create incentives to push vehicle innovation far below the limit value curve. However, the requirements for structuring the pool solutions at European level should be put into more concrete terms to counteract the legal uncertainties on the manufacturer side.

Summary

162. The SRU reaffirms its recommendation for wholesale-level emissions trading (see Section 3.5.5), through which the most efficient avoidance options for limiting CO_2 emissions in policy can be identified across sectors. As an interim strategy, the SRU advocates a closed emissions trading system for cars (Dudenhöfer model), because this would ensure that a specific fleet consumption goal was reached and the flexibility of the instrument makes it possible to achieve the target at minimal costs. The number of participating car manufacturers is sufficiently large, which makes it seem unlikely that the market mechanisms would fail due to strategic behaviour. In both trading systems, the market and the car manufacturers themselves regulate the allocation question of which CO_2 intensity the vehicles in the various classes have in order to reach the average value of 130 g CO_2/km across the entire car fleet. A limit value curve as proposed by the Commission will always lead to allocation conflicts upfront among the actors to improve their own position. This line of conflict between car manufacturers of mainly large-engine and small-engine vehicles will mean that the conflicts will now take place at the national level between Germany and Italy or France due to the national character of car manufacturers. A compromise solution, which would be difficult to negotiate, would result in efficiency losses and inevitably to distortions in competition. In addition, limit value or charge-based solutions entail much higher avoidance costs in most model variants. The target value should be considerably reduced after 2012. The figure of 95 g CO_2/km proposed by the European Parliament for 2020 can be considered an upper limit in a proposed range of 80 to 95 g.

The European Commission's proposal falls short of the original self-imposed political target of 120 g CO_2/km by 2010 and the requirements for this type of efficient solution. Its proposed weight-dependent limit value curve with fines and more flexibility makes considerable concessions to the demands of the automotive industry, particularly the German one. The pool solution envisaged by the Commission makes it possible for the manufacturers to avoid fines through compensation activities. The limit value is only expected to be effectively implemented starting in 2014. The weight-dependent limit value curve will ultimately not fully exploit cost-efficient CO_2 avoidance options. The concessions that have already been made to the automotive industry thus have to be seen as expensive for the national economy. In light of the technical potential and the necessity for emission reductions with a quick impact, favouring high-powered vehicles is unacceptable.

In view of the concessions the European Commission has already made, the unanimous protest of the automotive industry and the Federal Government does not make sense from an objective point of view. The protest is aimed primarily at the high fines and the limit value curve which is thought to be too flat. Without high fines, however, the regulatory instrument – which is otherwise accepted by the same actors – would be ineffective. Comparing fines with the price of emission certificates is just as misleading as adding them up as costs under the misguided assumption that the fleet consumption will not decrease by 2015. Opening up the discussion on emissions trading or the proposed pool solution would be more useful for curbing costs. A steeper limit value curve would further reduce incentives to "downsize" the vehicle fleet. On the other hand, it has to be kept in mind that a structural change toward lighter passenger cars with less engine capacity will determine, and has to determine, the development trends over the medium term. The trend for several years has been a global increase in energy prices and generally more stringent climate protection, which will set the tone of the next few years. The German automotive industry closed itself off to these developments for a long time and looked on idly as the period of developing and marketing climate-friendly and fuel efficient cars as a voluntary undertaking passed by. The increasing pressure to adapt that has emerged from this trend is the consequence of functioning market laws, and there is thus no case for economic policy intervention.

3.4.7 Conclusion

163. The increase in energy efficiency not only has special importance in climate protection. It is also the key to dealing reliably with rising and volatile energy prices. While annual efficiency increases have fallen considerably since the early 1990s; achieving the climate protection targets requires today's rates to be tripled. This is what the success of the German climate policy will depend on and not on revising the phase-out of nuclear energy. The context of liberalised energy markets requires sectoral measures to create competition for energy efficiency to prompt a corresponding structural change from energy supply to energy services. A central element is a general incentive using CO_2 or energy prices. Often, however, price signals are not clearly discernible due to limited information and other restrictions, which is why other measures make sense. Energy consumption concentrates on the key areas of fuel and electricity use in buildings, electricity use for energy-using devices and fuel use in road traffic, each of which has great, unused potential for economic efficiency. Even though the German Action Plan on Energy Efficiency has the right focus, almost half is made up of measures that have already been undertaken (business-as-usual) and it does not fully exploit existing potential.

The most important energy savings potential lies in the key area of buildings in lowering the heating requirements in older buildings. The most important instrument of regulatory law, the Energy Saving Ordinance, does not have very ambitious standards due to the narrowly defined profitability principle, and it ignores the external costs of energy consumption. The targeted stricter efficiency standard is thus useful even if it falls short of the indicative specifications of the European Commission (toward the goal of the passive house standard by 2015). The flexibility is greater in rental law than in regulatory law because the former allows modernisation costs to be passed on to the basic rent (limited, however, to 11 % of the annual basic rent). Assistance programmes can compensate for the consequences of investor caution caused by the market and regulation. There should, however, be more incentives set within the scope of funding policy for concentrating on cost-efficient maintenance and modernisation measures. Deficiencies in the implementation of energy saving measures continue to be a regular occurrence and the theoretical effects of saving energy do not always materialise due to heterogeneous user behaviour. Consequently, subsidies should be geared more toward actual energy savings. Rental law and the Heating Cost Ordinance should be restructured so that both the tenant and the landlord feel the direct economic consequences of rising energy prices and can respond appropriately. However, to achieve this, the increase announced in the consumption-dependent portion of the heating bill is inadequate. Introducing the energy pass as an informational tool will make an important contribution.

In the key area of product-related energy efficiency strategy, the preferred instrument is currently defining standards. The standards have to be strict enough, they have to be adjusted on a regular basis and at the right time, and the regulated products must not be limited to niche markets. Improved and dynamic product labelling is also vital when it comes to making price signals more discernible. On the other hand, efficiency standards do not offer an incentive to give up energy-intensive product classes. That is why these standards need to be supported by general incentives using energy prices.

In the key area of road traffic, voluntary undertakings have failed as an instrument because no one has the power to impose sanctions. The draft directive of the European Commission that has now been presented grants heavy vehicles higher emissions (weight-dependent limit value curve) and envisions mandatory fines that are ultimately high enough to ensure compliance with the limit values. To lower costs, it also envisages more flexibility through compensation options which allow manufacturers to compensate internally or work together with other manufacturers (pool solution). The proposal effectively lowered the target level. The weight-dependent limit value curve undermines incentives to downsize vehicle fleets. Overall, the proposal makes considerable concessions, particularly to the German automotive industry – at much higher costs to the national economy. Instead, the SRU recommends – as an interim strategy for wholesale-level emissions trading – a closed emissions trading system for cars (Dudenhöfer model) with a weight-independent (i.e. standardised) average emission value of, if possible, 120 g CO_2/km for the entire new fleet of cars of all car manufacturers by 2012. The target value should be further reduced within a range of 80 to 95 g CO_2/km by 2020. The emissions trading scheme would lower costs because it would not be necessary for every vehicle to physically comply with the limit value, and potential savings would be tapped into in all consumption variations. In line with the Federal Government, the automotive industry has successfully discredited emissions trading as a distortion of competition. The industry demand for "competitive neutrality" serves rather to protect an industry segment from competition. This slows down structural change toward smaller, lighter and more efficient vehicles and thus makes it unnecessarily expensive to reach the fleet consumption target stipulated by policy. In addition, incentives that have contributed to excessive engine power in the vehicle fleet in Germany are to be corrected in the German tax system (company car privilege). This has unfortunately been shelved in the Federal Government's climate programme.

3.5 Emission reduction through emissions trading

3.5.1 Introduction

164. Emissions trading is the single most important instrument in European and German climate protection policy. The crucial advantage offered by emissions trading is the combination of benefits in the fields of regulatory law and ecological taxation. Firstly, a binding emissions budget is stipulated, and secondly the creation of a market which regulates microeconomic coordination offers the same efficiency-related advantages (i.e. static and dynamic efficiency) as ecological taxation (SRU 2006, Item 2).

The existing Emissions Trading Directive and the first period of trading are or were still strongly dominated by individual interests in Germany, although the SRU's main criticism is that emission rights were initially distributed free of charge. Not only did this trigger a "distribution battle" unprecedented in the field of environmental policy, which made the system unnecessarily complex and costly to consumers. It also led to a new variation on the theme of subsidy policy, which aimed to preserve existing structures in the energy supply sector. The planned continuation of this policy during the second phase of trading would have nullified the integrity of the entire system, if the European Commission had not intervened to correct the system.

Since summer 2006 the interest in emissions trading has moved more to the centre stage of everyday politics, along with the issue of climate change. As a result, the shortcomings of the emissions trading regime currently in place have become ever clearer. This in turn has triggered a political momentum that has surprised some observers, since even two years ago it would have appeared politically unthinkable. Since then, the instrument has undergone an astonishing development, thanks primarily to the staying power of the European Commission in addition to the changed political climate. The result is a markedly improved national allocation plan for the second trading period and a very welcome draft to revise the emissions trading directive, in spite of German resistance.

Nevertheless, in the long term, the SRU would plead for a transition to cross-sectoral emissions trading at the first level of trading. The impacts of the current system are limited by the fact that trading covers only certain sectors and certain greenhouse gas emissions (Item 165). An overarching emissions trading strategy for the first level of trading would, by contrast, embrace all energy-related emissions of greenhouse gases (Section 3.5.5). Moreover, the objectives of the emissions trading system in use to date have been overshadowed by wishes and visions influenced by industry policy and competition policy (Item 170 f.), and the system has proved to be susceptible to conflicts because of its enormous complexity (Item 172 ff.). Both of these factors appreciably affect the efficiency of the instrument.

3.5.2 The EU Emissions Trading Directive

165. Directive 2003/87/EC dated 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community (Emissions Trading Directive) imposes on the operators of installations in the power generation sector and certain energy-intensive industries (trading sectors) a scheme for trading in emission allowances (Article 2, Paragraph 1, also Annex I), with respect to CO_2 emissions. During the first trading period, more than 11,400 installations throughout Europe, including 1,849 in Germany (together accounting for some 59 % of national CO_2 emissions), were covered (German Emissions Trading Authority, DEHSt, 2005). With respect to the operation of these installations, the Emissions Trading Directive puts in place two central obligations: firstly, member states must ensure that the activities covered by the trading system are only pursued on the basis of a permit for the emission of the relevant greenhouse gases (Articles 4 to 6), and secondly the operators of the CO_2-emitting installations must be obliged to submit a certain number of emissions permits (known as “certificates”), corresponding to the actual emissions of the individual installations, to the relevant authorities (Article 12). The emissions permits are transferable and, following the primary allocation by member states, they can be traded on the market. The secondary allocation via the market is intended to ensure a cost-effective and economically efficient reduction in emissions of greenhouse gases (cf. Article 1). CO_2 savings are to be made primarily where they can be achieved at the lowest cost. The overall number of tradable certificates issued, their (initial) distribution to the individual sectors (energy, industry) and the criteria for allocation must be stipulated by member states within the framework of national allocation plans for the trading period in question (Articles 9 and 11). The plans must comply with criteria listed in more detail in Annex III of the Emissions Trading Directive, which are intended to ensure the objective and transparent allocation of certificates. Although the compatibility of the allocation plans with these criteria is subject to an investigative procedure conducted by the European Commission (Article 9, Paragraph 3), the Emissions Trading Directive does give member states considerable leeway in devising their plans (European Court, judgement of 7 November 2007, ref. no. T-374/04). In line with the provisions of the Emissions Trading Directive, the initial allocation of certificates is to be largely free of charge for the first two trading periods. For the first trading period (2005 to 2007), a minimum of 95 % of certificates was to be allocated free of charge. The same is to apply to at least 90 % of certificates allocated during the following trading period (2008 to 2012) (Article 10).

3.5.3 Implementing the Emissions Trading Directive in Germany

166. In Germany, the Emissions Trading Directive is transposed into German law primarily by means of the Greenhouse Gas Emissions Trading Law (*Treibhausgas-Emissionshandelsgesetz – TEHG*) and the pertinent Law on the National Allocation Plan for Greenhouse Gas Emissions Permits (*Gesetz über den Nationalen Zuteilungsplan für Treibhausgas-Emissionsberechtigungen or Zuteilungsgesetz – ZuG*) for the respective trading period. The Law on the National Allocation Plan for Greenhouse Gas Emissions Permits translates the allocation guidelines for the respective national allocation plan into the form of an act of parliament.

3.5.3.1 The choice of legal regime

167. The Emissions Trading Directive largely determined the legal regime that underlies German climate protection law. Alongside a fundamental obligation to obtain permits for certain CO_2-emitting activities (Section 4, Paragraph 1, also Annex I Greenhouse Gas Emissions Trading Law), the Greenhouse Gas Emissions Trading Law for the first time established a mechanism for establishing contingents of a hazardous substance and trading in that substance, in a radical departure from the regulatory approach traditionally taken by German industrial authorisation law. Rather than establishing installation-specific ceilings for emissions, the respective operators of the installations are required for each calendar year to legitimate their CO_2 emissions by submitting the required number of certificates (Section 6, Paragraph 1 Greenhouse Gas Emissions Trading Law). While the emissions permit then regulates whether or not emissions are permissible per se, the permissible quantity is decided by the number of permits submitted. The respective Law on the National Allocation Plan for Greenhouse Gas Emissions Permits defines the total quantity of CO_2 certificates to be distributed (cf. Section 4, Law on the National Allocation Plan 2012 for Greenhouse Gas Emissions Permits) and lays down the regulations to govern the initial distribution of these rights by the state (cf. Section 6, Paragraph 2, Greenhouse Gas Emissions Trading Law). Should the installation operator emit more CO_2 than the volume covered by permits allocated, it must purchase the remaining permits required on the market, so as to meet the terms of its obligations to submit the correct number of permits to the authority responsible. The Greenhouse Gas Emissions Trading Law provides for financial sanctions to be imposed on operators failing to comply with these obligations, in addition to the requirement that the appropriate number of permits be submitted (Section 18, Paragraphs 1, 3, Greenhouse Gas Emissions Trading Law).

3.5.3.2 Conformity with European law

168. The decision at European level to introduce a binding system of greenhouse gas emissions trading raises no constitutional concerns nor any concerns under European law. Both the Federal Administrative Court (BVerwG) and the Federal Constitutional Court (BVerfG) have already dealt with the issue of the admissibility of the choice of legal regime in terms of constitutional law and European law. The two courts correctly agree that the binding provisions of the Emissions Trading Directive must be reviewed in terms only of European law and not using the yardstick of German fundamental rights (Federal Constitutional Court, judgement of 30 June 2005, ref. 7C 26/04; confirmed by the non-acceptance decision of the Federal Constitutional Court, BVerfG, on 14 May 2007, ref. 1 BvR 2036/05). This is fully in line with the known "*provided*" precedents of the Federal Constitutional Court, according to which binding European provisions need not be reviewed on the basis of the standards laid down by German fundamental rights, provided the European Court ensures an appropriate standard of fundamental rights (Federal Constitutional Court, judgement of 22 October 1986, BVerfGE 73, 339). Neither the Federal Administrative Court nor the Federal Constitutional Court have any doubts as to the appropriate standard of fundamental rights ensured by the European Court. The courts reviewed the binding provisions of the Emissions Trading Directive against the protection of European property rights and against the freedom of occupation guaranteed under European law. In both cases they came to the conclusion that the protection of the climate, an overarching duty of the international community and thus also of the European Union, justifies the restrictions placed by the Emissions Trading Directive on freedom of property and occupational freedom of businesses. Specifically the intervention in the basic right to freedom of property entailed by emissions trading law (cf. Article 6, Paragraph 2 of the Treaty on European Union) is considered to be an admissible restriction on the utilisation of the installation as property. The courts did not see the system of emissions trading as expropriation, which would only be permissible under more rigorous requirements and which would entitle owners to the payment of compensation. Installation operators are not banned from emitting CO_2. This right does not exist as an individual right which could be withdrawn, because the air is not privately accorded to the individual with exclusive rights of use. The allowance to produce emissions is only protected as part of the ownership rights relating to the installation and the right to operate an established and already practised industrial undertaking in the view of the courts, and as such is inseparable from the approved installations. The introduction of emissions trading, by contrast, does not in the view of the courts constitute even a partial withdrawal of these protected rights.

When reviewing the commensurability of the restrictions placed on fundamental rights, the Federal Administrative Court also considered it relevant that the Emissions Trading Directive permits auctioning of a maximum of 10 % of certificates during the first two trading periods. Since the Emissions Trading Directive thus obliges businesses to take part in a largely cost-free allocation of certificates as a result of the new system, the system cannot be said to constitute unacceptable hardship for the operator. With comparable arguments, both the Federal Administrative Court and the Federal Constitutional Court noted that the trading system does not infringe the occupational liberty guaranteed by European law.

3.5.3.3 The lack of contradiction between emissions trading and fundamental obligations under immission protection law

169. The trading system for emissions of greenhouse gases does not contradict the fundamental rights of operators of installations requiring an operating permit as laid down in immission protection law (see by contrast FRENZ 2005; Section 9, Greenhouse Gas Emissions Trading Law, marginal no. 71 ff.). It is, however correct that the introduction of this system marks a break with the interpretation of operators' duties that has hitherto taken the form of the so-called precautionary requirements laid down in Section 5, Paragraph 1, Number 2, Federal Immission Control Law (*Bundes-Immissionsschutzgesetz – BImSchG*) and the requirement to make economical and efficient use of energy as laid down in Section 5, Paragraph 1, Number 4, Federal Immission Control Law. The precautionary requirement requires operators to take precautionary measures to prevent environmental damage in line with state-of-the-art technology. Emissions trading law moves away from this approach in that it opens up the opportunity to continue to produce CO_2 emissions unchecked irrespective of state-of-the-art technology. The only prerequisite is that emissions are matched by the relevant number of certificates (RÖDER-PERSSON et al. 2002, p. 46 ff.). This is, however, merely the implementation of the precautionary principle using different means. The precautionary requirements laid down for individual operators and installations is simply replaced by a "collective" precautionary requirement in the form of total emissions limitations under the emissions budget laid down by the legislative and the collective responsibility of all operators not to exceed this (REHBINDER, no year stated, p. 2). Thus Section 5, Paragraph 1, Sentence 2 of the Federal Immission Control Law states that the precautionary requirements made of installation operators subject to emissions trading will be determined by their obligations under the provisions of the Greenhouse Gas Emissions Trading Law. The same applies to the requirement that operators maximise energy efficiency pursuant to Section 5, Paragraph 1, Sentence 4 of the Federal Immission Control Law, in so far as the energy efficiency requirement is related to the CO_2-relevant emissions of the installation. With regard to energy efficiency, the Emissions Trading Directive does, however, allow for specific requirements to be made of operators on an installation-by-installation basis in addition to the overarching trading regime (Article 26; for more information on the specific contents of the energy efficiency requirement see KOCH and WIENECKE 2001). Germany, however, has not made use of this option.

3.5.3.4 The national allocation plan I and the 2007 Allocation Law

Competition-policy debate misses the mark

170. The implementation of the European emissions trading system in the form of the first German national allocation plan (NAP I) and the 2007 Allocation Law (ZuG 2007) was marked in particular by the incorrect interpretation of the competitive dimension of the instrument with respect to the allocation of emission rights (SRU 2006; MICHAELIS 2006). The erroneous assumption that the allocation of a large number of emission rights free of charge (grandfathering) would boost the competitiveness of individual businesses or branches led to the call for a “needs-driven” allocation, which in turn spawned the generous allocation of emission rights for CO_2-intensive fuels (coal, especially lignite) and industrial processes (raw materials industries). The government also attempted to use the allocation to achieve other energy-policy and industrial-policy objectives (protecting domestic coal, renewing power stations, stepping up competition in the power generating sector, improving the competitiveness of German industry).

In fact the competitive situation was changed not by the allocation of the emission rights but by the introduction of emissions trading per se. The new regime makes emissions or the pertinent emissions trading certificates a tradable factor in production with a market price, which can be used by a business or alternatively sold on the market. Thus the same applies to CO_2 rights as to any other factor in production, including putting a price on the opportunity costs of emission trading rights originally received free of charge. Competitiveness (in terms of CO_2) comes about only through CO_2 efficiency. The distribution of emissions certificates free of charge can be equated with a subsidy, which makes the business in question richer in terms of its balance sheet but does not improve the profitability of the way it uses emissions rights. Emissions trading introduced a new element of shortage to the economic system, which ought to be countered by making more productive use of the element that is in short supply. This also applies to businesses which compete on the global market with other companies that are not subject to comparable pricing regimes for CO_2 emissions, since terms of competition and decisions on where to base a business are multidimensional, and since emissions trading can only be made responsible for differences in energy prices that are directly attributable to this system.

The call for distribution free of charge is then the expression of a fight for scarce resources, based on the subsidisation of this new factor in production. Its substantial value explains the extent of the efforts made by businesses concerned and their business associations to influence proceedings. Although the distribution per se has no influence over the incentive offered by the instrument, numerous provisions for special circumstances have led installation operators to adopt strategic approaches, which in turn have made it necessary to take action to limit abuse. This resulted in an unnecessarily complex system with a huge number of detailed regulations and an over-allocation of rights under NAP I, which ran counter to the objectives of the instrument. This unfortunate development was documented by the plummeting price of emissions rights after the publication of the verified emissions data for 2005 (Carbon Market Europe, 28 April 2006). All in all, the volume of emissions rights distributed in 2005 and 2006 was some 20 million certificates or 4 % higher than actual emissions (German Emissions Trading Authority, DEHSt, 2007). The free distribution of emissions rights thus had unmistakably negative impacts on the way the instrument works. The SRU then recommended modifying the system such that emissions rights would be auctioned. During a transitional period, the system ought to be significantly simplified by abolishing all special regulations including the regulation governing the new plant reserves and the fuel-specific benchmarks (for more detail, see SRU 2006).

171. In this context, the decision of the Federal Cartel Office defining pricing of more than 25 % of the market price of emission rights as an abuse of the market (press release issued by the Federal Cartel Office on 20 December 2006) must also be criticised. The whole purpose of emissions trading is to put a price on the (opportunity) costs of emissions rights as a new factor which is in limited supply, and this is taken to entirely absurd lengths in the decision of the Federal Cartel Office. The reference to a lack of competition on the German power generation market is not convincing, since markets which display a high level of competition in particular put a price on all factors involved. Anyway, the pricing is taking place in other EU member states too, which allegedly enjoy a higher level of competition (RADOV and KLEVNAS 2007). The out-of-court settlement achieved between the Federal Cartel Office and RWE in September 2007 must also be criticised. This provides for an auctionable electricity contingent for industrial clients on which the value of emission rights could be reimbursed (press release issued by the Federal Cartel Office on 27 September 2007). If attaching a price to emissions is genuinely abuse, then we must ask why private clients too should not be “protected”. In the final analysis, this controversial decision is another reason why all emissions trading rights should be auctioned so as to prevent problems of this sort arising in the first place.

The Allocation Law – an expression
of the constitutionally protected leeway open to the legislative

172. Because of their economic relevance on the one hand and their extreme complexity on the other (Item 170), the allocation regulations provided for in the 2007 Allocation Law triggered much controversy, also on the basis of constitutional law. In this regard, it has been pointed out in particular that various allocation regulations infringe the constitutional requirement of equality as enshrined in Article 3 of the German Basic Law, or constitution, and that they do not conform with the requirements of the principle of the rule of law. These objections have been rejected by both the Federal Administrative Court and the Federal Constitutional Court. They have confirmed the validity of the contested regulations, with reference to the considerable leeway open to the legislative in determining allocation regulations, which was made necessary by the entirely new nature and the complexity of the emissions trading regime (Federal Constitutional Court, judgement of 13 March 2007, ref. 1 BvF 1/05, with respect to taking into account earlier emissions reductions, Federal Administrative Court, judgements of 16 October 2007, ref. 7C 6.07 and 7C 28.07, with respect to making a distinction between process-related and non-process-related emissions, Federal Administrative Court, judgement of 16 October 2007, ref. 7C 33.07 for the partial reduction of allocations in order to comply with the emissions budget). Although this means that the regulations have withstood the test of a review on the basis of constitutional law, the court cases are evidence of the extent of legal uncertainty and macroeconomic inefficiency linked to the unnecessarily complex system of emissions trading as laid out in the 2007 Allocation Law.

3.5.3.5 The national allocation plan II and the 2012 Allocation Law

Simplifying allocation regulations

173. The negative experience of allocation in line with the NAP I, and the pressure of the European Commission to revise NAP II, have led to a simplification of the allocation regulations, which is a welcome outcome. The draft German NAP II submitted to Brussels was initially rejected by the European Commission. In particular the European Commission believed that the emissions budget was about 29 million tonnes too high at 482 Mt CO_2 per annum, with the result that sectors not involved in emissions trading too were subjected to additional requirements to avoid emissions. The (slightly modified) generous allocation of rights to new installations taken from NAP I was also rejected as distorting competition with comparable existing installations. The European Commission made it quite plain that within the framework of NAP II no pledges could be made with a binding impact beyond the period

2008 – 2012 (European Commission 2006b; 2006d; Federal Environment Ministry, BMU 2006). The German government complied with the modification demands of the European Commission with a slight delay by early 2007 (press releases of the Federal Environment Ministry on 24 November 2006, 9 February 2007 and 18 April 2007; Federal Environment Ministry, BMU 2007b). The final version was then adopted on 22 June 2007 by the German Bundestag and on 29 June 2007 by the second chamber of the German parliament, the Bundesrat, along with the amendments to the Greenhouse Gas Emissions Trading Law and the Project Mechanism Law (*Projekt-Mechanismen-Gesetz – ProMechG*) (Federal Environment Ministry, BMU 2007d; German Bundesrat 2007). The most important elements of the NAP II as adopted and the 2012 Allocation Law for the trading period 2008 to 2012 are as follows (MATSCHOSS 2008):

– Emissions budget: The budget of the trading sector (including new installations reserve and percentage for auction) was reduced from the 499 Mt per annum originally set out in NAP I to 482 Mt per annum in the first draft of the NAP II and then to a final figure of 453 Mt per annum (Section 4, Paragraph 2, 2012 Allocation Law).

– Auctioning: A new element, even as compared to the first draft NAP II is the sale of emissions rights for 40 Mt CO_2 per annum (or 8.8 % of the total) of the emissions budget (Sections 19 to 21, 2012 Allocation Law). This total is to be taken from existing, newer and new electricity generating installations (including the electricity generated in nuclear power stations) through additional cuts, whereby exceptions are made for industrial and small-scale plants.

– Benchmarks: The benchmarks contained in the new installation regulations of NAP I are taken for existing energy-sector installations (start-ups up to end of 2002), all newer installations (start-ups 2003 – 2007) and all new installations (start-ups 2008 onwards). These provide for a significantly higher allocation for coal-fired installations per kWh (more than double for power generation) than for gas-fired installations (Annex 3, Part A, 2012 Allocation Law). Existing plants are classed on the basis of past capacities (Sections 7, 2012 Allocation Law) while the so-called standard capacity factors are taken for the other installations. For the latter, the discrimination on the basis of fuel is even more marked, with anthracite-fired installations presumed to have 7.5 times the annual running time of gas-fired installations, and lignite-fired installations 8 times that of gas-fired power stations (Annex 4, I, 2012 Allocation Law).

– Past emissions: Only existing industrial installations (start-ups up to the end of 2002) see allocations cut by a factor of 98.75 % of past emissions, analogously to NAP I (Section 6, 2012 Allocation Law).

– Percentage cuts: The so-called sliding percentage cuts (SCHAFHAUSEN 2007) pursuant to Section 4 paragraph 3 of the 2012 Allocation Law is a combination of performance factor and extra premium rule taken from the NAP I, whereby cuts are more radical for inefficient installations than for efficient installations. The impact among fuels is, however, reduced by the utilisation of a benchmark and an additional higher benchmark for lignite. The sliding percentage cuts affect newer installations and existing installations used to generate power. Industrial installations, new installations and small-scale installations are not affected. Neither are installations subject to the early-action regulation of the NAP I affected (cf. Section 12, 2007 Allocation Law).

– New installation reserve: As part of the emissions budget, the new installation reserve totals 23 Mt CO_2 per annum (Section 5, 2012 Allocation Law). Alongside the allocations for new installations it serves to cover the costs of the German government, the repayment of the oversubscribed reserve of the NAP I (the so-called KfW mechanism) and any successful cases of legal action taken to demand higher allocations.

174. The staying power demonstrated by the European Commission, which has resulted in a significantly improved NAP II in terms of the budget and the new installation regulations – if we take the latter to be necessary (cf. Item 170) – should be welcomed. In view of the emissions of the base period (average emissions between 2000 and 2005) of 478 Mt CO_2 per annum (German Emissions Trading Authority, DEHSt, 2007) the budget now constitutes a genuine requirement to cut emissions, with which the targets laid out in the Kyoto Protocol can be achieved. The risk of earmarking large sections of the budget for several trading periods in advance as a result of the former new installation regulation, which is not compatible with reduction requirements introduced at a later date, appears to have been eliminated too. The start of auctioning too is expressly welcomed. The fight for allocations of emission rights, which will be superseded by the introduction of auctioning, will make it easier to enforce the necessary more rigorous reduction targets after 2012. The start to be made now will be an important contribution as a learning phase for complete auctioning at a later date. Alongside these positive developments, the following points must nevertheless be criticised:

– Fuel-specific benchmarks: Since the benchmark set for coal-fired power stations, at 750 g CO_2/kWh net power generation, is more than twice as high as the benchmark set for gas-fired power stations (365 g CO_2/kWh), the system of benchmarks continues to hamper the necessary adjustments in the fuel mix. This brings with it the danger that, where it would make business sense to substitute one fuel for another, operators will instead attempt only to improve the degree of efficiency of existing fuel technology, at a cost that makes the operation inefficient.

– Allocation for industry: With the argument that competition is harsher, the industrial sector is specifically treated more generously in terms of emission rights than the power generating sector. What we see here is a confusion of competition and distribution arguments. Even in energy-intensive businesses which are genuinely exposed to non-European competitors (which is not generally the case), energy-costs-related factors are of only secondary importance in the multidimensional decision on where to site the business as a general rule (cf. Item 170; SRU 2006, Item 28 f.). The industrial sector too will have to be involved in auctioning.

– New installation regulation: Here too, we see the inadmissible confusion of competition and distribution arguments, since once again it is not the free distribution of emission rights but the profitability of an installation under the new emissions trading regime which determines whether or not an installation is competitive. Rather than investing in the most cost-effective way of avoiding CO_2 emissions, investment planning on the part of operators is distorted by the desire to achieve a maximum allocation of emission rights. For this reason the entire set of regulations centering on new installations, new installations reserve and installation decommissioning should be rejected in spite of the welcome improvements made as mentioned above (SRU 2006, Items 12–13, 30–31). There are also very few true newcomers. There is thus a great probability that the system in this form will generate only take-home profits for established operators who would in any case have been renewing their stock of power stations (MICHAELIS 2006; HENTRICH and MATSCHOSS 2006).

These criticisms indicate that even the much improved NAP II still misses the competition-policy and energy-policy mark. The main points of criticism remain the separate benchmarking for coal-fired plants and the special treatment accorded to industry. NAP II can then only be an interim, if important, step on the way to achieving consistent and equal treatment of emissions generators and to the full auctioning of emissions rights as of 2012. Overall it must be recognised, however, that the (primarily European) policy has gone some considerable way to overcoming the power and influence of the polluter side. The final version of NAP II manages in no small way to restore the credibility of emissions trading as an instrument of European climate protection policy. The successful introduction of auctioning too marks an important step forward.

Auctioning of ten percent of certificates constitutionally acceptable

175. Doubts expressed on various sides as to the constitutionality of the planned (partial) auctioning of certificates have proved to be unfounded (BURGI and SELMER 2007; REBENTISCH 2006). The starting point, that an auction of certificates must be measured in terms of the guarantee of fundamental rights (Item 176 ff.) and the provisions of German financial constitutional law (Item 180 ff.) is appropriate. Since Article 10 of the emissions trading directive sets only a ceiling on the percentage of certificates that may be sold (Item 165), it leaves members states significant leeway to devise their own systems in line with the provisions of their own national legislation.

Guarantee of fundamental rights

176. The planned auctioning of greenhouse gas emission rights entails for operators an intervention both in their property rights and in their freedom to exercise their occupation, in terms of the financial burden imposed thereby. Both interventions are, however, justified, because of the higher importance that must be attached to climate stability. They are in no way disproportionate, but rather must be deemed suitable and indeed necessary in order to achieve the overarching goal. The emissions trading system aims to achieve not only more effective climate protection, but also more cost-effective protection. Auctioning certificates is in line with these requirements, in particular the goal of achieving cost-effective climate protection, because it avoids the inefficiencies linked to the initial allocation of certificates free of charge. In the case of the allocation of certificates free of charge, businesses no longer gear their production primarily to the imperatives of the artificially created shortage of the new production input “emissions permits” but also to ensuring the allocation of maximum certificates as an asset and a legal position. The aim of gearing the installation structure of the Federal Republic of Germany to the costs of emissions is countered by the strategic response adopted by businesses. If the certificates are distributed free of charge periodically, this strategic approach will become permanent to the detriment of the lasting efficiency of the trading system. Inefficiencies resulting from the free allocation of certificates could be ignored in a system which involved a one-off distribution of certificates. In a system of this sort, the strategic orientation to the allocation of assets that could be expected would be relegated to secondary importance in the subsequent period, as businesses geared operations to the costs of the production factor “emission permits”. This is absolutely not the case under the current emissions trading system, which provides for the periodic new distribution of rights (cf. also Item 170; SRU 2006).

177. The efficiency of the trading system in the interests of achieving cost-effective climate protection is one aspect of the objectives of the Emissions Trading Directive (cf. Article 1, “in order to promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner.”). This was also recognised by the European Court in the first instance in its judgement of 7 November 2007, in which it deemed “ensuring of the conditions of cost-effectiveness and economic efficiency” of emissions trading to be a sub-objective of the Emissions Trading Directive (European Court, ref. no. T-374/04, Items 124 f., 136). This in no way contradicts the restrictions placed on the sale of certificates under Article 10 of the Emissions Trading Directive. It must be admitted that partial auctioning of the certificates will only be able to eliminate inefficiencies to a certain extent, but the partial opening of the allocation system for market mechanisms is not an expression of any general reservations vis-à-vis a system of auctioning. It is a result of the attempt to give economic players as smooth a transition to the emissions trading system as possible, and to combine this with a learning phase.

As the initial allocation of certificates free of charge proves to be less efficient than the auctioning of certificates, it is then not an equally suitable way of achieving the goal of emissions trading that imposes a lesser burden on operators (see by contrast BURGI and SELMER 2007, p. 45, 65 f, who are of the opinion that allocation efficiency is relevant for the overall volume of certificates distributed but not for the procedure by which they are allocated).

178. The burden that partial auctioning imposes on installation operators also proves to be appropriate. It is not only proportionate to the intended purpose. In view of the importance of climate stability and in terms of the costs that will be entailed by restructuring the national economy to ensure climate orientation, efforts must be stepped up to ensure that the shortage of the production factor “CO_2 emission rights” becomes the key consideration in business decisions rather than the allocation of assets free of charge. To this end, it would appear appropriate in a system based on periodic allocations to auction certificates (Item 176). The introduction of an auctioning solution of this sort, covering only a small percentage (8.8 %) of certificates, and which only commences during the second trading period cannot be said to impose an unacceptable burden on installation operators. Although the Federal Administrative Court considered the allocation of certificates free of charge to be a major consideration when assessing the obligations imposed on installation operators under the emissions trading regime (Item 168), this judgement referred only to the change of system. The leeway accorded to the legislative to auction a larger percentage of certificates in future is not, per se, obstructed by the guarantee of fundamental rights and the requirements to protect confidence (MARTINI and GEBAUER 2007, p. 230).

Since the certificates to be auctioned are to be procured by means of reducing a percentage of the certificates allotted to power generating plants (§ 20, 2012 Allocation Law), these plants will, however, bear a greater burden than installations in other sectors. The assertion that this constitutes an unacceptable burden, however, is countered by the fact that the low price elasticity for electricity means that this sector in particular can cope with a higher degree of pricing; the sector also tends to chalk up greater windfall profits (Deutscher Bundestag 2007). These advantages are only tapped by the mechanism of allocation by sale, though one has to take account of the fact that in return, businesses receive a product that they are free to trade.

179. The low level of price elasticity and the pricing option are also objective reasons for the differentiation to be made between power generating plants and installations in other sectors, with respect to the equal treatment provisions of Article 3, Paragraph 1 of the German Basic Law or constitution. The new system cannot then be said to contravene the equal treatment provisions.

Financial constitution provisions

180. Auction revenues constitute levies of a non-tax nature under public law, whose admissibility must be determined on the basis of the provisions of financial constitutional law (according to, for instance Körner and von Schweinitz, in: KÖRNER/VIERHAUS 2005, Section 18 Allocation Law, marginal no. 35). The categorisation of the revenues as public levies is in no way contradicted by the fact that the state does not specifically and solely stipulate the rationale and the amount payable. This takes the form of successful participation on the part of installation operators in auctioning. When a levy emerges it is not unusual for it to depend on the will of the individual who subsequently becomes obliged to pay the levy. The determination of the trading system by the state, which establishes an artificial market, requiring the participation of certain players in emissions trading as a result of its sole responsibility for the initial allocation of certificates, also justifies the categorisation of the revenues as levies under public law.

According to the consistent findings of the Federal Constitutional Court, non-tax levies must be specially justified because the sovereign tasks of the state must, under the provisions of the financial constitution, be financed using tax revenues (the principle of the tax-based state; cf. Federal Constitutional Court, judgement of 9 November 1999, ref. 2 BvL 5/95, BVerfGE 101, 141, (147 f.); judgement of 17 July 2003, ref.: -- 2 BvL 1, 4, 6, 16, 18/99, 2 BvL 1/01, BVerfGE 108, 186 (214 ff.)). In its decision on the so-called “water pfennig”, the court recognised the fact that advantages accorded to a private entity or individual by the state in the form of authorisation to utilise a natural resource can form the basis on which a levy can be raised (judgement of 7 November 2005, BVerfGE 93, 319 ff.). This is, however, only intended to apply when the natural resource in question is governed by a state management ordinance. The Federal Constitutional Court considered that a state management ordinance could be deemed to exist when the state imposes contingents on how much of the natural resource may be used and when the resource is considered to be a “public good” for which there is no automatic entitlement to access.

Only if the rights of liberty do not entail a right to use the public good in question, can a state allocation entitling the holder to use the public good extend the legal entitlements. This “additional” liberty can then be taken to be a permissible basis on which to raise levies.

181. These justifications can be transferred to the emissions trading system. Contrary to some opinions in pertinent literature, transferability is not precluded by the lack of any de facto management ordinance (although this is the argument advanced by BURGI and SELMER 2007, p. 26 ff., 51 ff.; REBENTISCH 2006, p. 752 ff.). The structural similarities between the water and emissions trading regimes outweigh the differences (Item 182). It is correct to say that the emissions trading regime differs from the utilisation regulations for water in that the permit to use the good is not fully removed from the field of liberty of the installation operator. It is also true that the utilisation permits in the water sector are nontransferable. These differences from the customary, narrower interpretation of a management ordinance, however, do not stand in the way of applying the essential contents of the “water pfennig” judgement to emissions trading, because they do not affect the concerns arising from such a narrow definition (Item 183).

182. Both in the water and in the emissions trading sector, the scope of utilisation of natural resources is subject to a ceiling. There is no constitutionally guaranteed right to utilise the resource “air” any more than there is in the water sector (cf. Item 168). However, the emissions permit, as an inseparable and integral part of the permit accorded to the installation operator to operate its plant does continue to enjoy fundamental constitutional protection. If we assume that the permit to generate emissions is inseparable from the ownership rights of the installation (cf. the decisions of the Federal Administrative Court and the Federal Constitutional Court as set out in Item 168), emissions trading would be precluded on the basis that it would constitute a removal of this authorisation to generate emissions. It is then only consistent to make a distinction between the question of “whether” an installation operator may generate emissions, and the question of “the volume” of emissions the operator may generate. While the installation operator retains the basic authorisation to pursue the activity resulting in emissions of CO_2, the volume is subject to conditions (emissions may be generated only on the basis of the relevant number of certificates). This differentiation is needed in order to ensure the flexibility of the trading system. If the admissibility of installation-related emissions is made dependent on the subsequent submission of an appropriate number of certificates as provided for under EU law, and should these certificates be tradable, there must then be an entitlement to generate emissions for the entire emissions period and independent of the ownership of certificates.

183. Whether or not a limitation of the authority to utilise natural resources, although installation operators retain a fundamental entitlement to emit CO_2, is deemed to contradict the existence of a management ordinance, depends on whether or not it contradicts the objectives of a narrow definition of the concept. The latter is to introduce a commercialisation of activities protected by fundamental rights by the state (BURGI and SELMER 2007, p. 26 ff. with additional notes). Critics fear that the instrument of a utilisation ordinance could be used to impose contingents with the purpose of raising funds, and that these contingents could then be offered for sale. The right of liberty is intended to provide protection against precisely this sort of restriction, however. A utilisation ordinance could then only be considered where the utilisation is not classed as being part of the field of activities protected by fundamental rights. This line of argument is not convincing in its absolute nature. After all, commercialisation of activities protected by fundamental rights is nothing other than an intervention in the fundamental right in question, which must be thoroughly justified. In particular it must be ascertained whether the economisation of interests per se is justified. If, in addition to regulatory instruments, market mechanisms are being used to steer behaviour, economisation cannot per se be inadmissible. Whether or not it is justifiable depends on the constitutionality of the intervention in fundamental rights. Emissions trading is clearly constitutional (Item 176 ff.). There is then no reason why the findings of the Federal Constitutional Court with respect to the “water pfennig” cannot be applied to the allocation of contingents of emission certificates.

3.5.4 Revision of the Emissions Trading Directive

3.5.4.1 Introduction

184. In line with the commitments laid out in Article 30 of the Emissions Trading Directive, the European Commission has submitted a report on the implementation of the directive. On the basis of the main requirement of the report – a simplified and more predictable system – a working group undertook a series of additional evaluations within the framework of the further review process. These focused on the following four topic areas (European Commission 2006c, p. 6, 12 ff.):

- Extending the system to embrace other greenhouse gases and sectors (air travel and shipping) and excluding small-scale incineration plants
- Harmonising emission ceilings and allocation regulations
- Monitoring and reporting
- Linking up with non-EU member states.

At its 2,812th meeting the EU Environment Council identified the same strategic key questions. It urged in particular a greater standardisation of the system, with minimum quotas for auctioning and a harmonised method of establishing the emissions budget (Environment Council meeting on 28 June 2007).

One result of the review process was that in January 2008 the European Commission submitted a proposed directive to revise the Emissions Trading Directive (European Commission 2008e) within the framework of the so-called second energy package (Item 100). The salient elements of the proposed directive are as follows:

- A Europe-wide emissions budget with a linear reduction beyond 2020 and automatic adjustment to bring it into line with new European targets when an international climate protection agreement comes into force after 2012
- Auctioning as the general rule with immediate effect for the power generating sector and following a pre-determined transition phase for industry; exceptions for the latter sector only after a review and if no post-2012 agreement is reached
- Extending the field of application to cover certain process emissions (CO_2 and non-CO_2) with an option to exempt small-scale plants
- A number of other harmonisation measures to simplify enforcement.

3.5.4.2 Europe-wide emissions budget

185. With respect to the stipulation of a ceiling on emissions (i.e. in the macro plan or emissions budget), the options of a single EU-wide ceiling on the one hand and of separate restrictions to be set by each member state on the other were explored. For the first case, the option of auctioning all rights was also explored.

Dispensing with national allocation plans, the directive provides for a common budget for the European emissions trading sector as of 2013 as well as a fixed reduction path, which will lead to cuts of 21 % of the 2005 levels (2005 is to be the new EU base year, cf. Item 100) by 2020. Arithmetically, the budget as of 2010, i.e. starting with the average permissible annual emissions of the second trading period, will be reduced by 1.75 % per year on a linear basis. Thus, at the beginning of the third trading period (2013) a total emissions volume throughout the EU of 1,720 Mt CO_2 per annum would be available, in line with the old emissions trading segment. The trading period is set at eight years, whereby the reduction factor would continue to apply beyond 2020 and would be reviewed no later than 2025 (Article 9 of the draft emissions trading directive). Should an international climate protection agreement be adopted for the post-2012 period, in the course of which the EU undertakes to make more far-reaching cuts (cf. Item 100), the factor will automatically be adjusted such that the European emissions trading segment is responsible for the same proportion of overall reductions (Article 28).

Should changes be made to the emissions trading segment (cf. Section 3.5.4.4) the budget will be modified accordingly (Article 9a). The actual budget figures are to be made public no later than mid-2010 (Article 9).

186. The stipulation of an EU-wide budget with a long-term, predictable reduction path is the main innovative aspect of the proposal, alongside the transition to auctioning. This applies to both the volume of the budget, which now constitutes a de facto requirement to cut emissions, as started in NAP II (see Item 173), and to the fact that in the sector with the most efficient instrument a conscious decision has been made to require a higher contribution than that required in non-trading sectors (cf. Item 100). The fact that this principle will be retained and adjusted accordingly if more far-reaching reduction targets are agreed does much to underpin the stability of the regime. All in all, the importance of this regulation complex cannot be overstated, and it is more than welcome. It will now be crucial to ensure that this proposal makes it through the legislative process with as few changes as possible.

3.5.4.3 Auctioning and harmonised allocation regulations

187. The proposed directive sees the auctioning of emissions rights as the principal allocation mechanism (Article 10). Power generators (with the exception of providers of long-distance heating) and refineries shall then as of 2013 acquire all emissions certificates within the framework of auctioning (Article 10a, Paragraph. 2). Industrial plants (and heat generated in nuclear power stations) will be subject to a transitional regulation according to which the percentage of rights to be auctioned will rise annually in a linear fashion from 20 % in 2013 to 100 % in 2020 (Article 10a, Paragraphs 3-7). The proposal, however, also provides for exceptions to be made for sectors where there is a particular risk that businesses will simply relocate to countries with less strict climate regulations (so-called carbon leakage) (Article 10a, Paragraph 8). Within the framework of a review process (which is to be repeated once every three years), these (sub)-sectors will be listed for the first time no later than mid-2010 on the basis of certain criteria (cost structure, market form, etc.) (Article 10a, Paragraph 9). By mid-2011 it is to be ascertained whether or not a higher allocation of emission rights free of charge than in other industries is in fact justified, in particular with a view to the status of a post-2012 agreement (Article 10b).

All in all it is assumed that in 2013 two-thirds of emissions rights will be auctioned. The auctioning is to be coordinated by the European Commission and conducted by member states (Article 10, Paragraphs 1, 5). The respective percentage of emissions rights will be 90 % based on the percentages of emissions verified in 2005, while 10 % will be redistributed to member states with a below-average per capita income (Article 10, Paragraph 2). The revenue generated will go to the member states, whereby 20 % is to be used for climate protection in the widest sense of the term (research promotion, adaptation to climate change, preventing deforestation, etc.) (Article 10, Paragraph 3).

188. In legal terms, no serious constitutional concerns have been raised vis à vis the complete auctioning of certificates, which is geared to the aspect of acceptability (taking into account pricing options and the competition situation as well as step-by-step plans). It would also be compatible with the fundamental rights guaranteed under European law (cf. Items 168, 175 ff.).

189. Where certificates are still distributed free of charge in future, this is to take place in line with EU-wide harmonised regulations still to be defined by the European Commission (Article 10a, Paragraph 1). Separate regulations for new installations and decommissioning regulations, which have to date been dealt with very differently from one member state to another, are in future to be abolished. While in future no provision will be made for allocations for decommissioned plants, allocations for new industrial installations will come from an EU-wide reserve for new installations (to account for 5 % of the emissions budget) in line with the same regulations that apply to existing installations. New power generation plants will have to acquire emissions rights on the market (Article 10a, Paragraph 6).

190. The second main innovation of the draft directive in its current form is the transition to auctioning as the regular allocation mechanism, alongside the EU-wide budget. The SRU has repeatedly pointed out (cf. Items 170-174), that the distribution of emissions rights free of charge and the identification of emission ceilings and allocation regulations by each individual member state had led to a shift in the reduction burden to sectors not covered by emission trading. Over and above this, the current regulations for new installations and decommissioning make for distortion and make climate protection unnecessarily expensive. To this extent the planned transition to auctioning of all rights should be expressly welcomed.

For the remaining free allocation of rights, harmonisation is indubitably preferable to the wide spectrum of different national allocation regulations. Nevertheless, even given EU-wide standardised regulations, the additional complexity this adds to the system must be weighed carefully against the benefits of the alleged prevention of distortion of competition. It seems safe to assume that when the EU-wide benchmarks are drawn up, the pressure from specific interest groups that previously focused on national governments will simply be transferred to the European Commission. Product benchmarks may also appear simple at first sight, but problems can arise in enforcement, if data is required which was not gathered for former emissions reports. The question as to the cost-benefit ratio is all the more acute since these regulations apply only to the transitional period, and industry too will have to adapt to the system of purchasing rights in the medium term. The revision clause should be applied as sparingly as possible. It would in particular be desirable to ensure a differentiated approach, which would take into account the terms of competition, which vary from branch to branch. In this context, the SRU welcomes the fact that the European Council at its 2008 spring summit confirmed the line of the European Commission, which entailed according priority to the conclusion of a post-2012 international climate protection agreement; any carbon leakage measures would only be stipulated should this agreement then fail (EU Council 2008, p. 12).

3.5.4.4 Scope of the emissions trading directive

Criteria to be used to select the scope

191. The inclusion of additional greenhouse gases, sectors and activities should basically be welcomed on the grounds of efficiency (MICHAELIS 1997). To review the practicability of this move in individual instances, the following list of criteria was drawn up within the scope of the review process (cf. WARTMANN et al. 2006):

- Monitoring: It should be possible to determine the pertinent emissions precisely enough at an acceptable cost.
- Attributability: It should be possible to clearly attribute the emissions in question to an individual polluter.
- Relevance: The emissions in question should constitute a relevant percentage of the total greenhouse gas emissions in the EU.
- Transaction costs: The transaction costs entailed, which depend in particular on the number of emissions sources and the complexity of the processes involved, should be of an acceptable level when compared to the environmental benefits achieved.

– Alternative regulatory options: The costs of integration in emissions trading should be lower than the costs of alternative regulatory options (in particular tax-based solutions).

Including additional greenhouse gases

192. In 2005, some 82.4 % of EU-wide greenhouse gas emissions (measured as CO_2 equivalent) were accounted for by CO_2. The remaining 17.6 % was accounted for mainly by methane (CH_4) and nitrous oxide (N_2O), each of which represent 8.1 % of total emissions, while the remaining 1.4 % of emissions includes hydrofluorocarbon (HFC), perfluorated carbon (PFC) and sulphur hexafluoride (SF_6). By far the largest polluter is the agricultural sector, which generates almost half of non-CO_2 emissions, in particular CH_4 emissions from livestock farming and N_2O emissions arising in conjunction with fertilisers (WARTMANN et al. 2006; EEA 2007a, p. 87 ff.).

193. From the point of view of relevance, the inclusion of methane and nitrous oxide emissions from agriculture could be considered. By contrast, the proposed directive provides only for N_2O emissions from the manufacture of nitric acid and ammonia to be taken into account, along with PFC emissions from the manufacture of aluminium (Annex I). In the view of the Commission, this would increase the emissions trading segment of the second trading period by about 100 Mt CO_2-equivalent (or roughly 4.6 %) (European Commission 2008e).

The decision not to directly include these gases generated in the agricultural sector in emissions trading would appear reasonable in terms of the other criteria listed above, since in the view of the SRU this would indeed make the emissions trading system enormously more complex. The review of the option of introducing a levy on emissions would appear more effective in this context. In the case of methane emissions, any levy of this sort would have to take as its starting point the specific emissions factors involved in agricultural production methods. Taking into account nitrous oxide emissions would be implicit in the nitrogen surplus levy already recommended by the SRU in the past (SRU 2004, Section 4.2.3.2).

Exemption for small-scale incineration plants

194. Currently, incineration plants with a heat output of over 20 MW are included in emissions trading (with the exception of plants used to incinerate hazardous waste and domestic waste). In view of the above criteria, doubts must be voiced as to whether or not a positive cost-benefit ratio can be achieved even now for a number of plants already covered by the emissions trading system, given that the definition looks only at the capacity of the plant. Thus, during the first allocation period in Germany, 31 % of the plants accounted for only 0.5 % of emissions rights. Across the EU as a whole, 14 % of all plants accounted for only 0.14 % of emission rights (MATTHES and ZIESING 2006; European Commission 2008e).

Accordingly, in order to cut transaction costs, the proposed directive provides for incineration plants with a heat output of up to 25 MW to be removed from the system of emissions trading, provided their annual emissions are less than 10,000 t CO_2, and provided comparable reductions can be achieved by means of other measures (Article 27). In the EU-wide trading system, this would entail removing from the system some 4,200 plants, which together generate 0.7 % of system-wide emissions (European Commission 2008e). There are no plans to include incineration plants with heat outputs of less than 20 MW irrespective of their levels of emissions.

Including air traffic

195. Although air traffic currently accounts for only about 3 % of EU-wide emissions of greenhouse gases, there is a sharp upward trend (European Commission 2006g). The greenhouse gas emissions accounted for by the EU's share of international air traffic, for instance, rose by 7.5 % between 2003 and 2004 alone, while the cumulative growth recorded between 1990 and 2004 was of the order of 87 %. If this trend were to continue it would be safe to assume that by 2012 air traffic would wipe out more than one-quarter of the reduction in greenhouse gas emissions which the EU must achieve under the terms of the Kyoto Protocol. Emissions caused by air traffic also have a far greater impact on the climate than CO_2 emitted at ground level, since in addition water vapour, NO_x and particles are emitted, and the emissions cause the formation of condensation trails at a great height, which influences cloud and ozone formation. Although uncertainties persist as to the precise contribution of air traffic, it is thought that two-thirds of potential reductions could come from avoiding condensation trails and cirrus clouds alone (ANDERSON et al. 2007, p. 13 f; IPCC 2007c, p. 187 f; LUCAU 2007, p. 4 ff.; WIT et al. 2005, p. 25 ff.; CAMES et al. 2004, p. 27 ff.). On the other hand, the air traffic sector still offers significant potential to cut emissions by optimising routes and ensuring that aircraft fly at higher capacity, as well as improved communication, navigation and monitoring systems, the optimisation of engines and improved aerodynamics (CAMES et al. 2004, p. 120 ff.). The European Commission proposed in 2005 that air traffic be included in emissions trading (European Commission 2005c). Building on this, the Commission then submitted a proposal for a pertinent directive to include air traffic in the system of trading in greenhouse gas emissions certificates within the Community (European Commission 2006g), which included the following salient points:

- The system would apply as of 1 January 2011 to all flights between EU airports (including domestic flights) and as of 1 January 2012 also to all flights taking off from or landing at EU airports. The proposed regulation exempts state aircraft, non-instrument flights, sight-seeing flights, test flights, training flights and rescue flights, as well as flights of aircraft with a maximum take-off weight of less than 5,700 kg.

- The aircraft operator would be required to obtain the relevant certificates, whereby operators (including operators based in non-EU member states) would be managed at the level of the individual member states.
- The total number of certificates to be distributed would be determined on the basis of the average air traffic emissions during the period 2004 to 2006.
- A percentage of the total number of certificates still to be stipulated would be auctioned, while the remainder would be allocated free of charge to aircraft operators in line with a harmonised, EU-wide procedure.
- Emissions for which certificates must be submitted would be calculated on the basis of fuel consumption multiplied by a standard emissions factor in line with the 2006 IPCC guidelines, whereby the emissions factor for biofuels is zero.
- The new trading system would be linked to the existing trading system such that aircraft operators can also acquire emissions certificates from other sectors involved in the EU trading system.
- By the end of 2008 the Commission will present a proposal for inclusion of emissions of nitrogen oxide caused by air traffic.

With the exception of the Hungarian Environment Minister, the Ministers of the Environment of the EU member states noted with approval the proposed directive on 20 February 2007, whereby criticism was voiced from the point of view of competition, that flights outside the borders of the EU would only be included in the system one year later (ENDS Europe DAILY, 21 February 2007). Some member states also called for exemptions for flights to areas that are difficult to reach by land or which are particularly dependent on tourism.

196. Within the scope of an initial reading in the European Parliament on 13 November 2007, the proposed directive to include air traffic was in principle noted with approval, although the Parliament called for some provisions to be tightened up (cf. EurActiv, 13 November 2007). The system, for instance, should apply as of 1 January 2011 to all flights taking off from or landing at an EU airport, and the total number of certificates to be distributed should be equivalent to only 90 % of the average emissions over the period 2004 to 2006, whereby one quarter of these should be distributed by auction. The Parliament also called for a doubling of the emissions factor used as the basis for calculations so as to take account of the additional climate impact of air-traffic-related NO_x emissions, and the airlines are to be obliged within the framework of a so-called efficiency clause to make independent efforts to avoid emissions before they are permitted to purchase emissions certificates from other sectors.

These proposals to tighten up the provisions were, however, rejected by the EU Environment Council on 20 December 2007 (cf. EurActiv, 20 December 2007). Instead, the system is to apply to all flights taking off from or landing at an EU airport as of 2 January 2012, and the emissions budget is to be based, as originally planned, on the average air traffic emissions over the period 2004 to 2006, whereby only 10 % of the total certificates available are to be auctioned. The compromise reached by EU environment ministers does not provide for any measures to take into account the detrimental impact on the climate of air-traffic-related NO_x emissions or to restrict the purchase of certificates from other sectors.

197. Given the strong growth in the sector, and its impacts on the climate, the inclusion of air traffic in greenhouse gas emissions trading is in principle to be welcomed. To achieve supra-sectoral optimisation it also makes sense to have unrestricted links between the air traffic sector and the EU trading system for stationary sources of emissions. The compromise achieved by the EU environment ministers, however, remains unsatisfactory on several fronts, in particular the determination of the emissions budget on the basis of the average air traffic emissions over the period 2004 to 2006. This must be criticised as not sufficiently rigorous. While the planned EU-wide harmonised allocation procedure should be welcomed, complete auctioning of rights would have been preferable to the free distribution of certificates because of the problems described above with respect to distributing rights free of charge (cf. Items 170-174). Moreover, the failure to take into account the climate-related impacts of water vapour, NO_x and particle emissions must be criticised. The graduation of take-off and landing fees on the basis of pollutant categories called for in the current debate could also be a good way to complement emissions trading. This could be a starting point for taking into account NO_x emissions, as considered by the European Commission.

A more recent study also warns that 2011 or 2012 is too late to include air traffic in the emissions trading regime because of the dynamic growth in the sector. The authors base their calculations on annual increases in emissions of between 6 % and 7 %. These would have to be cut at the point when the sector is included in the system in order to achieve an ecologically ethical emissions budget, which is then considered to be politically unrealistic (ANDERSON et al. 2007). In this context, attention is also drawn to the counterproductive impacts of infrastructure subsidies for air traffic (EurActiv, 4 September 2007; UPHAM et al. 2007).

198. In its current form the proposed directive, if adopted, provides for air traffic to be dealt with along the same lines as industry with respect to the allocation of emissions rights (European Commission 2008e). Thus, the initial percentage of certificates being auctioned, of 20 % in 2013, is to be raised in line with a linear model, reaching 100 % by 2020 (cf. Item 187). This regulation appears sensible. Given the rate of growth of air traffic, an introduction of these provisions prior to 2013 would nevertheless be welcome.

Including shipping

199. The European Commission also plans to include shipping in emissions trading. Here it is taking up a recommendation laid out in a study it commissioned (ENDS Europe DAILY, 17 April 2007; CE DELFT et al. 2006). Currently, shipping is responsible for some 0.5 % of all greenhouse gas emissions in the EU, whereby between 1990 and 2004 a cumulative rise in emissions of some 9 % was recorded (EEA 2007a). Given the low rates of growth of greenhouse gas emissions, the inclusion of shipping in greenhouse gas emissions trading is a less urgent task, it is true, and the alternative of imposing differentiated port dues would be easier to administer. Because of the parallels to air traffic, however, it would appear possible to deal with the open questions. The SRU believes, for instance, that the correct mode of allocating emissions rights, which is seen as one of the main problems, could easily be answered by introducing across-the-board auctioning, such that some results are transferable. The ecological advantage of involving shipping in emissions trading rather than imposing differentiated port dues must be seen in the absolute limit thus placed on emissions. Pertinent regulations for shipping have not, however, been included in the draft emissions trading guideline, since the European Commission sees a need for greater clarification first.

3.5.4.5 Further harmonisation, simplification of enforcement

200. The draft directive also provides for a number of simplifications designed to harmonise enforcement. These include a standardised definition of the term” installation” (Article 3), standardised guidelines on monitoring and reporting (Article 14), an EU-wide standardised verification procedure and an EU-wide procedure for authorising the verifiers (Article 15). These not unimportant detailed regulations should be welcomed, since this can be expected to reduce system-wide transaction costs. In future there is also to be only one EU-wide emissions trading register (Article 19). This too should be welcomed in principle, provided the European Commission provides the pertinent administrative resources in order to avoid problems such as those currently being encountered in efforts to link the EU and UNFCCC trading register (Carbon Finance, 20 February 2008).

3.5.4.6 Linking up with non-EU member states

201. The review process also explored the extent to which comparable systems are in use or planned in non-EU member states, and the extent to which these can be linked up with the EU system (cf. ICAP 2007). A link of this sort is in principle to be welcomed, since market integration reduces the macroeconomic costs of protecting the climate because of the additional options it opens to reduce or avoid emissions, and secondly because this entails lower volatility. The current distortion of competition as compared to industries in non-EU member states too would be ended (SRU 2006, Items 28 to 29). A link of this sort would, however, presuppose certain technicalities, such as mutual recognition of emissions rights, compatibility of the registers, a clear demarcation between the systems to avoid any installations being counted twice, etc. (BUCHNER 2007; EDENHOFER et al. 2007). The European Commission has underlined its point of view within the scope of the draft directive, which is that it will not accept any link-up to systems that use relative (rather than absolute) reduction targets (ENDS Europe DAILY, 18 June 2007). This stance was confirmed by the EU Council at its 2008 spring summit meeting (European Council 2008, p. 13). Thus, apparently with a view to the emerging emissions trading system in the north east of the USA, provision is made for the mutual recognition of emissions rights traded under other systems that use absolute emissions ceilings, "in third countries or sub-federal or regional administrative units" (Article 24a).

202. Another question to emerge within the framework of the review process was the extent to which emissions credits from projects in developing countries and emerging economies (handled by the CDM and JI) should continue to be recognised. In order to retain the pressure to avoid emissions within the EU and the pressure to negotiate outside the EU, the proposed directive makes this dependent on the international community achieving an international climate protection agreement post-2012 (cf. Item 97 f.) and on the reduction targets laid out in such an agreement. Given the current 20 % target, it is only possible to use up the credits already admitted for the second trading period but not traded in during this period (totalling more than one-third of the emissions to be avoided during the third trading period). Should a stricter avoidance target be imposed, half of the additional emissions to be avoided could, by contrast, be achieved in this way. The additional credits, however, will only be accepted if the emissions reductions are achieved in countries that are signatories to the new international agreement. For certain project types and projects in least developed countries, some exceptions are to apply (Article 11a). From the point of view of negotiating strategy this is understandable. In view of the potential for achieving low-cost emissions reductions in developing countries and emerging economies, however, an extension of the CDM/JI activities would have been welcome from a purely economic point of view.

3.5.5 Emissions trading – an upstream approach

3.5.5.1 Introduction

203. In 2002 the SRU proposed an overarching emissions trading strategy, which would have embraced all emissions arising as a result of the use of fossil fuels at the first level of primary energy generation and import (SRU 2002a, Item 473; SRU 2004, Item 48; SRU 2006, Item 6; SRU 2005a, Item 15; SRU 2007, box after Item 151).

The sectoral approach of the current system is a significant weakness, since it embraces only a section of national emissions. If the state intended to pursue a cost-minimising climate policy with this approach, it would have to be aware of the costs of avoiding emissions in all sectors to enable it to decide on the optimum break-down of the emissions budget between sectors covered by emissions trading and sectors outside this system (BÖHRINGER et al. 2006). The necessary additional measures, listed in the national climate protection programme (Deutscher Bundestag 2005) and in the newly adopted energy and climate programme (cf. Section 3.3.4), regularly record lower effectiveness and higher macroeconomic costs (lower efficiency). Thus, the measures laid out in the 2005 programme have proved largely ineffective. Of the envisaged 15 Mt per annum, the European Commission considered 11.6 Mt CO_2 per annum (or 77 %) to be insufficiently substantiated, and (in line with the share of total emissions accounted for by the sectors embraced by emissions trading) 5.4 Mt CO_2 per annum were subtracted from the emissions budget so as to at least not entirely preclude the achievement of Germany's targets under the Kyoto Protocol (European Commission 2006b, p. 10 ff; Deutscher Bundestag 2005, p. 4).

The planned inclusion of air traffic and shipping in emissions trading would de facto be a first step towards a more comprehensive and overarching regulation. It would then be logical to have a transition to a more upstream model, which raises the fundamental issue of whether or not it makes sense to progressively include more and more sectors in greenhouse gas emissions trading (vehicles, aircraft, ships, perhaps white certificates for final energy consumption), which would mean that the interplay between the various sub-systems would become more and more complicated and the complexity of the overall system would be hugely magnified. The inclusion of other sectors should then be considered as a transitional strategy leading towards an upstream model.

3.5.5.2 Basic functionality

Approach

204. In contrast to the current system of emissions trading at sectoral level, an upstream model targets the level of producers and importers of fossil and carbon-based fuels, meaning that significantly fewer businesses would have to be recorded and monitored. It is not the direct emissions of carbon dioxide from any one production unit that are recorded, but the carbon traded (so-called fuel certificates). This form of emissions trading thus targets:

– Refineries: Recording of all oil products along with the oil content thereof (around 104 plants throughout Europe, REINAUD 2005)

– Oil importers: Recording of oil products imported into the EU

– Gas trade: Recording of market sales of piped gas and liquid gas

– Coal trade: Recording of EU-wide coal production and trade (2005: Anthracite and lignite consumption of 769.4 million tonnes, of which 28.2 % was imported).

All businesses offering fossil fuels for sale must provide evidence of emission rights for the carbon they sell on the market, up to a ceiling set by the state – which is possible given the proportional correlation between carbon content and the carbon dioxide emissions resulting from combustion. Rather than recording and restricting total emissions for the sector in question, the system restricts the total carbon sold (seen as potential emissions). This is not, however, linked to any absolute restriction on the quantity of primary energy that can be sold, since the calorific value of fossil fuels depends not only on the carbon content but also on the percentage of other combustible materials contained.

Incentives

205. Depending on the number of carbon dioxide emissions rights, there is an incentive for producers and importers of fuels to substitute fuels. Substitution processes involving different fossil fuels to minimise the percentage carbon content of primary fuels are thus possible. Moreover, fossil fuels can be replaced by fuels based on renewable raw materials or by other renewable energies. In contrast to the current system of emissions trading, the energy-related carbon dioxide emissions arising as a result of the production of renewable raw materials are taken into account in the upstream model of emissions trading. Neither system records any emissions that may be caused by changed land use systems (SRU 2007). Economic incentives of the instrument are triggered by the artificially created shortage of overall carbon sold as part of fossil fuels. Basically, this will lead in the short term to a reduction in the supply of primary energy. The tradability of emissions rights, however, allows producers to maintain an optimum fuel production and marketing system in terms of volume and structure, in line with prevailing market conditions. The individual producers and traders are not forced directly by the tradability of fuel certificates to reduce the fuel they offer in line with the fuel certificates distributed to the business. By buying and/or selling the certificates they can in fact adjust far more flexibly to the shortage created at administrative level. Similarly to the situation in the current system of emissions trading, the tradability of fuel certificates means that those sellers for whom sales reduction and substitution represent the lowest production and procurement costs will cut the carbon contents of the fuels they sell most drastically. The fuel certificates thus released can be acquired by sellers for whom the costs of adjustment would be higher.

The impact of price signals in upstream emissions trading does cause an adjustment response in all sectors of the economy, in contrast to the current trading system. Through trading, those businesses determine the price of emissions rights that can most cost-effectively reduce the sale of fossil fuels or substitute other fuels for fossil fuels. This price is passed on to all production sectors and households such that all sectors are given an identical price signal in line with the minimum costs of avoiding carbon content. Sectoral trading systems do not allow for this broad-based cost-sharing and thus force the actors within the trading sectors to undertake more complex and costly measures to avoid generating emissions. Consequently, the overall macroeconomic costs and the price impacts of the partial trading system rise, in the case of Germany several times over (BÖHRINGER et al. 2006).

Passing on the costs of adjusting the range of fuel on offer to downstream industrial and private consumers is inherent to the system and is an intended impact (SRU 2006, Item 5f). The costs of this instrument are thus borne, via the price signals for primary fuels, by *all* energy consumers in line with their share of consumption of the primary fuel in question or of the goods produced using the primary fuel. At the next level of production, the higher final energy costs will bring about a reduction in the maximum profitable production quantity, which will entail relative price rises on the market for final products with a concomitant reduction in demand in terms of volume. In the medium term, both fuel supply and demand will adapt to the new situation (through fuel substitution, energy efficiency gains, drop in demand for energy-intensive goods). The price signals initiated by emissions trading will trigger on both sides of the market an impetus to innovate and thus cut costs, which will in the long term help ensure that targets are achieved in a dynamic and efficient way. The rise in the market price of energy as a final product should then flatten off in the course of time, whereby the dynamics of price adjustment will depend on the rate of technical progress triggered.

Distribution impacts

206. The way the costs of fuel certificates are spread across production sectors and final consumers will depend on the relative adaptability of the two sides of the market to the changed costs situation. Whichever side of the market is least able to adapt to price changes because of a lack of cost-effective alternatives will, in the final analysis, bear the brunt of the increased overall costs. Differences in the costs of adjustment will be determined first and foremost by the technology available. The spread of the burden will be determined firstly by the market form and secondly by the existence of alternative technical options. The costs of emissions trading must be borne above all by the consumer in a situation of intensive competition among sellers, because the sellers can as a general rule adjust the volume they offer for sale more rapidly to the higher production costs while the demand side cannot reduce their demand so quickly in terms of volume because of a lack of rapidly available alternatives. By contrast, the main burden of fuel certificate trading on markets on which few actors compete against one another tends to be borne by the businesses (HEISTER et al. 1990). Because of their higher market share they cannot simply gear the volume they offer for sale to the prevailing market prices in order to maximise profits, but have to take into account the fact that any reduction in the volume they offer for sale will raise fuel prices and thus have a direct impact on the demand for the product and on the market price, as well as on the future market share of current and potential competitors. In order to maximise profits in this situation, the individual oligopolist will reduce volumes by less than would be the case on a market with greater competition (VISCUSI et al. 2005, p. 174 ff.).

Two fundamental options exist for the initial allocation of fuel certificates. Alongside the distribution free of charge in line with a predetermined key, it would also be possible to auction the emissions rights. The system selected does not really have any influence on the incentive impact of the system, but is politically highly controversial against the background of the need to distribute a huge volume of assets to a very small number of businesses. Distribution procedures whose result can be influenced by businesses in the form of certain production-related or investment-related decisions will also lead to efficiency losses. Thus, every effort must be made from the outset to avoid a struggle for the distribution rights between businesses covered by the emissions trading obligation. This can only be assured by auctioning all fuel certificates. The revenues raised by auctioning the rights can be used to achieve additional efficiency gains by reducing taxes and levies entailing particularly high additional macroeconomic costs (SRU 2006).

Low administrative costs

207. Since an upstream emissions trading system, in contrast to the sectoral system, will be required to cover a significantly smaller number of businesses (some 1,000 businesses rather than the current 11,400 installations throughout the EU currently covered), and since no noteworthy delimitation problems can be expected, the costs of allocating emissions rights and the monitoring costs can be expected to be significantly lower. It seems safe to assume that in view of the comparatively small number of businesses in an upstream system and the comparatively simple indicators that can be used to calculate the carbon content of fuel traded, the costs will not be higher than those of the current system (which records only about 60 % of total emissions in Germany). This does not impact on the political difficulties of introducing a system of this sort, and the differentiated implementation thereof (for example with respect to the import of oil products).

3.5.5.3 Realisation

Approaches in the trading sector

208. For upstream emissions trading, there are basically three possible approaches:

– The raw materials extraction level (coal mining, oil and gas extraction)

– The processing level (refineries, upgrading)

– Transport and distribution of fuels.

At each of these steps, the release of carbon dioxide can be monitored by making it obligatory to notify the relevant bodies of carbon inputs or outputs. In this way fuel certificates would allow a refinery to process a quantity of oil which, when used at a later date, will release a corresponding quantity of carbon dioxide. A certificate based on the output of the refinery would allow the plant to sell a certain quantity of the processed product which, when further utilised, would liberate the quantity of carbon dioxide for which emissions rights are available. The same options apply to coal and gas.

The option selected will depend on the administrative handling and on the suitability of the various options to embrace as high a percentage as possible of all potential carbon dioxide emissions. It must be taken into account here that the more closely industry is involved at the level of raw materials extraction, the more complete the recording of emissions will be. With respect to the administrative handling and monitoring burden of the system, the number of businesses that have to be included in the system must be taken into account, as must the volume of production data and the time and effort involved in procuring these. The system should target the levels where it is possible to estimate the later emissions with adequate precision. Taking into account these criteria, it would be possible to record the relevant data at the following points in the value chain (HARGRAVE 1998; 2002):

– Refineries: A large percentage of fuel used in Europe is produced here. The number of businesses, by contrast, is manageable from an administrative point of view (104 plants). It would make sense to record the raw materials inputs of refineries, since this would involve recording the carbon contents of a small number of inputs (oil, liquid gas) rather than that of a wide range of refinery products. The administrative costs for industry and the state would be significantly lower, and emissions would be recorded far more completely, since this system would also take into account the fuel consumed by the refineries themselves.

– Oil importers: The refinery products imported by these businesses would not be included in data recorded for European refineries.

– Operators of gas pipelines: Emissions released at the level of gas transport (own consumption in the compression plants) can be taken into account to an adequate degree here. The relevant data to determine potential emissions exist in the form of the energy contents of the gas transported, which correlates well with the carbon content of the gas. Duplicate recording of multiple transport can be prevented by making notification obligatory only for supplies from primary sources of gas and processing plants but not for transport from other networks.

– Gas processing plants: Recording the carbon content of liquid gases (ethane, butane, propane, heavy oils). These gases are used both to generate energy and as process gases in the chemical industry and must thus be recorded separately. It would be beneficial to take the processed product as the basis for recording, since the plant operators can provide precise information on the carbon content of the final products, which is not the case for the relatively heterogeneous inputs. Here too, ideally standardised procedures ought to be developed so as to incorporate the plants' own consumption in emissions trading. Exports and imports of liquid gas too must be taken into account.

– Coal upgrading plants: The emission potential of imported coal processed in Europe can be recorded here.

– Coal mines and opencast lignite mines: A large percentage of the coal used in Europe in also mined in Europe (over 70 % in 2005) (EURACOAL 2006). The number of mines is likely to be comparatively small, making it relatively easy to obtain reliable data at a reasonable cost. Fuel certificates are not needed to supply coal upgrading plants since the processing plants must submit evidence of the pertinent number of certificates for their final products.

As a transitional solution it would be conceivable to adopt a "hybrid approach", in which the existing system would be combined with upstream emissions trading. Initially only those sectors not currently covered by emissions trading would be recorded at this level, while the regulations would remain unchanged for those sectors already covered by the EU Emissions Trading Directive (HARGRAVE 2000; SORRELL 2006). In the scope of a second stage, however, the latter would then be transferred to the upstream level of trading and the systems integrated. For the transitional period, this would however entail separate accounting procedures for energy sold at the points listed above, so as to avoid any duplication. That would mean that buyers covered by the existing emissions trading directive would have to be excluded from the obligation to obtain certificates at the above points, because under the current system they are obliged to produce the certificates downstream. Against this background it is worth considering whether it might not make more sense to overhaul the entire system in a one-off move.

Taking into account fossil fuels not used to produce energy and exports

209. A percentage of fossil fuels (2004: 7.4 % of primary energy sold; IEA 2006a) is used in manufacturing in the chemical industry as raw materials for a number of products (oils, waxes, asphalt, liquid gases such as butane and propane for use in the chemical industry). During production, the carbon content is sequestered in the final products for a period of time that can only be roughly estimated. There is a greater temporal discrepancy between the time point of the compulsory acquisition of certificates and the emission than is the case with fuels. It would be conceivable here to issue credits for the percentage of non-energy related carbon recorded in the past in greenhouse gas inventories, which would then be brought into line with actual percentages at regular intervals (HARGRAVE et al. 1998, p. 7 f.). Given the relatively low percentage involved, however, it must be asked whether or not this is really necessary.

To avoid any double recording of liquid gases for refinery processes, these would have to be excluded from emission trading at production level. The percentage of liquid gases supplied from plants to refineries for gas processing could conceivably be exempted from emissions trading. The potential emissions of these fossil raw materials would then be taken into account in the refineries. Finally the system would have to avoid double recording of intermediary products traded between refineries. In line with the above procedure either the manufacturer or the recipient would then be obliged to produce the appropriate number of fuel certificates.

A percentage of oil imports include already processed oil products (2004: EU-15 almost 30 %) and would thus have to be incorporated in emissions trading when imported by importers. The situation with exports still needs to be clarified. Since emissions outside the EU become relevant for targets, they would have to be exempted from emissions trading in line with the country-specific emissions targets.

Taking into account carbon capture and storage and carbon sink projects

210. In upstream emissions trading, restrictions are already placed on the volume of potential emissions arising from the use of fossil fuels. This would not take into account either the CO_2 capture and storage described in Chapter 3.6 or the carbon sinks generated by (re-)afforestation projects. However, the same approaches that are being discussed in order to incorporate CCS in the current emissions trading system could be transferred to the upstream emissions trading model. It is, for instance, possible to issue emission credits for the successful and guaranteed secure storage of carbon dioxide, and to permit trade in carbon sink certificates of this sort in upstream trade. In a system of this sort both emitters and operators of carbon sinks are covered by emissions trading regulations. Guaranteed net carbon dioxide storage volumes generate additional emissions certificates, which can be sold by the operators of carbon sinks on the certificate market. Carbon storage operators would have an incentive to acquire emissions from installation operators in order to sell the allocated carbon sink certificates at a profit on the market for emissions rights (verbal statement issued by the German Emissions Trading Authority, DEHSt, 11 July 2007).

3.5.6 Conclusion

211. During the initial period, emissions trading suffered as a result of the high level of complexity and inefficiency of the system caused by individuals seeking to defend their own interests. The NAP II now adopted has brought about significant improvements within the existing framework. The revision of the emissions trading directive now presented has also launched more than welcome enhancements for the European framework with the standardised emissions budget, which is calculable in the long term, and the step-by-step introduction of complete auctioning as well as other intended simplifications. With respect to the transitional regulation for industry, although harmonisation is definitely preferable to regulations that vary from one member country to another, the additional complexity this involves for the system has to be weighed against the probable benefits. The same applies to the planned exemptions to be granted to industries likely to move their facilities to a third country; sparing use should be made of this option. It is now crucial to prevent the proposal being watered down in the course of the legislative process.

While the introduction of auctioning (if successful) would eliminate a major weakness in the current system, the sectoral approach has been retained. For this reason the medium-term recommendation is a transition to an integrated upstream emissions trading concept which would record all energy-relevant emissions for all sectors. This would then prevent measures from missing their mark, as has happened in the past. A series of (hitherto fairly ineffective) measures of the climate protection programme and the corrective intervention on the part of the European Commission would then no longer be necessary. An emissions budget appropriate in the face of the climate problem facing us is essential in either case. Additional measures to mobilise special innovation potentials and overcome specific obstacles to innovation and adjustment (from maximum consumption standards to product designation) continue to be possible and rational within a system of this sort, provided they do not entail major cost distortions within the system. In administrative terms the system seems unlikely to be more complicated than the current one.

3.6 Emission reductions through carbon capture and storage

3.6.1 Introduction

212. The abbreviation CCS (carbon capture and storage) is the term used to cover the sequestration and storage of carbon dioxide from power stations. The SRU has evaluated numerous studies on this subject, including publications by the Forschungszentrum Jülich, Wuppertal Institute, Federal Environment Agency, Federal Institute for Geosciences and Natural Resources, and the IPCC (DIETRICH 2007; Federal Ministry of Economics and Technology, BMWi et al. 2007; LINßEN et al. 2006; Wuppertal Institut et al. 2007; RADGEN et al. 2006; Federal Environment Agency, UBA 2006b; IPCC 2005b; IPCC 2005a; CRAMER 2007; MENZEL 2007; DÖLL 2007; KUNDZEWICZ 2007; UYTERLINDE et al. 2006; CONINCK et al. 2006; IEA 2005; IEA 2007b; IEA 2007d). The following sections will look at the individual steps involved, from capture to transport and storage, assessing each from the viewpoint of technical options, availability, risks, problems and costs.

3.6.2 Development status of CCS technology

3.6.2.1 Capture

213. There are three main technical options for capturing CO_2 released during combustion:

- Post-combustion (CO_2 is sequestered from the flue gas flow, CO_2 flue gas scrubbing),
- Oxyfuel (combustion with pure oxygen),
- Pre-combustion (gasification combined with gas and steam turbine plants).

In the post-combustion process, carbon dioxide (10 to 14 % CO_2 in the flue gas) is captured from the flue gases after combustion, in a scrubber using an absorption process based on chemical solvents like amines. In principle the technology is available, but no experience has yet been gained with large-scale trials. The process is also costly and energy-intensive. One advantage is that older power stations could be retrofitted to make use of this process, although retrofitting does entail major performance losses.

The second option, oxyfuel, involves combustion using pure oxygen such that the flue gas contains practically no nitrogen and is strongly enriched with carbon dioxide (about 70%). This process requires an air separator through which air is passed to remove nitrogen prior to combustion. This means that the process can only be used in new power stations. The inputs required to plan the installation and the energy consumed by the technology are still massive.

The third option, pre-combustion, requires an entirely new power station technology, based on gasification combined with gas and steam turbine plants. The fuel is gasified with pure oxygen (meaning that the nitrogen must again be removed by an air separator), producing carbon monoxide and hydrogen. These gases are then converted to carbon dioxide and hydrogen using water vapour. From this mixture the carbon dioxide is captured using membranes. The subsequent combustion is then a pure hydrogen combustion, which generally uses a gas turbine. The technology is highly complex, using ground-breaking technical procedures and probably only makes sense in the context of a large-scale hydrogen economy. Coal-fired power stations based on this technology offer efficiency rates of over 40 %.

3.6.2.2 Transport

214. The carbon dioxide captured either after combustion (post-combustion, oxyfuel) or before combustion (pre-combustion) should then be stored in geological formations, which entails transporting it to the storage sites.

Before it can be transported carbon dioxide must first be compressed, so that it can be transported as a super-critical liquid (e.g. at a pressure of 74 bar and a density of 1,100 kg/m^3). Transport per se is only economical if ships or pipelines are used. No experience has been gained with these processes in Europe. The USA and Canada have a pipeline network of over 3,000 km, which is used for enhanced oil recovery, in which carbon dioxide helps operators recover more oil from oil fields. Current experience indicates that transport by ship is only economical for distances of over 1,000 km, so that in Germany pipelines would be indicated. Initial investments are thus extremely high. The costs of transport are put at 10 % of those entailed for the entire CCS chain. It would only make sense to establish a CO_2 transport structure once the technologies for CO_2 capture in power stations were marketable, which is not yet the case.

3.6.2.3 Storage

215. The carbon dioxide must then be stored securely for a long period. In principle the following options are conceivable:

– Former gas and oil fields

– Oil and gas fields during exploration

– Underground aquifers and deep oceans

– Unused coal seams

– Use as inputs in the chemical and food industries

– Mineralization as stone.

The international state of the art procedure is to store carbon dioxide in former gas fields and is, for instance, used as interim storage for natural gas. There is, however, no long-term experience as would be needed for the storage of carbon dioxide. Storage in underground aquifers would take place at a depth of between 900 m and 1,000 m where the aquifer has no links to any other aquifers. Deep ocean storage is currently being tested, but almost all experts reject the idea. Storage in old coal seams would force out methane, which on the one hand could be used, but on the other could worsen the greenhouse effect as a result of uncontrolled release of gas.

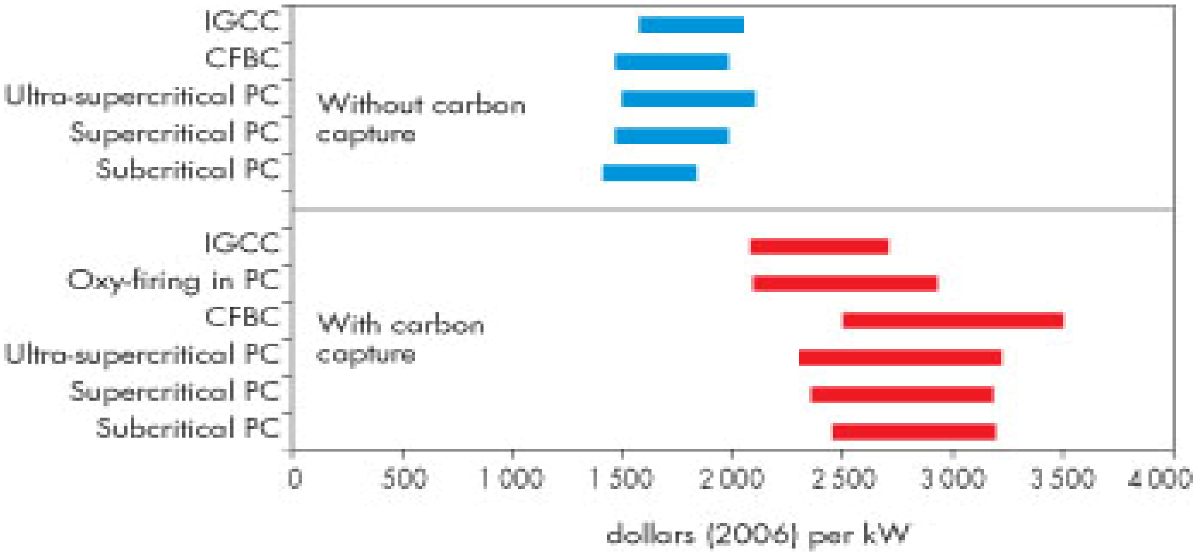
For Germany only former gas fields and deep aquifers would be viable options at present. Estimates of storage potential vary widely, from 30 to 130 years. Estimates do, however, indicate that CCS does not offer a long-term solution to the problem.

3.6.2.4 Costs

216. To date the costs are high, and it is uncertain if and when the technologies will be marketable. The International Energy Agency (IEA) reckons that the investment and power generation costs would be up to double those of a modern coal-fired power station without CCS, depending on the procedure adopted (see Fig. 3-5). Table 3-12 lays out the costs of avoiding CO_2 emissions presented in two other studies for different types of power stations at different time-points. For 2020 they put the costs of avoiding CO_2 emissions at between 38 and almost € 64 /t CO_2. The IEA estimates the range for new power stations at between € 24 and € 72 /t CO_2 (USD 30 to 90/t CO_2) for capture and € 8 to € 32 /t CO_2 (USD 10 to 40/t CO_2) for transport and storage (with the exception of enhanced oil recovery). Overall, the best case scenario assumes costs of € 40 /t CO_2 (USD 50/t CO_2). Retrofitting a coal-fired power station with CCS technology is, however, significantly more expensive, and the IEA puts the costs at between € 53 and € 97 /t CO_2 (USD 66 to 122 /t CO_2) (IEA 2007d, p. 218 ff.).

Figure 3-5

OECD Coal-Fired Power Plant Investment Costs



Source: © OECD/IEA, 2007, World Energy Outlok

Table 3-12

Cost of avoiding CO_2 emissions in CCS power stations (including transport and storage) in euro/t CO_2 for various fuel price scenarios and start-up time-points

Time-point of start-up	2020	2030	2040	2050
Scenario I (EWI 2005)				
Gas-fired power station, gas and steam	58.20	51.50	45.80	47.80
Anthracite-fired power station, steam	42.00	39.80	38.80	39.50
Anthracite-IGCC	38.20	36.60	36.10	36.60
Average	46.13	42.63	40.23	41.30
Scenario II (DLR 2005)				
Gas-fired power station, gas and steam	63.70	58.30	51.90	54.20
Anthracite-fired power station, steam	43.20	42.50	40.40	40.70
Anthracite-IGCC	39.20	38.10	37.40	37.90
Average	*48.70*	*46.30*	*43.23*	*44.27*
Fuel price scenarios: EWI 2005: median prices for the period 2020 to 2050: gas 4.87 €/GJ, anthracite 1.98 €/GJ, lignite 0.83 €/GJ DLR 2005: median prices for the period 2020 to 2050: gas 7.20 €/GJ, anthracite 2.64 €/GJ, lignite 1.30 €/GJ Acronyms used: IGCC: Integrated Gasification Combined Cycle. A rate of CO_2 capture of 88 – 90 % has been assumed.				
Source: Wuppertal Institut et al. 2007				

These costs should also be seen against the background of the falling costs of renewable energies (VIEBAHN et al. 2007b; VIEBAHN et al. 2007a). In the meantime, several CCS projects around the world have been halted because of the costs. In Norway a gas-fired power plant project of Shell and Statoil-Hydro near Trondheim has been completely abandoned because of the costs involved. The thermal station planned by the Norwegian government in Mongstad will initially forego carbon storage, i.e. after capture the CO_2 will be emitted (WATSON 2007). In the USA the Department of Energy has halted a CCS project after the costs threatened to double, and has restructured its main research and demonstration programme on CCS (DOE 2008; WALD 2008). Because of the high costs involved, the European electricity sector is lobbying for subsidies.

3.6.3 Conclusion

217. The state of development of the three possible process (post-combustion, oxyfuel and pre-combustion) varies hugely. In economic terms, the oxyfuel and pre-combustion procedures are considered comparatively economical. They can only be expected to be used on a large scale from 2020 onwards, however. It must also be taken into account that CO_2 capture in power stations reduces efficiency rates by at least 10 percentage points. Investment and electricity generating costs are almost doubled. The CCS technology also breaks new legal ground in many areas. For instance an international legal framework will be needed for transport, storage and monitoring. An initial proposal has been made within the scope of the EU's second energy package (Item 100) (European Commission 2008d).

Although the above studies of the Forschungszentrum Jülich and the Wuppertal Institute see CCS as a way of bridging the gap until renewable energies are able to take over, the age structure of the pool of German power stations makes it a particularly difficult transitional solution. Precisely in this period in which CCS *cannot be expected to make any significant contribution* (i.e. between now and 2020) it is estimated that 40,000 MW of installed capacity will have to be replaced (investment planning until 2012 provides for some 19,000 MW) (Federal Environment Ministry, BMU, 2006, p. 53 f; BADE et al. 2005; LANDGREBE et al. 2003, p. 9). Since the technology will come too late for this wave of renewals (cf. also SRU 2004, Item 36), the only option would then be to retrofit the power plants, which would further raise costs significantly according to the above estimates. In view of the dubious economic efficiency of the measures, in addition to the general question of large-scale feasibility, the strategy of retrofitting would appear to be particularly questionable.

Currently, three pilot projects are being implemented worldwide to investigate the way CO_2 behaves in underground storage sites. No sufficient knowledge is yet available about leakage rates and thus about the long-term security of CO_2 storage. The Federal Environment Agency considers a rate of leakage of < 0.01 % per annum to be realistic, so that 1,000 years after initial storage 90 % of the originally stored gas would still be trapped.

Storage of CO_2 can however, give rise to conflicts with the use of geothermal energy and mine backfill. Experts consider the risks of deep ocean storage to be so incalculable that this option should be entirely discounted. Even further research and development in this area is considered by the authors to be questionable (Federal Environment Agency, UBA, 2006b).

218. All in all it must be asked whether or not CCS is a realistic option in the German context. In global terms, because of the expected worldwide boom in coal-fired power plants it makes sense to continue research into CCS in Germany too. Should it prove successful, this technology could be an exportable product quite apart from the positive impacts its application would have on the global climate. It remains uncertain, however, if and when this technology will be marketable and accepted (with respect to storage), and the retrofitting that would be necessary in the case of German power plants is the most expensive option. Given the influence wielded by the German power-generating industry, it seems safe to assume that climate policy will come under massive pressure if CCS should prove to be uncompetitive or unacceptable in terms of storage. For this reason too it would be a risk to authorise coal-fired power stations today on a large scale with the vague promise of possible retrofitting, which then proves to be uneconomical and unacceptable at a later date. The acute danger posed by climate change is such that climate-protection targets must not be jeopardised by failure to introduce competitive CCS technology. Between 1999 and 2007 more power was again generated from coal (AGEB 2008; SRU 2005a, Item 17), which makes the public criticism of the construction of new coal-fired power stations comprehensible.

The emissions of the power generation sector are regulated by European emissions trading, the whole purpose of which is to generate efficient climate protection solutions by triggering a searching process. The climate efficiency of power generation is thus a function of market conditions (including CO_2 pricing) and not vice versa. The market and emissions trading will then decide whether or not CCS will ever make a contribution to reducing emissions in the German energy mix. If power utilities place their faith in CCS, they will also have to bear the business risk involved. For this reason the proposed directive of the European Commission does not comprise any additional regulations relating to the use of CCS (European Commission 2008a). What is crucial in this respect are stable framework conditions and a credible long-term insistence at political level that the emissions budget be complied with. If the power utilities believe that, should CCS fail, climate-policy concessions will be made, their business risk becomes a (climate) risk for society as a whole that cannot be accepted. To avoid this risk or the alternative of seriously misplaced investment, there is an urgent need to redress the privileged position hitherto enjoyed by power generated from coal in emissions trading. The revision proposed by the European Commission points in the right direction here (cf. Item 187–190).

3.7 Climate protection and adaptation to climate change through appropriate land use

3.7.1 Introduction

219. Climate change and loss of biodiversity are central environmental problems of the 21st century. The interrelations have long been discussed. The United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD) have already emphasised the need to coordinate climate-policy goals and conservation objectives (OTT 2006).

Article 2 of the Framework Convention on Climate Change lays down the goal of stabilising the concentration of greenhouse gases in the atmosphere at a level which prevents a dangerous anthropogenic disturbance of the climate system. This level should be achieved within a timeframe that would give ecosystems time to adapt naturally to climate changes. The Convention on Biological Diversity attempts, among other things, to retain the variability of ecological complexes.

220. Climate and ecosystems are linked by complex interactions, which do not generate any linear cause-and-effect system. They influence one another and generate a complex web of feedback processes. On the one hand ecosystems and their components (soil, water, flora and fauna) are adversely affected by climate change because they are vulnerable to any changes in the climate. But the actual damage sustained by an ecosystem as a result of climate change depends on the specific vulnerability of its components and the scope of climate change.

On the other hand, ecosystems also influence the climate, by acting as a source, sink or reservoir of greenhouse gases (Articles 1 and 7 to 9 UNFCCC). They can act as a reservoir by storing a greenhouse gas or precursor thereof for a period. We talk about an ecosystem acting as a sink if a process, activity or mechanism of that ecosystem removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere and binds it in the ecosystem in the long term. Ecosystems can, however, also become sources of greenhouse gases as a result of trees being blown down in storms, forest fires and the consequences of changing land use, such as ploughing grassland or intensive farming with a high level of fertiliser use.

In order to mitigate the scope and consequences of climate change, it is important to exert an influence on all components of that system. It is important in particular to take into account the consequences of anthropogenic land use change, which can turn natural carbon reservoirs into sources of carbon (MARLAND et al. 2003). At the same time, land use must be brought into line with climate change. Conservation measures and sustainable land management can both reduce the vulnerability of ecosystems to climate change and thus the consequences of climate change for important factors in the natural balance, and have an impact on the extent of climate change as a result of greenhouse gas emissions. Because of this, there can be no clear dividing line between mitigation and adaptation measures, and adaptation measures are combined with measures to mitigate climate change (ALCAMO 2007). The following sections will look at this in more detail.

3.7.2 Impacts of ecosystems as greenhouse gas sinks, reservoirs or sources, and the influence of land use

3.7.2.1 State of the art knowledge about fixation and release of greenhouse gases

221. Carbon dioxide (CO_2) is fixed in ecosystems in the vegetation and in the soil, or is released from these. The processes by which carbon dioxide is fixed or formed in soils in particular has not yet been adequately explained (Federal Environment Agency, UBA, 2006a). Mechanisms such as aggregation, complexation with metal ions, clay-humus coupling and a cold, acidic or anaerobic environment within the soil provide good conditions for fixing carbon, whereas a high level of micro-bacterial activity fosters the release of carbon (FREIBAUER and SCHRUMPF 2006). The extent to which transformation of organic substances in the soil (humus, living and dead soil organisms, roots) into CO_2 is fostered by rising temperatures has not yet passed the stage of scientific debate (KIRSCHBAUM 2006).

There are indications that organic substances in the soil react significantly more sensitively to temperature changes than had hitherto been assumed (SCHULZE and FREIBAUER 2005; POWLSON 2005). Measurements of the organic substance content of various soils in a variety of land use systems (6,000 measuring points) in England and Wales over a period of 25 years (initial measurements made between 1978 and 1983, follow-up investigations 12 to 25 years later) noted a drop in the carbon content almost across the board, irrespective of the land use system in place. Over this period, an average rise in temperature of 0.41°C per decade was recorded (ALCAMO et al. 2007). The average losses of carbon were equivalent to about 8 % of the current annual industrial CO_2 emissions of the United Kingdom (BELLAMY et al. 2005). Some models of the carbon cycle assume positive feedback mechanisms between rising atmospheric concentrations of CO_2 and the levels of carbon released by the soil (POWLSON 2005; SCHEFFER et al. 2006). According to these models, soils might no longer act as a carbon sink but as a net source of carbon by the mid-21st century as a result of climate change. This would mean that significantly higher emission reductions would have to be achieved to stabilise the climate than had previously been assumed (JONES et al. 2005).

Methane (CH_4) is produced in soils by methanogenic bacteria. Methane formation and oxidation are influenced by factors such as the climate, oxygen, soil composition and soil texture. Under anaerobic conditions and with an adequate level of organic substances, soils are the most important sources of methane. This is the case in many wetlands (FLESSA et al. 1998, p. 12 ff).

Nitrous oxide (N_2O) is generally produced by micro-bacterial processes of nitrification and de-nitrification. The formation of nitrous oxide is influenced in particular by temperatures, precipitation (quantity and distribution), the moisture content of soil, the availability of nitrogen and carbon, the soil texture, the pH and the porosity of soil at the location in question (FLESSA et al. 1998, p. 9).

The emission of these greenhouse gases and the potential of land used for agriculture or forestry as well as bogs in terms of acting as a reservoir or a sink depend to a very great extent on the type of land use practised. Carbon dioxide emissions are caused in particular by land tilling and melioration measures. Nitrous oxide emissions are determined primarily by addition of nutrients as a result of the use of nitrogen-based fertilisers in agriculture (FLESSA et al. 1998, p. 9 ff.) and the methane released as a result of the digestive processes of ruminants (CARBOEUROPE IP 2004a, p. 13). These factors, however, always have an impact in conjunction with numerous other factors (FLESSA et al. 1998, p. 11).

222. In addition to the spatial component, the temporal component is crucial in the development of greenhouse gases, because emissions can fluctuate strongly over the years (CARBOEUROPE IP 2004b, p. 40). Since the majority of studies, however, cover only a relatively short period of time (hardly any results of long-term studies are available), the temporal variability of greenhouse gas development has to date been largely ignored.

One problem in deducing the flow of carbon dioxide on the basis of changes in the carbon contents of soil is the unsatisfactory basis of data available. Throughout Germany few figures are available with respect to the carbon stored in soil. It is equally difficult to calculate the carbon content of vegetation: root mass, foliage and soil vegetation have not to date been adequately taken into account in calculations (CARBOEUROPE IP 2004b, p. 36 ff.).

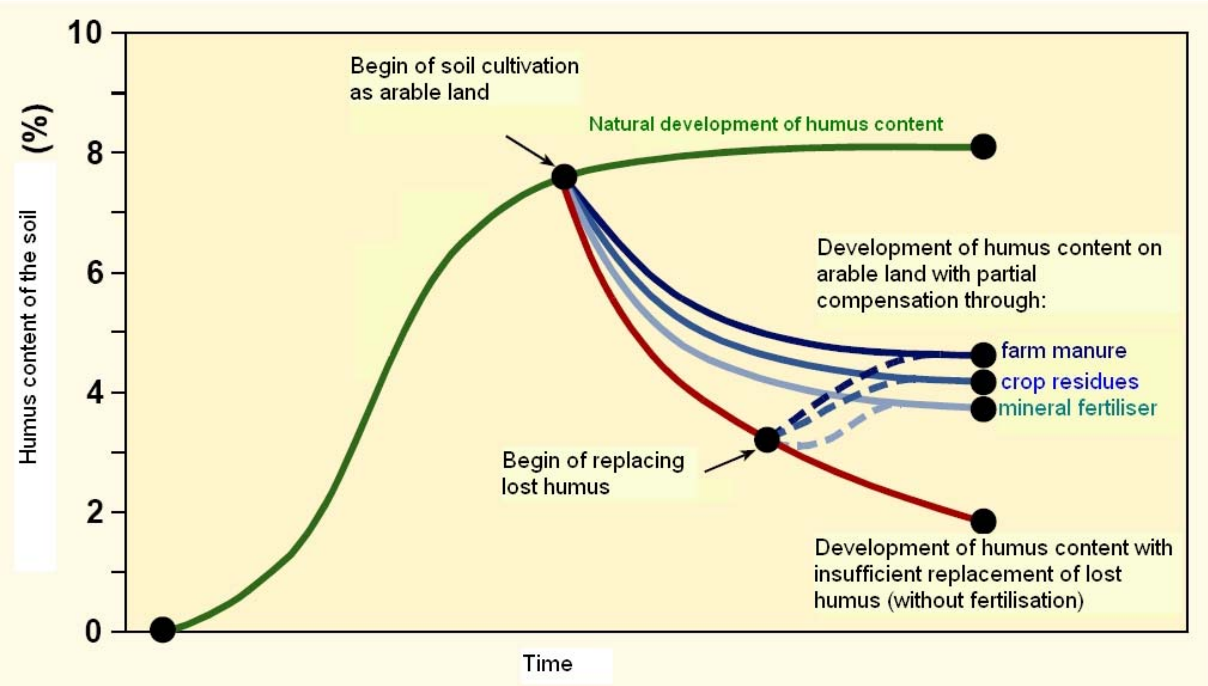
Although it is possible to roughly define the fundamental factors that influence the fixation and formation of the greenhouse gases nitrous oxide, carbon dioxide and methane, not enough research has yet been performed into the processes by which they are produced. These uncertainties are reflected in the results of the measurements of greenhouse gases, which vary widely, in particular with respect to methane (FLESSA et al. 1998, p. 15) and nitrous oxide.

3.7.2.2 Global balance of carbon fixation

223. About two-thirds of terrestrial carbon reserves worldwide (in the soil and in vegetation), which are actively involved in the carbon cycle, are fixed in the soil. In the form of stable humus, carbon can be stored in soils for several thousand years (KÖGEL-KNABNER and LÜTZOW 2005). Soil is a natural carbon reservoir as a result of the decomposition and fixation of organic substances – in soils left to nature a carbon balance develops, influenced by external factors (such as temperature, precipitation, soil structure, nutrient content and vegetation cover). Harvesting processes on farmed land remove nutrients from the soil in the form of plant biomass, and this must be replaced with the help of specific measures. This can take the form of applying fertiliser (mineral fertiliser, farm manure, sewage sludge) or adopting appropriate cropping techniques (e.g. crop rotation). On farmland, a carbon balance can again be established with the help of adequate fertilisation, but at a lower location-specific level (see Fig. 3-6).

Figure 3-6

Development of the humus content in cropland soil over time



Source: GISI 1997

For Europe JANSSENS et al. (2005) determined the carbon balance through sequestration processes (carbon fixation) and the release of CO_2 from soil and vegetation under the current land use regime. Cropland and agriculturally used bogland are generally net emitters, whereas forests and grassland provide temporary carbon sinks and long-term reservoirs. Carbon fixation in cropland, grassland and bogs generally takes the form of the formation of organic substances in the soil, whereas in forests the vegetation dominates carbon sequestration processes.

During the 1990s, the European forests reduced the rise in the concentration of atmospheric CO_2 by 20 % of fossil carbon emissions of the EU, which was roughly equivalent to the emissions of the transport sector. Over the same period terrestrial carbon reservoirs in Europe absorbed between 100 and 200 million tonnes of carbon per annum. By balancing the sink and source functions it can be determined whether European ecosystems act overall as a carbon sink or as a carbon source. According to a calculation of the net carbon balance of cropland, forested land, bog and grassland for 34 European states, Germany is currently ranked in fifth place with a net carbon fixation of + 43.3 g carbon per m^2 surface area per annum. This is primarily thanks to its forests. Only in Austria, Slovakia and Slovenia do forests make a greater contribution than in Germany (JANSSENS et al. 2005).

In European forests and bogs 30 to 40 billion tonnes carbon are stored. A reduction of only 5 % in these reservoirs would be equivalent to the annual carbon emissions of the entire continent from the combustion of fossil fuels. Conversely, the storage of additional carbon from anthropogenic emissions in reservoirs could significantly reduce the increase in concentrations of atmospheric CO2 (JANSSENS et al. 2005).

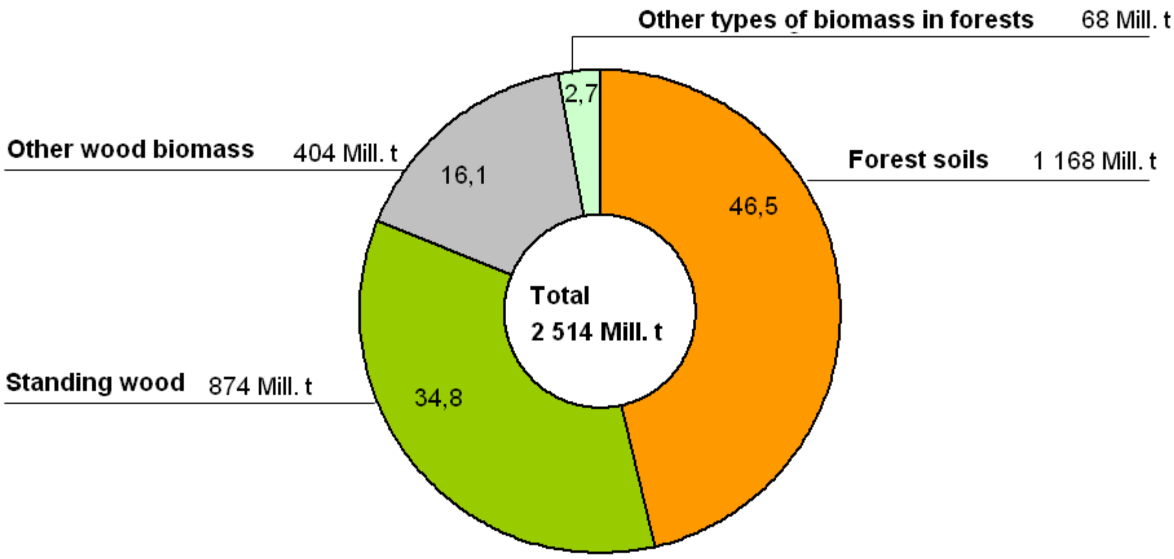
3.7.2.3 Greenhouse gas flows in various terrestrial ecosystem types and the way these are used in agriculture and forestry in Germany

Agriculture and forestry

224. To date Germany's forests have acted as a carbon sink, because more timber has grown than has been harvested. Between 1987 and 2003 the forests in Germany fixed some 75 million tonnes CO_2 every year, which was equivalent to about 3 % of the CO_2 emissions of the Federal Republic of Germany over this period (Federal Ministry of Food, Agriculture and Consumer Protection, BMVEL, 2005). The carbon sink function resulted primarily from the reduced volume of timber harvested and will not be sustainable unless protection regulations are introduced. Currently, economic stimuli are encouraging more intensive forestry practices, which should reduce the existing soil and biomass pool. The rising rate of utilisation of German forests in recent years is reflected in particular in 2005 and 2006 in a downward trend in the reservoir function of forests (Federal Statistical Office 2007b, p. 106). In 2006, 5.5 million tonnes carbon was fixed for the first time in forests, 5.2 million tonnes in the form of wood biomass (cf. Fig. 3-7). A comparison of the figures for 2006 with those for 1993 indicates that the annual rate of carbon fixed in the form of wood biomass for the first time in 2006 was only about a quarter of the 1993 level. In 2004 the volume of timber harvested, at some 54.5 million m^3, was about one quarter higher than the average volume over the preceding ten years (Federal Ministry of Food, Agriculture and Consumer Protection, BMELV, 2006a). The current developments in terms of crude oil and energy prices give us grounds to expect that this trend will continue, and indeed that the pressure of use will lead to a further increase in volumes of timber harvested and in the mobilisation of remaining timber reserves. The use of timber as a source of energy and the use of the forests as carbon sinks and reservoirs are two mutually exclusive climate-protection options. Statements issued by the forestry industry tend to focus one-sidedly on the former option. It is, however, indispensable to weigh up the pros and cons of both options in order to optimise the contribution that forests can make to climate protection. Another option is to fix CO_2 in timber products. The processing of timber leads to a significantly longer-term impact. The use of timber as a material also replaces the use of energy-intensive products such as cement and aluminium as materials.

Figure 3-7

Carbon balance in forest ecosystems in Germany in 2006



Source: Statistisches Bundesamt 2007b

The extent to which temperate forests act as a source of greenhouse gases is not a constant, but is affected by temporal parameters such as climatic changes and changes in the nitrogen input. The latter factor has direct impacts on emissions of nitrous oxide (N_2O) for instance (FRITZ 2006, p. 185). Inputs of nitrogen compounds in forests have remained at a consistently extremely high level over the last few years. As a result of industry, transport and agriculture, almost all 76 Level II long-term observation areas in forests across the country exceed the critical loads for nitrogen and acid inputs (Federal Ministry of Food, Agriculture and Consumer Protection, BMELV, 2006b, p. 40). At these locations increasing quantities of nitrous oxide are produced and released.

SCHULTE-BISPING et al. (2003) estimate that the average nitrous oxide emissions of forests in Germany are 0.32 kg N/ha per annum, while BUTTERBACH-BAHL et al. (2002) put the figure as high as 1.4 kg N/ha per annum. The wide discrepancy between these estimates is probably the result of a different categorisation of forest types and the concomitant extrapolations. It must also be taken into account that the results of short-term measurements cannot necessarily be taken as a basis for deductions about average greenhouse gas emissions, which are extremely variable over a longer time-scale (CARBOEUROPE IP 2004b, p. 32).

Undesirable feedback impacts between climate change and changes in the vegetation cover can, for instance be caused by forest fires, which result from prolonged periods of drought, and are reinforced by imbalances in the biodiversity structure and the loss of the natural biodiversity balance. Forest fires release huge quantities of the carbon stored in timber into the atmosphere in the form of carbon dioxide, thus contributing to the greenhouse effect. Climate stress and pest disasters too, however can lead to unexpected timber losses.

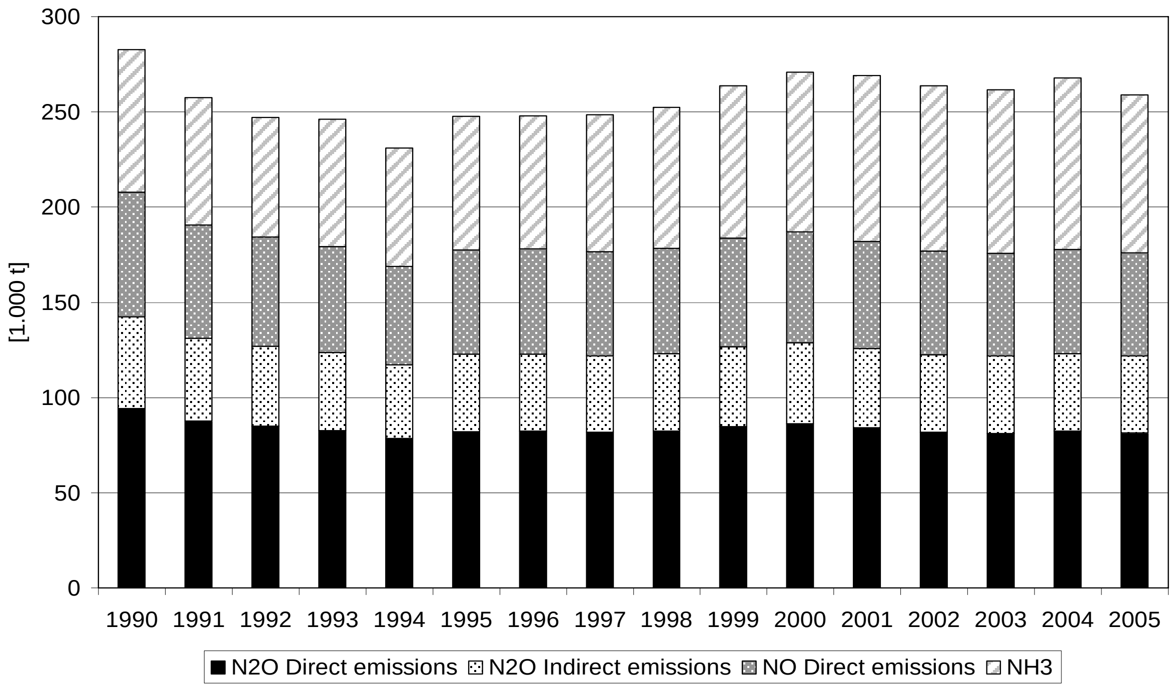
Agricultural ecosystems (not including bogs)

225. German agriculture is responsible for producing some 128 million tonnes CO_2 equivalent every year, which is equivalent to 13 % of the country's greenhouse gas emissions (6 % of carbon dioxide emissions, 48 % of methane emissions, 80 % of nitrous oxide emissions). Of this total, 77 % is caused by ruminants (methane) and cropping (carbon dioxide and nitrous oxide) (Federal Ministry of Food, Agriculture and Consumer Protection, BMELV, 2006c, p. 17).

A distinction must be made between direct and indirect emissions from the soil. Direct emissions of nitrogen-based climate-relevant gases (N_2O, NO_x) come for the most part from the use of mineral fertilisers and farm manure, sewage sludge, cultivation of leguminosidae, ploughing plant residues into the soil, livestock excrement on grazing land and nitrogen mineralization in the farming of organic soils. Indirect N_2O emissions are calculated on the basis of the atmospheric absorption of reactive nitrogen compounds from agricultural sources, the nitrogen washed out of the soil and the run-off of nitrogen applied to the soil (Federal Environment Agency, UBA, 2005). Emissions of nitrogen-based climate-relevant gases from the use of agricultural land depend to a great extent on the farming methods used and have not shown any downward trend since 1990 (Fig. 3-8).

Figure 3-8

Nitrogenous greenhouse gas emissions from agriculture



Source: UBA 2007c

Even the 1996 Fertilisers Application Ordinance has not managed to bring about any reduction in the nitrogen surplus and thus a reduction in emissions. The extent to which the 2007 revision of the Fertilisers Application Ordinance results in any tangible reduction in the nitrogen surplus remains to be seen.

Use of grassland

226. In Germany and most other European states grassland on mineral soil acts as a net carbon sink (Items 223). Drainage and ploughing of organic grassland, however (Item 227) results in the release of significant quantities of greenhouse gases (WEGENER et al. 2006).

On average in Europe, grassland on mineral soils stores 60 g carbon per m^2 per annum. This figure is almost double that achieved by forested land (JANSSENS et al. 2005, p. 20). If the grassland is disturbed, the fixed carbon can be released back into the atmosphere relatively quickly in the form of carbon dioxide. For this reason, grassland should be protected as far as possible as a reservoir.

Over the last fifty years, however, more than 3 million hectares of grassland in the former West Germany have been ploughed and used as cropland (which is equivalent to about 21 % of the total area). The percentage of grassland lost in former East Germany was even higher (BRANDT 2004). One reason for the current rise in the conversion of grassland is the trend to grow biomass for use as fuel and the policies which foster this with the help of incentives (SRU 2007, Item 29). This calls into question the effectiveness of some ways of using biomass as a way of cutting greenhouse gas emissions (SRU 2007, Item 19 f.).

Bogland

227. In bogs left in a natural state, carbon is accumulated to form peat in the long term, so that the bog acts as a carbon dioxide sink. At the same time, left to their own devices bogs generate methane as a result of anaerobic biodegradation processes. Wetlands, of which bogs account for a large percentage, are the world's largest natural source of methane emissions (CHRISTENSEN and FRIBORG 2004, p. 6). The precise extent of carbon fixation and methane emissions depends largely on the location of the bog, in particular on the climatic conditions, and the type of bog. Taking stock of the two greenhouse gases over an observation period of one hundred years (calculated in terms of carbon dioxide equivalent) indicates that methane emissions outweigh carbon fixation, such that both undisturbed and restored bogs (where soil moisture has been restored) are net emitters of greenhouse gases, with emissions of between 0.1 and 0.7 Mg CO_2 equivalent per hectare per annum (CHRISTENSEN and FRIBORG 2004, Table 6).

When studying the role of bogs in the greenhouse gas cycle, an extremely long observation period is called for because bogs store carbon for thousands of years, while the methane gas emitted by bogs is generally broken down after a period of twelve years. The longer the observation period selected, the lower is the difference between the climate-relevant impacts of the two greenhouse gases methane and carbon dioxide. Over a period of one hundred years the conversion of methane into CO_2 equivalent gives a factor of 21, but this factor drops to only 7.6 if an observation period of five hundred years is taken (SOLOMON et al. 2007). Over their entire life span then, bogs must be considered as a net sink for greenhouse gases or the precursors thereof, provided the essential factors remain unchanged (water level etc.).

The balance for drained bogs and bogs used for agriculture is much less rosy, making it very important to protect intact bogs and restore the soil moisture in used areas (DRÖSLER 2005). Drainage of bogs results in mineralization of the carbon stored as peat and thus in the release of carbon dioxide. At the same time, however, methane emissions drop significantly. When peat is mineralised in drained bog areas, a third climate-relevant gas, nitrous oxide, is also released. The precise scope of emissions of carbon dioxide, methane and nitrous oxide depends largely on the form of use. Bogs used as cropland or grassland demonstrate a particularly poor balance, with greenhouse gas emissions of between 2.4 and 5.6 Mg CO_2 equivalent per hectare per annum above that of functioning bogs. In Germany, the use of bogs as cropland is the largest single source of greenhouse gas emissions in the agricultural sector (WEGENER et al. 2006).

A study which investigated existing carbon reserves and greenhouse gas balances of European bogs makes it quite clear that an overall view of all greenhouse gases over a period of one hundred years will show that bogs emit more greenhouse gases than they fix (CHRISTENSEN and FRIBORG 2004). The largest percentage of net European greenhouse gas emissions is accounted for by the European part of Russia (which is responsible for 37 % of total emissions, dominated by emissions from used bogs). Germany is the second largest source of emissions. Although it is home to only 3.2 % of Europe's bogs, it is responsible for 12 % of emissions. The high levels of emissions in Germany can be explained by the intensive agricultural use of large areas of bog and the resulting high emissions of carbon dioxide and nitrous oxide (CHRISTENSEN and FRIBORG 2004, Table 7).

With respect to the impact of the changing climate on the processes and material flows in bogs, there are still huge gaps in our knowledge at present. Higher temperatures and shorter periods of frost seem likely to reduce carbon accumulation, while higher precipitation could boost the productivity of peat moss and thus counter this trend to some extent (CHRISTENSEN and FRIBORG 2004, p. 15).

3.7.3 Measures to mitigate the impacts of climate change on ecosystems

228. Nature conservation measures and sustainable forms of management can reduce both the vulnerability of ecosystems to climate change, and the extent of climate change brought about by greenhouse gas emissions. Adaptation measures and greenhouse gas reduction measures are thus in many cases interrelated (ALCAMO 2007). It makes no sense in this context to establish a clear distinction between the two types of measures. The impacts of climate change on managed ecosystems can be cushioned both with mitigation and adaptation measures. The form of land use chosen, for instance, can help fix carbon, which in turn helps reduce greenhouse gas emissions (mitigation). Land use is equally important to preserve biodiversity, the water balance and soil quality in view of the ongoing climate change (adaptation). In addition to the traditional measures of energy-related climate protection, it is crucial that the performance capacity of ecosystems be retained and strengthened.

3.7.3.1 Management of protected areas and integration into other land use forms

229. Since the negative consequences of climate change can only be compensated to a certain extent and only at a high cost, robust global climate protection policy is an indispensable prerequisite for protecting biodiversity. A drastic reduction in greenhouse gas emissions is essential if changes at biological level are to remain within a management framework. Conversely, the protection of biodiversity is one of the most important mitigation and adaptation measures (OTT et al. 2008). Carbon-rich ecosystems with a high conservation value can be promoted, for instance, by:

– restoring the moisture content and protecting wetlands and wet grasslands that are not currently used
– declaring 5 % of forested areas as absolute nature reserves (SRU 2002b, Table 2-6).

Against the background of climate change and the concomitant uncertainties, nature conservation should be designed such that it allows species to migrate and adapt. Protected areas should, to this end, be linked by corridors in the form of a biotope network (ecological network to retain animal populations) and the landscape should be permeable with corridors of conservation-appropriate management. Migration barriers such as habitat fragmentation should be avoided. The species and populations that have dwindled over recent decades as a result of intensive land use should be strengthened by adopting more extensive forms of land use. The variety of management and cropping forms in agriculture, forestry and water resources management should be optimised with the objective to provide maximum support for conservation (DOYLE and RISTOW 2006; SRU 2007, Items 60-62). Since the desirable, generally extensive forms of managements usually result in lower profits, agricultural-policy and financial incentives will be needed to achieve the desired results.

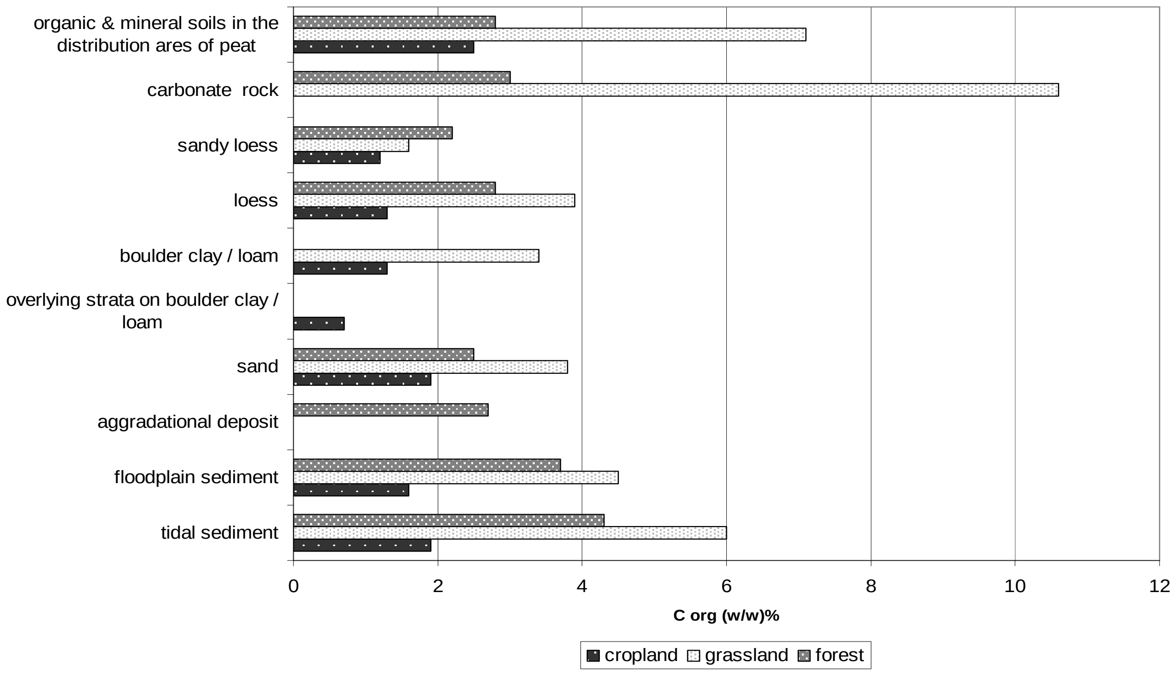
3.7.3.2 Use of land for agricultural purposes

230. The changes triggered by climate change vary from one region to another, such that soil protection measures too must be appropriate for the specific region in question. Erosion protection measures and measures to retain organic substances in soils serve at the same time to retain the carbon storage properties of the soils and thus to protect the climate. To this extent, climate protection strengthens the need to achieve protection targets on the basis of precautionary action and on a more effective basis than has hitherto been the case.

In addition to acting as a carbon reservoir, organic substances have other important functions. They influence the water retention capacity of soil, ventilation, the nutrient supply for plants, the soil structure and soil biodiversity. The preservation of location-typical humus contents of soil, for instance, is an important factor of the principles of good practice in agricultural soil use pursuant to the provisions of Section 17, Federal Soil Protection Law (*Bundes-Bodenschutzgesetz – BodSchG*). Nationwide data exist on the organic substance contents of Germany’s soils. It is impossible to put an exact figure on the loss of organic substances in Germany’s soil, since the data available does not allow us to evaluate it over time. The influence of land use can, however, be clearly demonstrated (see Fig. 6-8).

Figure 6-8

Content of organic carbon in different types of top soil for the climatic zone 33 (cropland, grassland, forest)



SRU/UG 2008/Abb. 6-8; Source: following DÜWEL et al. 2007

Appropriate cropping methods that protect the soil and save water are considered to be highly effective. These include mulching (KRETSCHMANN and BEHM 2003) and tilling the soil without ploughing. Procedures that are less harsh on the soil not only cut water consumption as evaporation drops, but also minimise the release of carbon and reduce erosion risks. The sink function of grassland can be improved by reducing the frequency with which the land is worked, or discontinuing this altogether (Federal Ministry of Food, Agriculture and Consumer Protection, BMVEL, 2005). According to the calculations of NEUFELDT (2005) for cropland in Baden-Württemberg, for instance, if 40 % of cropland were farmed using soil-conserving methods (no ploughing), between 5 % and 14 % of greenhouse gas emissions from agriculture could be dispensed with. At the same time soil biodiversity is preserved.

As laid down in the Fertilisers Application Ordinance, the quantity of fertiliser used should in practice be geared to actual needs rather than to the need to dispose of the quantities of farm manure produced. On the other hand, the use of composted harvest residues and farm manure reduce the need to use of synthetic nitrogen-based fertilisers which are produced using fossil fuels (FLIEßBACH et al. 2006). The volume of nitrogen-based climate-relevant gases emitted as a result of agricultural use of land can be reduced by optimising the use of farm manure and mineral fertilisers as well as by extending the area farmed using organic methods. To date, however, there is a lack of long-term studies on the effectiveness of plough-free soil tilling with respect to the release of N_2O and supporting the function of the soil as a sink or reservoir of greenhouse gases in conjunction with the type of soil and crop rotation.

The cropping methods used in organic farming raise soil fertility and increase the humus content of the soil. By comparison with conventional and integrated farming, organic farming accumulates significantly more carbon in the soil, depending on the location. At the same time, soils with higher humus content can adapt more readily to changing climatic conditions, since they can store more water for a longer period. This property is also important in view of intense rainfall events and flooding (FLIEßBACH et al. 2006). The goal of achieving a 20 % share of organic farms on the total area of land used for agriculture (German government 2002) by 2010 is thus also very important for climate protection and adapting to climate change.

From the point of view of climate protection it would appear appropriate to introduce an across-the-board ban on ploughing permanent grassland. In the short term this could be achieved by tightening up state-level regulations on the basis of the Direct Payment Commitments Law (Direktzahlungen-Verpflichtungsgesetz) (Section 5 paragraph 3, no. 1). At European level it would equally be possible to make a short-term modification to Commission Regulation (EC) No. 794/ 2004. In the medium term a ban on ploughing should be incorporated in Regulation (EC) No. 1782/2003 relating to direct payments. A ban on ploughing permanent grassland could also be imposed within the framework of the drafting of the Federal Conservation Law (*Bundesnaturschutzgesetz – BNatSchG*) (SRU 2007, Item 73).

3.7.3.3 Forestry

231. Biodiversity-conserving and soil-conserving forms of forestry management protect the function of forests as carbon reservoirs (cf. Item 224; METZGER and SCHRÖTER 2006). Natural regeneration and mixed tree stands also help reduce the concentration of greenhouse gases in the atmosphere, while thinning out and subsequent underplanting can be expected to raise emissions of nitrous oxide over a period of 15 years (FRITZ 2006, p. 203). Forest clearance raises the greenhouse gas potential of the affected forest ecosystem seriously, for more nitrous oxide will be released from the soil (e.g. five to ten times as much as would otherwise be the case), while more methane remains in the atmosphere (FRITZ 2006, p. 203). In contrast to this, femel felling (partial regeneration) increases nitrous oxide emissions by a factor of only 1.6 (FRITZ 2006, p. 203). Nitrogen fertilisation in order to foster increased absorption of carbon is controversial from a forestry point of view (MAGNANI et al. 2007; HYVÖNEN et al. 2007), and should be rejected in order to protect species, the biotope and water resources.

Measures that permit a long-term increase in carbon reservoir function include the following (HÖLTERMANN 2006):

– Raising average stand reserves
– Renouncing production methods that release greenhouse gases
– Raising the percentage of deadwood
– Lengthening the rotation period
– Regeneration and/or reforestation of degraded land.

Additional stress factors such as substance inputs, soil compression and the disturbing of sensitive forest ecosystems should be reduced, for instance by cutting down vehicular traffic (ZEBISCH et al. 2005). These demands, however, are at odds with the current strategy of 'mobilising' timber resources.

3.7.4 Conflicting objectives of conservation and climate protection, and synergies

232. There can be no question that the utilisation of renewable energy sources plays a central role in reducing emissions of greenhouse gases. However, increased use of renewables also has major potential for conflict with respect to comprehensive conservation. This applies in particular to areas which have grown dramatically in recent years (use of land-based wind power) or which are expected to be substantially expanded in future – like the use of off-shore wind power, the use of biomass and their impacts on the soil, water, biodiversity and landscape (SRU 2007; DOYLE et al. 2007; SRU 2003). Without going into more detail about the potential for conflicts, it can be said that, also in view of the above-mentioned interplay between climate and biodiversity, there is no easy answer in the form of a generally valid priority either for climate protection or biodiversity protection. Rather, conflicts should be avoided or minimised as far as possible by selecting appropriate procedures and low-conflict locations (DRL 2006).

Nevertheless important synergies can be achieved between conservation and climate protection (cf. Item 229). One example is the use of mowings from protected areas to generate power. In addition to helping to avoid CO_2 emissions otherwise caused by fossil fuels, this will help make it more attractive to preserve areas of this sort (GRAß et al. 2007; PROCHNOW et al. 2007; cf. SRU 2007, Table 2-1, Items 31, 62). Restoring the moisture content of degraded low-lying bogs in conjunction with site-appropriate management methods too will help encourage the formation of biological carbon sinks (reeds, sedge and alder use; JOOSTEN and AUGUSTIN 2006; SCHÄFER 2005). "Climate-friendly" land use can thus do much to increase carbon fixation, reduce emissions of nitrous oxide and methane, and thus make a contribution to avoiding emissions of greenhouse gases. In the final analysis, sustainable and nature-appropriate land use is the crucial bridge between the

UN Framework Convention on Climate Change and the Convention on Biological Diversity (SCHULZE et al. 2007).

3.7.5 Implementation instruments

233. To date the German federal states of Brandenburg, Baden-Württemberg, Bavaria, Hesse, Mecklenburg/ Western Pomerania, North-Rhine/Westphalia, Schleswig-Holstein, Thuringia and Saxony have drawn up regional scenarios to allow them to respond to climate change (GERSTENGARBE et al. 2003; STOCK 2005; Bavarian Climate Research Network 1999; BEIERKUHNLEIN and FOKEN 2008; STREITFERT et al. 2005; field of activity of the Saxon State Ministry for the Environment and Agriculture 2005; GERSTENGARBE et al. 2004; Thuringian State Agency for the Environment and Geology 2004; TMNLU 2000; Hessian Ministry of the Environment, Rural Areas and Consumer Protection 2007; AUGST et. al. 2007; OTT et al. 2008). Often, these studies remain imprecise in terms of impacts of biodiversity and conservation.

In the interests of a broad-based climate protection strategy which incorporates the natural resources and the question of how to deal with summer heat, winter rain and flooding, there is a need for the demands of climate protection and climate change adaptation to be mainstreamed in landscape planning too (see also HEILAND et al. 2008). The representation of the areas important for air exchange and the production of cool air with the help of general rules of climate behaviour, and the representation of land use restrictions for ecosystems with a high greenhouse gas emission potential will become more important in planning. Presentation of adaptation measures and linking these with other multifunctional measures in rural areas as well as proposals of ways of increasing the greenhouse gas sink function should also become part of the standard contents of landscape planning. The pertinent measures and imperatives of landscape planning can be implemented with the help of the other instruments used in nature conservation law, regional planning and land use planning and instruments used in other areas of technical planning, especially water resources management planning.

Regional planning and municipal development planning are important both for climate protection and for adapting to the consequences of climate change (FLEISCHHAUER and BORNEFELD 2006). Regional plans and municipal development plans, however, generally work on a time scale of 10 to 15 years, whereas the model calculations for climate change look at a time scale of up to 2050 or 2100. Regional planning and municipal development planning are, however, obliged to ensure sustainability, and must for this reason take a longer time scale into account in planning.

The Water Framework Directive offers a suitable framework for taking into account the impacts of climate change on water resources and river basins in management and action plans (EEA 2007b). Full use should be made of the scope offered by this framework.

3.7.6 Outcome

234. In order to mitigate the consequences of climate change, it is important to mobilise ways of influencing every component in the system. Climate problems must be seen in conjunction with overall ecosystems and thus also in conjunction with changes in anthropogenic land use systems. The non-technical side of mitigation and adaptation has not yet been adequately reflected in climate protection policy. Integration of the objectives of the National Biodiversity Strategy represents an important field of action for the National Climate Protection Strategy. Land use in line with the imperatives of nature conservation makes land use systems less sensitive to climate change, and also reduces greenhouse gas emissions. It can and should make landscapes permeable, such that species can migrate in the wake of climate change. Measures that increase carbon reserves in the soil not only help store carbon and preserve biodiversity. They also improve water resources and the nutrient cycle of terrestrial ecosystems. Revitalisation of natural areas thus fosters climate protection, adaptation to climate change and the objectives of nature conservation. Adaptation measures should be geared to the potential synergy offered by combining climate protection imperatives with those of nature conservation.

Targeted land management to reinforce the capacity to absorb greenhouse gases is urgently needed and should aim to do three things:

- to preserve and strengthen the current carbon reservoirs and sink (forests, grassland, growing bogs, soils)
- to develop and promote agricultural management systems to reduce greenhouse gas emissions from cropland or to transform these soils into sinks
- to strictly protect in particular wetlands and bogs, carbon-rich soils and old forests since the destruction of these ecosystems would release huge quantities of carbon.

In the National Climate Protection Strategy and the German Strategy for Adaptation to Climate Change, joint solutions are to be sought by the line ministries, as well as federal, state and local government bodies, and the synergy offered by an integrated climate protection and biodiversity protection strategy are to be harnessed.

In the scientific climate change scenarios drawn up for Germany, the consequences of land use change have not hitherto been taken into account. It is imperative that this factor be incorporated in future, so as to make the models more reliable in terms of a basis for forecasting.

3.8 Conclusions and recommendations

235. The 4th Assessment Report published by the IPCC contained alarming new findings, which are much more disquieting that all other forecasts to date. The targets are therefore much more far-reaching than has hitherto been the case. In many cases a global greenhouse gas reduction target of between 50 % and 85 % of the 2000 levels by 2050 is quoted. For the industrialised countries, emissions cuts of 25 % to 40 % of the 1990 levels by 2020 are quoted, and cuts of 80 % to 95 % are considered necessary by 2050. The Bali Action Plan (December 2007) does not lay out any quantitative targets, but it does indirectly refer to these targets, which go well beyond the discussion to date. The SRU recommends that these more ambitious targets and the rationale on which they are based be incorporated into the further target-setting process. This can be justified because the more ambitious targets have to be seen in the context of a new dynamism in innovations and growth with respect to climate-relevant technologies, which has extended our scope for action. Not only the requirements, but also the potential to act in climate protection policy has changed dramatically.

The approach adopted by Germany and the EU of forging ahead in climate protection in the hope that other countries will follow is correct, and has also proven to be economically effective. It is, however, crucial to the credibility of this policy that the targets set are actually achieved. The measures for the climate protection programme adopted by the German Cabinet on 5 December 2007 are basically welcome. In some areas, however, such as electricity savings and the continued fiscal incentives for company cars with high fuel consumption, provision has been made for exceptions that are not objectively justified. In view of the economic importance of climate-friendly technologies, and also with a view to Germany's pioneering role in climate protection policy, there is a need for speedy removal of structure-preserving obstacles such as those that have apparently come into effect here.

Rapid limitation and reduction of greenhouse gas emissions with the help of binding regulations that are calculable in the long term must be and must remain the absolute goal of climate protection policy. A suitable range of instruments can keep the costs of adaptation low, if properly used. Experience to date with emissions trading indicates that a transition should be made to a system of complete auctioning that covers all sectors.

236. Special importance must be attached to boosting energy efficiency: with a view to the high profitability of pertinent measures and in view of the great importance of energy prices and the competition among innovators in this field, the SRU believes that more ambitious measures are not only possible but also, in view of the speed of climate change, advisable. Basically, when these are put into practice, ambitious, calculable targets should be pursued using monetary instruments to steer trends, complemented by detailed steering measures (e.g. dynamic consumption standards). The latter can mobilise additional specific innovation potential and help overcome specific obstacles to innovation and adaptation. Priority areas of the energy efficiency strategy are buildings, energy-consuming appliances and machinery and traffic. These areas still offer huge untapped economic potential.

In the field of residential buildings, efforts should be made to implement the passive house standard for new buildings by 2015, going beyond the current planning but in line with the spirit of the EU's climate protection policy. It must, however, be said that the realisation of structural and consumption-related energy-saving measures often fails because of unfavourable framework conditions. The regulation of the housing market has not, to date, offered sufficient incentives to invest. The promotion programmes, which are thus justified, should take adequate account of the efficiency of the subsidy approach and the actual energy savings.

In terms of energy-consuming appliances and machinery, orientation to the top runner on the market plays an important part in the discussion. Making these standards dynamic has fostered innovation, which has in turn further increased the technical potential for energy savings. The European eco-design directive for energy-consuming products, which extends this approach to incorporate ecological criteria, should be put into practice more rapidly, with an initial focus on energy efficiency.

The voluntary commitment of the European automobile industry to limit the CO_2 emissions of passenger cars has failed. As an alternative, the SRU recommends setting a standard limit to apply to all passenger cars, which would, however include a more flexible compensation mechanism that would apply internally to each manufacturer and would allow for the possibility of trading between manufacturers. The limits set should be significantly reduced as of 2012. The level proposed by the European Parliament (95 g CO_2/km for 2020) can be taken as the ceiling with a targeted range of 80 g to 95 g. This standard should be flanked by economic instruments designed to influence the way consumers decide which car to buy. The European Commission's proposal falls short of the political target set of 130 g by 2012 and of the calls for an efficient solution. The limit curve proposed, dependent on the weight of the vehicle, with fines and greater flexibility makes concessions to the demands of the German automobile industry, and fails to measure up to the technical potential available or the imperatives of climate protection.

237. Carbon capture and storage (CCS) is basically feasible from a technical point of view, but still faces a number of unresolved technical and economic problems. The costs of investing in a power station fitted with CCS are twice as high as in a power station without the technology. The additional costs for retrofitting an existing power station are even higher. Whether or not and to what extent CCS technology will become marketable, and whether acceptable storage options can be identified, is completely open, in particular given the recent problems encountered in plants in Norway and the USA. In the final analysis the European emissions trading scheme will decide whether or not CCS will help reduce emissions in the German energy mix. If the technology fails to live up to expectations and/or if retrofitting power stations proves to be uneconomical, the climate protection targets must not under any circumstances be called into question. If energy utilities put their faith in CCS technology, they must bear the business risks involved. The crucial factor is that politicians must insist on compliance with the emissions budget, such that the business risk does not lead to any (climate) risk for society as a whole. In order to avoid inappropriate investments, the privileged position of coal-fired power stations must be eliminated clearly and in good time in the emissions trading scheme (by 2012). Not only does it contradict the logic of the efficiency of the instrument and undermine the credibility of German policy, but it will not be possible to maintain it in the long term anyway in the face of worsening climate change. The SRU does, however, believe that research into CCS technology should continue to be pursued.

238. The European emissions trading scheme was significantly improved, within the existing framework, during the second trading period. The proposed revision of the European directive, with a standardised emissions budget that is calculable in the long term and complete auctioning of rights as well as the intended further simplifications, makes for some more than welcome improvements to the general framework. In terms of the transitional regulations for industry, while it is true that harmonisation is preferable to regulations laid down separately by each individual member state, the additional complexity that this brings to the system must be weighed against the likely benefits. The same applies to the planned exemptions for industries where there is felt to be a risk that facilities will simply be moved to other countries with less strict regulations. These options should be used extremely sparingly.

In the long term, an upstream model of emissions trading should be adopted. Some aspects of realisation, such as the way consumption for purposes other than power generation is treated, must be investigated in more detail. It seems likely, however, that this variation of emissions trading will not be any more complicated that the current system. A ceiling or cap appropriate for the scale of the climate problem will be needed in either case. The crucial advantage offered by the upstream emissions trading model is that energy-related emissions are recorded across all sectors. Additional measures to mobilise special innovative potentials, from dynamic standards for maximum consumption to product labelling, continue to be possible and meaningful under a system of this sort, provided they do not significantly distort costs within the system.

239. Natur conservation and landscape protection have an important part to play in both climate protection and in adapting to climate change. This non-technical side of climate protection and adaptation has hitherto been largely neglected by climate protection policy. A system of land use in line with the imperatives of nature conservation reduces the sensitivity (or vulnerability) of land use systems to climate change and, at the same time, reduces emissions of greenhouse gases. It is intended to make landscapes permeable for species migration in the wake of climate change. Measures which increase the carbon reserves in the soil, can help not only to increase carbon reservoirs and preserve biodiversity, but also to improve water resources and the nutrient cycles of terrestrial ecosystems. Vitalisation of natural areas thus fosters climate protection, adaptation to climate change and the goals of conservation. Targeted land management to step up the ability of the ecosystem to absorb greenhouse gases should then attempt to do three things:

– preserve and strengthen the current carbon reservoirs and sink (forests, grassland, growing bogs, soils)

– develop and promote agricultural management systems to reduce greenhouse gas emissions from cropland or to transform these soils into sinks

– strictly protect the major carbon reservoirs represented by wetlands and bogs, soils and old forests, since carbon is released significantly faster than it can be fixed.

The options laid out to step up the capacity of ecosystems to absorb greenhouse gases should be pursued, making the best possible use of synergies emerging in connection with nature conservation goals (see SRU 2002b).

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