**Deutscher Bundestag**

**14. Wahlperiode**

# Enquete Commission

on
Sustainable Energy Supply
Against the Background of
Globalisation and Liberalisation

## Summary of the Final Report

2 July 2002

# 1 Executive Summary[1] [2] [3] [4]

## 1.1 The key findings

**Consensus view:[5] The current energy supply system is not sustainable**

(48) In February 2000, the German Bundestag established the Enquete Commission on "Sustainable Energy Supply Against the Background of Globalisation and Liberalisation". The Commission was given the mandate to furnish scientific evidence to be used as a basis for the German Bundestag's future decision-making in the field of energy policy.

According to the wording of the Bundestag's decision to establish the Commission, the latter's brief is to identify "robust", sustainable development paths in the energy sector for the period until 2050, as well as options for political action against the background of growing problems in the fields of the environment and development and in view of the changes brought about in the general setting by globalisation and liberalisation. The Commission's Final Report is a contribution made by Germany toward implementing the sustainable development objectives defined in Rio de Janeiro (Agenda 21) for the energy sector.

(49) In its First Report, the Commission covered several areas: it defined and operationalised the term "sustainable development"; and it discussed the current scientific

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1 Minority opinion by the CDU/CSU and FDP members of the Commission:
This is due to the different methodological and substantive approach adopted in key points and the resulting findings and assessments, some of which are diametrically opposed to the results put forward by the majority of the Commission members in the Final Report (cf. minority opinions, especially in Chapters 1 and 7).

2 Cf. end of chapter for the minority opinion by the Commission member of the parliamentary group of the PDS, including the expert Professor Dr. Jürgen Rochlitz, who was nominated by the parliamentary group of the PDS.

3 For the dissenting opinion by the expert Professor Dr. Alfred Voß on Chapter 1.5, see end of chapter.

4 Dissenting opinion by the expert Professor Dr. Schindler:
Chapter 1 was submitted for the first time during the last meeting on 24 June 2002. Hence, a thorough analysis and discussion of this chapter was no longer possible for the minority group of the Commission members.

5 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
This "consensus view" was not a commonly agreed view among the members of the Enquete Commission; nor does it reflect a clear-cut and generally accepted body of evidence in the current scientific debate.

evidence on climate change (greenhouse effect), as well as the available resources and reserves of fossil fuels. On this basis, the Commission has come to the common conclusion that the current energy supply system is not sustainable.[1] This view is mainly based on the realisation that today's system of energy supply and use to a large extent negates environmental costs, that it overexploits scarce resources, and that it does not pay sufficient attention to risk aspects.[2] Another important aspect of the non-sustainability of today's energy supply system is that the energy services required for economic and social development are not available at all, or only inadequately so, for large parts of the world population.

**Enquete Commission confirms: Sustainable energy supply is technically feasible and economically beneficial**

(50) In order to assess the prospects of sustainable development up to the year 2050, the Commission has examined economic and technological capabilities as well as options for practical and political action. To this end, the Commission developed 14 scenarios and variations for Germany, with different assumptions and implementation perspectives. Based on these scenarios and the evaluation of additional studies conducted on behalf of the Commission, the Commission has come to the conclusion that it is technically feasible[3] and economically possible[4] in a modern industrialised country to reduce greenhouse gas emissions by 80 per cent, even if nuclear energy is phased out as agreed.[5]

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1 Dissenting opinion by Kurt-Dieter Grill, MP:
This statement is not true in such absolute terms; instead, it is only true if no corrective action is taken. Our energy supply system has proven that it is capable of changing, and will continue to do so.

2 Dissenting opinion by Dr. Ralf Brauksiepe, MP:
This view ignores both economic and social concerns.

3 Dissenting opinion by Professor Dr. Paul Laufs, MP:
This view disregards the fact that isolated national efforts alone will not be sufficient in view of the global dimension of the problem.

4 Dissenting opinion by Kurt-Dieter Grill, MP:
The term "economically possible" is misleading because it suggests that such targets can be attained without any economic consequences. However, there will be considerable adverse economic effects that will curtail Germany's attractiveness for business enterprises.

5 Dissenting opinion by Franz Obermeier, MP:
This view disregards the economic effects, which have been estimated by the Federal Ministry of Economics to amount to € 250 billion.

Three scenarios were used to study the concrete implementation of this reduction target, which is necessary to stabilise the global climate. The first scenario is primarily focused on reducing emissions in the conversion sector, including the separation and storage of $CO_2$ in repositories. The second scenario is mainly characterised by a massive increase in the efficiency of energy supply systems and the consistent introduction of renewable energy sources in the market. At the suggestion of the minority of the CDU/CSU and the FDP, the Commission defined a third scenario that permits an increase in the use of nuclear energy in order to attain the reduction target of 80 per cent, which in the final analysis will lead to the construction of between 50 and 70 new nuclear power stations.[1]

**Overview of the Key Characteristics of the Scenarios**

| Reference Scenario | Efficient Conversion | RES/EEU Initiative | Fossil-Nuclear Energy Mix |
|---|---|---|---|
| Continuation of the current energy policy ("business as usual") | Accelerated efforts to increase the efficiency of the use of fossil fuels | Accelerated efforts to increase the efficiency in all fields of application | Construction of new nuclear power stations after 2010 |
| Eco-tax only until 2003 | More stringent energy regulation | Greater use of renewables | Moderate implementation of energy conservation policy |
| Constant energy taxes in real terms | Continuous increase in energy taxes<br>Separation and storage of $CO_2$ in repositories | Continuous increase in energy taxes<br>50-percent share of renewables by 2050 | |

(51) On behalf of the Commission, the scenarios were calculated by the *Wuppertal-Institut für Umwelt, Klima, Energie* (WI – Wuppertal Institute for Environment, Climate, Energy) and the *Institut für Energiewirtschaft und Rationelle Energieanwendung* (IER – Institute of Energy Management and Efficient Energy Use), with PROGNOS AG, Basle, in charge of the lead management. The scenarios and their variations were first calculated without including any external costs. The subsequent integration of the external costs of emissions of atmospheric pollutants and greenhouse gases and of nuclear energy into the scenarios and the calculation of variations has shown that the nuclear energy scenario is not sustainable from an economic perspective, either.[2]

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[1] Dissenting opinion by the expert Jürgen-Friedrich Hake:
This scenario was suggested by the Commission members of the CDU/CSU and the FDP in order to have at least one scenario that does not contain any technological bias and that describes future structures that comply with economic efficiency criteria.

[2] Dissenting opinion by Walter Hirche, MP:
This conflicts with the EU Commission's ExternE study of 2001. This statement is based on the arbitrary assumption that the external costs of nuclear energy amount to 2 €/kWh, which is not substantiated by any scientific evidence.

**Sustainable energy supply: An opportunity for Germany**

(52) The Commission dealt in detail with the adjustments that the German economy will have to accomplish in the next 50 years in order to become sustainable, i.e. in order to be able to continue to defend its position successfully against international competitors. The Commission has examined the measures required for successful structural change both from a microeconomic and from a macroeconomic perspective. Based on this examination, the Commission has come to the conclusion that Germany's competitiveness and attractiveness for business enterprises will be jeopardised unless the principle of sustainable development is applied on a large scale.[1] For the Commission, therefore, pursuing a policy of sustainable development is not only ecologically necessary but also in keeping with well-founded economic and social precepts.

(53) The approaches adopted in the various scenarios to achieve the envisaged $CO_2$ reduction vary widely. This deliberate range of different strategies and instruments chosen thus provides a diversified spectrum of potential actions. The solar-efficient development path[2], for instance, shows how the transformation of the energy supply system can be accomplished within half a century. For this development path, two factors play a key role: a substantial improvement in the efficiency of the energy supply system and the consistent introduction of renewable energy sources. At the same time, the industrial-scale structure of the energy supply system will be progressively decentralised, supplemented by a wide variety of more efficient technologies and reorganised by the increasing use of renewable energy sources. This development path takes into consideration that it will be necessary in the next few decades to replace the general infrastructure, the buildings and the power stations. This will make it possible to tap enormous potentials, which will be necessary (in the near future). The Commission feels that now is a particularly opportune time to develop a low-risk[3] and sustainable energy supply system.

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[1] Dissenting opinion by Prof. Dr. Paul Laufs, MP:
The contrary is true: The CDU/CSU and the FDP have demonstrated repeatedly that the tight targets envisaged by the SPD and BÜNDNIS 90/DIE GRÜNEN will put a burden on the German economy and thus pose a major risk ín terms of Germany's attractiveness to business enterprises.

[2] Dissenting opinion by the expert Dr. Hans Jörg Henne:
The term "solar-efficient" has not been defined. More specifically, the costs associated have not been specified.

[3] Dissenting opinion by Franz Obermeier, MP:
Questions relating to risks have not been discussed during the work of the Enquete Commission. As a general rule, however, all energy supply systems and all energy sources are associated with risks. Hence, the term "low-risk" is misleading.

(54) The Commission is firmly convinced that any measures adopted to make the energy supply system sustainable will be closely linked with the modernisation of the German economy. The Commission feels that the development of low-emission and risk-free[1] technologies will present major economic opportunities for German industry. The Commission expects that these opportunities will help create new jobs, both through domestic activities and through exports. As the use of efficient technologies and technologies of renewable energy sources[2] becomes more widespread, the Commission believes that globalisation processes will also be steered in a more sustainable direction, which will help countries in transition, as well as newly industrialised countries and developing countries to achieve a sustainable development.

(55) Based on these thoughts, the Commission comes to the following conclusion: The continued use of nuclear energy is not sustainable because of the high safety and system risks involved (residual risk, vulnerability to terrorist attacks, etc.), the as yet unsolved question of disposal and the fact that nuclear energy preserves current structures.[3] The scenarios have shown that it is not necessary to have recourse to nuclear energy to attain the ambitious $CO_2$ reduction targets. If external costs are included, the macroeconomic costs associated with the nuclear energy scenario are substantially higher than the costs associated with the other scenarios. [4]

**Sustainable development: A technical, economic, social and institutional challenge**

(56) The Commission is aware of the fact that sustainable development in Germany will also require changes in production methods, consumption patterns and life-styles. The Commission does not see any economic or social alternative to the process of anticipating in time the ecological structural change that will be necessary worldwide.

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1 Dissenting opinion by Walter Hirche, MP:
There is no such thing as “risk-free” technologies. The risks associated with technologies differ in terms of the extent of damage they cause and the probability of their occurrence.

2 Dissenting opinion by Professor Dr. Paul Laufs, MP:
There is no such thing as “technologies of renewable energy sources”. In the long term, however, it will also possible and necessary to use non-renewable technologies worldwide to cover the growing demand for end-point energy.

3 Dissenting opinion by Kurt-Dieter Grill, MP:
From a technical and ecological perspective, it is possible in principle to use nuclear energy in a responsible manner, providing that it is possible to achieve a consensus to this effect in society.

4 Dissenting opinion by Dr. Ralf Brauksiepe, MP:
The nuclear energy scenario leads to much lower macroeconomic costs than all the other scenarios. The advantages of the scenarios that do not include the use of nuclear energy result only from the assumption of very high and unrealistic external costs.

(57) The Commission feels that risk management alone will not be sufficient to cope with the challenge at hand. For this reason, the Commission considers that it is necessary to pursue a precautionary policy. Without a shift of paradigms in a wide variety of areas of the economy, research, etc., such a major effort will not be possible.[1]

(58) The Commission is convinced that the sooner the path toward sustainable development is taken, the more successful this process will be economically and the more smoothly it will be implemented structurally. In this context, the Commission strongly emphasises that it will not only be necessary to solve technical and scientific problems in the implementation of this process. Instead, there are many social and institutional interdependencies when technological innovations are introduced. Hence, the Commission feels that it is necessary to pay increasing scientific and practical attention to such interdependencies. If they are not taken into consideration, the process of sustainable development cannot be successful at the level of the market.

(59) The Commission thoroughly discussed the question as to whether it is necessary to adopt new regulatory approaches to implement the principle of sustainable development. In this context, the Commission feels that it is necessary to establish introductory programmes for innovations in the field of sustainable energy services in order to improve their prospects in the market.[2] (Example: German legislation pertaining to feeding into the grid electricity that has been generated from renewable energy sources).[3]

**Sustainable development: A political response to globalisation**

(60) The Commission perceives globalisation as a highly complex process. As globalisation progresses, it will affect nearly all social, cultural, economic and ecological

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[1] Dissenting opinion by Professor Dr. Paul Laufs, MP:
In view of the considerable uncertainties with regard to the nature and the impact of ecological, economic and social factors, it is necessary to adopt a cautious approach when developing measures in the context of energy policy.

[2] Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
Such programmes for the introduction of innovations in the market only make sense if the technologies involved can be expected to become competitive in the foreseeable future. One should abstain from introducing innovations that will be permanently dependent on subsidies.

[3] Dissenting opinion by the expert Professor Dr. Volker Schindler:
Financial support programmes that extend over periods of more than ten years are evidence of persistent problems in the market. This is a euphemistic explanation for an unjustifiable introduction of subsidies.

sectors of society. The organisational framework and the frame of reference of the traditional energy sector – and also that of a sustainable energy sector - will change accordingly.[1]

(61) The Commission has given itself the task to identify those aspects and conditions in the energy sector that can be used as opportunities for a globally sustainable energy system. The Commission emphasises that globalisation will only generate positive effects if it is accepted as a major challenge in terms of national and international policies. A definition of globalisation that is largely limited to its economic aspects is too restrictive. Instead, the Commission suggests a broader definition of the term "globalisation" ("integrative globalisation") that includes all aspects of sustainable development.

(62) Globalisation that is designed to provide benefits solely for the industrialised nations is dangerous.[2] It fails to see that co-operation between polluters and polluted countries or between developed and developing countries will be indispensable in the future if we want to preserve the substance of the global natural resources that humanity needs for its survival. The Commission is aware of the fact that a large number of clarification processes will be required for this purpose. It will be necessary, for instance, to find answers to a number of issues such as the unfair distribution of opportunities in life due to differences in the availability of resources; greater participation of developing countries in the capital, know-how and technology transfer; combating poverty; the provision of appropriate development aid; and fair integration of all countries (including currently underprivileged countries) into global economic cycles, etc.[3]

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[1] Dissenting opinion by the expert Jürgen-Friedrich Hake:
There is no scientific foundation for a distinction between "traditional" and "sustainable" energy management systems. In fact, this distinction suggests that there are discrepancies that actually do not exist.

[2] Dissenting opinion by the expert Dr. Hans Jörg Henne:
Globalisation that is in the interest of the industrialised nations as well as the developing countries and the newly industrialised countries is not "designed" to provide benefits for the industrialised nations only. This is borne out by the Rio process.

[3] Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
Globalisation has provided benefits for all developing and newly industrialised countries that have consistently pursued the opening of their markets as well as democratisation.

**Sustainable development: Liberalisation as a supporting measure**

(63) The Commission dealt with various ways of liberalising the energy markets in order to drive sustainable development. For the Commission, it is important to point out that viable competition can be productive in the interest of sustainable development (focus on efficient use of resources, innovations due to a wide variety of market players, etc.). To this end, however, it is necessary to remove market access barriers in order to allow for a variety of players, to dissociate the interests of the various market levels, and to create market transparency. The Commission feels that these requirements have not yet been sufficiently met. Technological innovations will only have a genuine chance if they can prove their worth in the market under fair conditions. In this context, the Commission is aware of the fact that new technological developments in changing structures (e.g. fuel cells and virtual power stations) may have a considerable impact in terms of sustainable energy supply.

(64) The Commission feels that it is important to take advantage of the opportunities provided by liberalisation. However, it sees considerable risks in the oligopolisation of the markets, which is rapidly increasing again,[1] and in the associated strategic crowding-out of competitors. The economic attractiveness of ecological and efficient products and processes is jeopardised by sending the wrong (short-term) price signals to manufacturers and consumers.[2] During its debate on liberalisation, the Commission was aware of the fact that the market would not automatically lead to the attainment of long-term societal objectives (competition is a short-term optimisation mechanism that lacks a long-term perspective).[3]

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1 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
Liberalisation will not inevitably lead to the development of oligopolies in the markets. The crucial point is that the markets must be kept open.

2 Dissenting opinion by Franz Obermeier, MP:
I do not share the view that “only high energy prices are ecologically acceptable”. There is no evidence to support such a view. What is needed are efficient systems.

3 Dissenting opinion by the expert Dr. Hans Jörg Henne:
I do not share this view. This statement is an attempt to denigrate market principles in order to justify the use of interventionist measures.

(65) The Commission considers that in order to achieve the long-term restructuring process of the energy industry, it is indispensable for Government to play an active role (as a competition watchdog and as an organiser of the transformation process).[1] At present, Government plays this role to a limited extent only; and some of its actions are even counterproductive. For reasons of equity, competition and sustainable development, the Commission draws attention by way of example to the Government's duty to internalise external effects (including liability for nuclear power stations) and to step up efforts in this field by incorporating external effects into market prices, and to remove other obstacles systematically.

**Sustainable development: Observing the barriers imposed by nature – Removing the barriers in our minds**

(66) The work of the Commission has clearly shown that a successful implementation of a sustainable energy supply system will mainly depend on the concepts associated with this objective. The Commission objects to any deliberate inflation of the term "sustainable development". It recommends that such a tendency should be counteracted by specifying and operationalising the term "sustainable development". It dealt extensively with the so-called "three-pillar model". The three-pillar model is often interpreted as suggesting that aspects of sustainable economic, sustainable ecological and sustainable social development are of equal importance in the political decision-making process. As far as this theoretical equality of status is concerned, the majority of the Commission members declare that sustainable development can only be safeguarded by means of an intelligent organisation of the long-term preservation of vital functions of nature. Any attempt to water down this overarching principle would be counterproductive.[2]

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[1] Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
The contrary is true: Governmental regulation currently destroys the positive effects of liberal markets in the interest of pursuing a sustainable energy policy.

[2] Dissenting opinion by Professor Dr. Paul Laufs:
It is also counterproductive to call for major social and economic restrictions by drawing attention to risks that cannot be ultimately assessed. To say that the various sustainable development objectives are not of equal importance is tantamount to rejecting Rio and to denying that citizens are able to decide for themselves.

**Sustainable development: Linking objectives with concrete measures**

(67) The Commission was bound by the objective stated in the German Bundestag's decision to establish the Commission. In its work, it was confronted with the challenge of translating the overriding objective of reducing emissions by 80 per cent by the year 2050 into specific objectives and measures in such a way that the adjustment processes required for their implementation can be economical and largely avoid social friction.

(68) The Commission was aware of the fact that strategies that extend over a period of 50 years would be confronted with a variety of social developments and technological innovations in the course of half a century. They will go far beyond what is imaginable at the beginning of the 21st century. The objectives mentioned below have been chosen deliberately with this aspect in mind.[1] The Commission has selected objectives and instruments in such a way that, from today's perspective, they will make a major contribution toward attaining the objective of sustainable development in the medium and long term. Hence, they are expected to provide a political foundation for sustainable energy supply. The Commission decided to describe both exemplary and specific objectives. In this context, the Commission attached importance to the fact that all the specific short-term and medium-term measures described must be compatible with the long-term objective of sustainable development.

(69) With regard to the objective specified in the German Bundestag's decision to establish the Commission, the latter recommends that the German Bundestag should pursue the following specific objectives and strategies and should adopt the measures and instruments listed below.

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
The rigid requirements defined by the SPD and BÜNDNIS 90/DIE GRÜNEN do not take this into consideration. Instead, they will for decades perpetuate structures that reflect the current state of the art and thus prevent innovations.

**Objectives of sustainable energy supply to be pursued up to the year 2020**

- To improve the macroeconomic energy productivity by 3 per cent p.a. in the next 20 years,[1]
- To reduce national greenhouse gas emissions by 40 per cent by the year 2020,[2] [3]
- To increase electricity generation from renewable energy sources by a factor of 4 by the year 2020 and to increase the use of renewable primary energy sources by a factor of 3.5 by the year 2020,[4]
- To increase electricity generation from CHP by a factor of 2 by the year 2010, and by a factor of 3 by the year 2020,[5]
- To decrease the average specific end-point energy consumption of recently modernised older buildings to 50 kWh/$m^2$ by the year 2020,
- To decrease the fleet consumption of new passenger cars to between 3.5 and 4 litres per 100 km by the year 2020,
- To increase research and development expenditure for the non-nuclear energy sector by at least 30 per cent, while at the same time focusing research programmes on sustainable technologies,[6]

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1 Dissenting opinion by the expert Jürgen-Friedrich Hake:
The increase of 3 per cent p.a. postulated above is completely unrealistic. Between 1991 and 2001, the average increase in energy productivity achieved was 1.4 per cent per year.

2 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
It is not possible to fix specific absolute reduction targets in the framework of a sustainable energy supply concept; instead, such targets can only be the result of a strategy that is ecologically and economically sound and socially acceptable.

3 Dissenting opinion by the expert Dr. Hans Jörg Henne:
This objective is in conflict with the policy pursued by the German Federal Government, because this much discussed target of reducing emissions by 40 per cent was deliberately not included in the Federal Government's sustainable development strategy; instead, the Government publicly dissociated itself from this target.

4 Dissenting opinion by Franz Obermeier, MP:
If electricity generation from renewables is to grow, it must become cost-effective, while giving fair consideration to external costs. However, it is an illusion to believe that electricity generation from renewables can be increased by a factor of 4 and from CHP plants by a factor of 2 to 3.

5 Dissenting opinion by Kurt-Dieter Grill, MP:
Electricity generation from CHP plants can only be increased if the heat generated in this process is used at the same time.

6 Dissenting opinion by Walter Hirche, MP:
Further research should also study sustainable forms of the use of nuclear energy (nuclear fission and fusion).

- To achieve or maintain the leading global position in research and development in the fields of energy-conserving technologies and renewable energy generation technologies, and
- To increase the volume allocated to environmentally sound energy generation and conservation technologies in the field of development co-operation.

(70) The Commission recommends that the **strategies** adopted to implement these objectives should be attuned to the foreseeable general economic and political development. The Commission suggests that the most effective way to counter fears that these objectives may overtax our economic capabilities is to start the process as soon as possible because the resulting optimisation in small steps will then lead to the most cost-effective development. To this end, Germany will also have to play a pioneer role in the introduction of innovation and the diffusion of sustainable technologies.[1] The Commission recommends that the following actions should be taken as part of the strategy to be pursued:

- Modernising the German economy (which will be necessary anyway in the next few decades against the background of globalisation and liberalisation). This should be achieved by means of a goal-oriented and long-term integrated policy approach, which should also be aimed at transforming the German energy supply structures into a sustainable energy system.
- Embedding national strategies in the international context – especially that of the EU. This will require reformed, efficient structures. The Commission feels that this does not bar Germany from playing a pioneer role; instead, Germany's example will motivate other countries to follow suit.
- Accelerating the development of the knowledge society, while giving due consideration to the sustainable development objectives. To this end, research and development efforts should be strongly focused on sustainable development objectives. An innovation-oriented technology policy will create and safeguard jobs in Germany and open up new opportunities ("first-mover advantages") for German companies in the world markets.

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[1] Dissenting opinion by the expert Professor Dr. Volker Schindler:
Any pioneer role presupposes economic strength. Playing such a role only makes sense if others follow suit.

- Providing more funding for activities that will help tap the potential for efficient energy supply and use (as a first step, so-called “no-regret” measures), and the use of renewable energy sources should be systematically increased.[1]
- Stepping up efforts to transfer capital, technology and know-how from the industrialised nations for the energy sector and to engage in fair energy-related co-operation with developing countries, newly industrialised countries, and countries in transition.

**Instruments and measures**

(71) The Commission agreed that the provision or the preservation of public goods, the removal of obstacles to competition and the internalisation of external costs are legitimate reasons for governmental intervention. The type, scope and duration of such intervention will depend on the degree to which the market or competition has failed in a given case.

(72) The Commission has thoroughly dealt with those instruments that it believed to be particularly effective with a view to achieving sustainable development, also bearing in mind that the general setting will change as a result of globalisation and liberalisation. The overview below shows the major categories of instruments, from which the Commission then selected specific instruments.

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[1] Dissenting opinion by Professor Dr. Paul Laufs, MP:
Why new technologies in the field of conventional energy sources are not considered to be worthy of funding remains a mystery.

**Table 1-1: Overview of the Various Categories of Instruments Discussed**

<table>
<tr><td colspan="2">International Instruments</td><td colspan="5">National Instruments</td></tr>
<tr><td>Global Instruments</td><td>EU Instruments</td><td colspan="2">Instruments with Global Effects</td><td colspan="3">Specific Instruments</td></tr>
<tr><td rowspan="4">Kyoto mechanisms<br><br>Development co-operation<br><br>External energy and environmental policies<br><br>Other global governance structures</td><td rowspan="4">European system of tradable emission permits<br><br>Directives and funding programmes<br><br>EURATOM revision<br><br>Energy competence of the EU</td><td>General instruments</td><td>Specific global warming management instruments</td><td>Sector-specific</td><td>Technology-specific</td><td>Player-specific</td></tr>
<tr><td rowspan="3">For example:<br><br>liberalisation<br><br>reduction of subsidies</td><td rowspan="3">For example:<br><br>ecological tax reform<br><br>local global warming management activities</td><td>Electricity</td><td>EEU[1)]</td><td>Plant operators</td></tr>
<tr><td>Heat</td><td>CHP[2)]</td><td>End users</td></tr>
<tr><td>Transport</td><td>RES[3)]</td><td>Manu-facturers</td></tr>
<tr><td colspan="7">Policy Mix</td></tr>
</table>

1) EEU stands for efficient energy use.
2) CHP stands for combined heat and power.
3) RES stands for renewable energy sources.

(73) In order to have a yardstick for assessing the quality of the instruments selected, the Commission proposed the use of a matrix of criteria for the assessment of the instruments. Table 1-2 provides an overview of the criteria applied.

**Table 1-2: Overview of the Criteria Applied**

| Overriding Criterion | Specific Criteria |
|---|---|
| Goal achievement | Effectiveness / goal achievement / controllability |
| | Spin-offs / achievement of secondary objectives |
| Economic efficiency | (statistical) cost efficiency (incl. administrative effort involved) |
| | Dynamic efficiency |
| | Equitable allocation of cost to polluters |
| Feasibility | Affordability |
| | Compatibility with EU |
| | Political feasibility / acceptability |
| Quality of implementation | Practicability |
| | Social acceptability |
| | Promotion of competition |
| | Conformity with market / competition |
| | Compatibility with other instruments |
| | Flexibility / modifiability |
| | Transparency |
| | Trade-offs / environmental effects |

(74) The Commission would like to emphasise that it is eminently important to define clear objectives with regard to the policy mix to be pursued to achieve sustainable energy management. A flexible set of instruments can then be used to attain these objectives. The Commission explicitly points out that it is necessary to use not only national and international instruments but also general and specific instruments in order to achieve the sustainable development objectives.

**The Policy Mix for Sustainable Energy Supply**

Clear objectives, flexible use of instruments

Internationally harmonised as well as supporting national instruments

General as well as specific instruments

**Instrument mix instead of one panacea**

Adjustment of instruments to market or competition cycles

Integrating economic instruments into the political and social context

(75) In addition, the Commission firmly believes that the political and social context will always have to be taken into consideration when choosing economic instruments. Hence, the effects of instruments may differ, so that the use of instruments will always have to be adapted to the prevailing environment.

**Sustainable energy supply: Recommendations for action**

(76) The Commission's recommendations for action are focused on the next 10 to 15 years. What can be done now, should be implemented. In the energy sector, top priority should be given to the development, improvement and implementation of sustainable development strategies that can be operationalised. More specifically, the Commission recommends that the German Bundestag should focus on the following issues and adopt initiatives to this effect:

**National approaches**

- Continuing to pursue liberalisation by using regulation to facilitate and safeguard competition
- Developing a greater variety of players, removing obstacles
- Preventing concentration of power and oligopolies, tightening provisions on merger control, involving Parliament in the decision-making process when exemptions are granted
- Adopting a grid access ordinance and establishing a competition authority that will act ex ante, if current provisions prove to be ineffective
- Eliminating privileges and subsidies that are not compatible with sustainable development objectives[1]
- Transferring the energy industry's provisions for the decommissioning of nuclear power stations to a public fund[2]

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
It is not clear whether this statement suggests that the hard coal subsidies should be eliminated.

[2] Dissenting opinion by Walter Hirche, MP:
This proposal is in conflict with the fiscal law system. Such conflicts must be avoided.

- Committing the Federal Republic of Germany to reducing the national greenhouse gas emissions by 40 per cent by the year 2020, relative to 1990[1] [2]
- Supplementing the centralised supply structures by decentralised options
- Consistently optimising the CHP Act (*KWK-Gesetz*) as a function of the evaluation to be carried out in 2004[3]
- Optimising the Renewables Act (*EEG – Erneuerbare Energiengesetz*) and the market introduction programme as well as the loan programmes[4]
- Introducing quantitative quotas as an environmental protection obligation for the players in the distribution chain of fossil fuels for the RES heat sector[5]
- Substantially increasing energy efficiency on the demand side and organising or supporting properly functioning competition for energy services
- Establishing an Energy Efficiency Fund[6]

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1 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
Any commitment of Germany must take into consideration Germany's international competitiveness. A commitment to a reduction target of 40 per cent by the year 2020 can only be provisional; it will have to be continuously reviewed to see whether it is reasonable in the light of new findings.

2 Dissenting opinion by the expert Dr. Hans Jörg Henne:
Such high commitments must be seen in an international context. Fundamental prerequisites for such commitments are their social acceptability and economic feasibility as well as the preservation of Germany's competitiveness.

3 Dissenting opinion by the expert Professor Dr. Volker Schindler:
One of the very problems of the CHP Act (*KWK-Gesetz*) is that it does not comply with the ecological criteria because it excludes efficiency criteria. CHP can make sense, especially in the industrial sector because heat consumption is guaranteed there.

4 Dissenting opinion by Franz Obermeier, MP:
The Renewables Act is an act that provides subsidies instead of promoting innovations. The Renewables Act will have to be reviewed, also against the background of the German Federal Government's status report in order not to create another area that will be permanently dependent on subsidies.

5 Dissenting opinion by Professor Dr. Paul Laufs, MP:
In a market economy, quantitative quotas will not produce the desired results; instead, such quotas will segment the markets.

6 Dissenting opinion by Kurt-Dieter Grill, MP:
This would be circumventing Parliament's budget privilege and thus lead to the development of shadow budgets, which is not acceptable.

- Optimising the eco-tax (without having a net impact on total tax revenues) as an instrument for internalising external costs (comprehensive ecological fiscal reform)[1]
- Introducing an EU system of tradable emission permits in Germany[2]
- Removing a large number of administrative and legal obstacles that prevent a large-scale expansion of energy-related services, the development of an energy services sector, and the use of renewable energy sources
- Adopting a set of measures designed to promote retrofitting existing buildings with thermal insulation materials in connection with the use of efficient space heating and water heating technologies (increasingly based on renewable energy sources)
- Strengthening and promoting the variety of additional and more regionally oriented players, as well as smaller generators and self-sufficient energy users
- Launching a research and education initiative for sustainable technologies [energy efficiency (including more efficient and "cleaner" coal-based technologies) and the use of renewables]; establishing an integrated research, development and education programme (run by the Federal Government and Germany's state-level governments) for an efficient and economic use of electricity (RAVEL/RAWINE programme)
- Establishing a research and development programme for socio-ecological "energy" research (scope for energy conservation through changes in behaviour and life-styles)[3]
- Establishing an enquete commission to deal with "Sustainable Mobility" in the next legislative period

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1 Dissenting opinion by the expert Professor Dr. Volker Schindler:
This is obviously inconsistent with the policy pursued by the German Federal Government.

2 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
This raises the question as to the implementation of such a system and the definition of the underlying assumptions. The successful use of this instrument depends on these two factors.

3 Dissenting opinion by the expert Jürgen-Friedrich Hake:
As the findings of the hearing held by the Enquete Commission have shown, the energy conservation potential in this area is expected to be very limited. For this reason, only very limited funds should be made available for research in this area in order to ensure an adequate cost/benefit ratio.

**Potential actions in the field of European policies**

- Creating energy markets with transparent and equal framework conditions within the EU
- Incorporating an Energy Chapter into the EC Treaty or the future EU Treaty, giving priority to energy efficiency and the use of renewable energy sources[1]
- Terminating the EURATOM Treaty and exercising extensive parliamentary control over the framework research programmes[2]
- Playing an active role in the EU's eastern enlargement (setting ecological standards, promoting policies designed to increase energy efficiency and to use renewables, supporting efforts to phase out nuclear energy, to restructure the energy sector and to initiate liberalisation)[3]

**Potential actions in the field of international policies**

- Establishing partnerships with developing countries, newly industrialised countries and countries in transition, with Germany serving as a model for the development and the optimisation of future energy systems
- Implementing a German and a European initiative to export renewable energy and efficiency technologies to developing and newly industrialised countries
- Acknowledging the new foreign policy dimension of energy policy by co-operating with today's and future energy-supplying countries and regions
- Establishing a special fund designed to provide systematic support for the introduction of the project-based mechanisms of the Kyoto Protocol (DUFIeM Fund)[4]

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1 Dissenting opinion by Franz Obermeier, MP:
I am against the creation of a separate energy chapter in the EU Treaty.

2 Dissenting opinion by Kurt-Dieter Grill, MP:
This is clearly incompatible with the interest of Germany's international obligations.

3 Dissenting opinion by the expert Dr. Hans Jörg Henne:
The countries of Eastern Europe should be allowed to exercise their sovereign right to decide for themselves what energy policies they want to pursue in the future.

4 Dissenting opinion by Walter Hirche, MP:
As a matter of principle, any support for the introduction of such mechanisms should only be granted within the framework of the existing organisations (ECB, IMF)

## Preliminary remarks

(77) The following abridged version is guided by the structure of the present Report. The Report begins by presenting the system of objectives to be pursued in the interest of sustainable energy supply (Chapter 1.2). This is followed by a description and discussion of the variety of conceivable "futures" for the period until 2050; this is done in the form of available scientific projections on a European and global scale, based on demographic, economic and energy-related variables (Chapter 1.3). The description and comparative evaluation of the various scenarios for the German energy system, which were prepared on behalf of the Commission, begins in Chapter 1.4 with the reference scenario ("business as usual"). This scenario is compared with energy consumption or emission reduction potentials in an analysis of specific sectors, technologies and behavioural patterns. The Commission comes to the conclusion that these reduction potentials amount to over 50 per cent of the current primary energy consumption. The philosophies underlying the three target scenarios (described in Chapter 1.5) were chosen so as to permit sufficiently characteristic development paths to be derived from their comparison. The development path "3E" (energy conservation, increasing energy efficiency, use of renewables), which the majority of the Commission members consider to be most effective, is then used as a basis to develop political strategies (Chapter 1.6), for which matching and suitable instruments are also described. Finally, Chapter 1.7 presents recommendations for action which are intended to be not only a basis for the development of a long-term national strategy but also a contribution toward the European and international energy policy debate.

## 1.2 Objectives of a sustainable energy system

(78) The production and consumption patterns that currently predominate worldwide create major environmental problems. The release of substances into the environment due to non-closed material cycles, the high energy consumption associated with these production and consumption patterns, the resulting emissions and the nuclear risks, as well as the vast areas of land used, are not compatible with the concept of sustainable development.[1]

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
Any energy conversion system involves risks that must be controlled by means of risk management. The decision on whether a given system should be used is the result of a risk analysis that examines alternative options.

(79) In its First Report, the Commission already stated that the current consensus was that the model of "sustainable development" encompassed three dimensions: the conservative use and preservation of natural life support systems, as well as the social and economic development. Bearing this in mind, the Commission wanted to define ecological, social and economic objectives that should be largely compatible with each other.

(80) The majority of the Commission's members feel that it is possible to identify objectifiable natural barriers for ecosystems and the atmosphere – barriers that as a matter of principle impose limits on human activities. The term "natural barrier"[1] is used metaphorically to indicate that nature imposes limits on man-made interventions in natural cycles, and that going beyond these limits is associated with unacceptable risks for the individual and society at large. However, these "natural barriers" are not rigid boundaries; they can be identified in terms of ranges, rather than clearly defined limit.[2]

(81) This leads to a hierarchy of sustainable development objectives that are not consistent with the factual priority still granted to economic objectives today: Any irreversible damage to natural life support systems must be prevented because intact natural resources are the prerequisite to economic and social development. For this reason, the Commission first defines the requirements to be met by a sustainable energy supply system from an ecological perspective. This leads to the emergence of a corridor of objectives, within which it is then possible to define social and economic objectives.[3]

(82) For the Commission, the overriding energy-related objective is to achieve a substantial reduction – in absolute and per-capita terms – in the energy consumption of today's industrialised nations by the middle of this century, while at the same time increasing the standard of living in all countries worldwide, including the developing and the newly

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1 Dissenting opinion by the expert Jürgen-Friedrich Hake:
The postulated "natural barrier", which is exclusively politically motivated, is an attempt at legitimating an interventionist government. Since there is no scientific evidence to rely on, ideology is used as a substitute.

2 Dissenting opinion by the expert Jürgen-Friedrich Hake:
The term "natural barrier" is not appropriate to describe the complex and dynamic (usually interrelated) processes that occur in the environment. This term is methodologically outdated and should therefore not be used as a "guard rail" or as a "range indicator" either.

3 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
There is no factual priority for any one of the sustainable development objectives. Economic, ecological and social objectives are of equal weight and rank.

industrialised countries (absolute decoupling).[1] In view of the rapid population growth that is expected in the developing and newly industrialised countries, this is a particular challenge. In principle, it will only be possible to master this challenge if we develop, and make widespread use of, efficient and low-emission (emission-free) technologies, as well as new organisational forms of energy conversion (e.g. virtual power stations) and energy use along the entire conversion chain, i.e. ranging from the development and production of end-point and usable energy to the demand for energy services. The Commission assumes that more efficient use of energy should take precedence over energy generation from non-renewable energy sources.

(83) The Commission expects that major contributions toward the development of sustainable energy generation structures will be made at regional and local level. Companies and other players acting at local and regional level will have to make greater use of their opportunities in order to be able to cope with the challenges and problems associated with more efficiently using energy and materials, recycling energy-intensive materials, and making more intensive use of products and product-related services. Often, various players from different production stages and trades have to co-operate in order to achieve optimised system solutions. An optimisation across various stages of production can help reach a qualitatively new dimension in increasing energy efficiency and in using renewable energy sources, while at the same time reducing energy consumption, transport requirements and material flows.

(84) The search and discovery processes of competition and market forces must be guided by the fundamental objectives of sustainable development. On the one hand, this is the only way to avoid misguided developments that put into question the objective of sustainable development; on the other hand, such processes are a key instrument to identify, and combine with each other, the wide variety of options available to achieve sustainable development. Competition and the market are not only the objectives; they are also important instruments for the implementation of the principle of sustainable development. However, this also means that it is necessary to monitor continuously whether, and in what way, specific allocation mechanisms of the market comply with the sustainable development principle in reality.

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[1] Dissenting opinion by Franz Obermeier, MP:
Energy consumption as such is not a relevant environmental criterion. It can even make ecological sense to consume more energy if this is associated with lower emissions (e.g. using district heating from CHP instead of building minimum-energy houses).

(85) The possibilities for transferring and spreading technological, organisational, entrepreneurial and political innovations to developing and newly industrialised countries, while taking into consideration local conditions, can make a major contribution toward achieving sustainable development if the industrialised nations with their substantial capabilities in terms of research, innovation and financial resources take the lead and support this process.

(86) The discussion on sustainable development loses its random character if agreement is reached in a democratic process about quantified environmental quality objectives and key indicators. The Commission has defined the following concrete objectives for the area of energy generation, energy use and energy services.

**Ecological objectives**

(87) The global reduction of energy-related greenhouse gases is the core of energy and transport policies designed to achieve sustainable development. The goal must be to stabilise the global climate. To this end, it is necessary to reduce global $CO_2$ emissions by approximately 50 per cent by the year 2050, relative to today's level. The Commission considers that it is necessary to reduce greenhouse gas emissions in the industrialised nations (i.e. also in Germany) by 40 per cent by the year 2020, by 50 per cent by the year 2030 and by 80 per cent by the year 2050, relative to 1990.[1] This would provide a sustainable development perspective to the over 80 per cent of the world population who live in developing countries.[2]

(88) The concentrations of harmful substances like sulphur dioxide, nitrogen oxides and ammonia, which are responsible for the acidification of soils and water resources, must be reduced below the so-called critical loads in all regions worldwide, and emissions of fine and ultra-fine particles will have to be reduced by 99 per cent in a long-term perspective.

(89) By the year 2050, the quality of water resources used as cooling water for the purpose of energy generation, as well as in hydro-electric power plants and in mining facilities should not drop below water quality grade II as defined in Germany.

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[1] In Chapter 5, the Commission evaluates various scenarios on future $CO_2$ emissions as a function of different mixes of energy sources.

[2] Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
Such targets impose considerable burdens on national economies.

(90) The net use of land for residential settlement and transport purposes and for the extraction of raw materials should be reduced to zero by the year 2050. This means that additional use of land will only be acceptable if it is accompanied by measures that will make up for this loss of land.[1]

(91) The majority of the members of the Commission believes that the global energy supply system should be designed in such a way that they will no longer generate any highly radioactive waste in future, which will have to be stored in repositories over geological periods of time. The volume of such waste that already exists today must no longer be allowed to grow substantially; the storage of such waste today is already one of the greatest challenges for the sustainable management of economic activities in the next few decades.

(92) The risk of extremely serious accidents occurring in energy generation facilities (e.g. in large-scale hydroelectric plants or nuclear power stations), leading to very large-scale damage and long-term effects, must be minimised as quickly as possible.[2] Since the reactor concepts that are foreseeable today cannot safely avoid the risk of large-scale reactor accidents – quite apart from hazards caused by terrorism – the Commission supports an accelerated phase-out of the use of nuclear energy in Germany.[3]

**Social objectives**[4]

(93) All citizens must be given free and reliable access to services in the energy sector; this is part of the obligation of government to provide “services of general economic interest”. This obligation implies providing affordable and safe access to efficient, state-of-the-art energy supply systems.

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1 Dissenting opinion by the expert Professor Dr. Volker Schindler:
Such a demand is unrealistic in view of the expected growth rates of the world population. In addition, this topic was never discussed by the Enquete Commission.

2 Dissenting opinion by Kurt-Dieter Grill, MP:
The use of nuclear energy can be technologically designed in such a way that it is controllable. As such, it should be further developed as a potential energy option. And providing that there is acceptance for nuclear energy in society, it should be used as a source of energy.

3 Dissenting opinion by Dr. Ralf Brauksiepe, MP:
With its decision to build a new nuclear power station, Finland has proven that it is very well possible to implement the priority given to global warming management by means of a different policy.

4 Dissenting opinion by Walter Hirche, MP:
The various points clearly reflect the planned economy approach that underlies them. Costs are apparently not incurred if this approach is implemented. The “free-lunch policy” propagated by the SPD and BÜNDNIS 90/DIE GRÜNEN could not be more blatant.

(94) For a given level of energy services, the percentage share of money spent by private households on energy costs – relative to their total budget – should not be allowed to increase.[1]

(95) The energy supply system must be subject to democratic decision-making structures in order to compensate for market power and to settle conflicts connected with the use of resources or environmental problems associated with the use of energy. Structures that are error-prone and lead to irreversible developments should be avoided. Suitable measures should be adopted to increase the democratic participation of all groups in society in energy-related decision-making processes.

(96) The Commission feels that it is indispensable that the decision-making scope of future generations should not be curtailed more than is absolutely necessary in order to solve current problems and preserve future options.

(97) The lives and health of employees in the energy sector must be protected. Stringent requirements must be met in terms of health and safety at work. The goal of replacing the number of jobs lost by creating new jobs must be vigorously pursued. This also calls for an active labour market policy to be pursued by the Government. In the framework of structural change and the reorientation toward a sustainable energy supply system, as many substitute jobs as possible should be created in the fields of efficient energy use or future energy sources at locations where energy industry facilities are based today.

(98) The interests of workers (working conditions, wages, social security benefits, shorter working hours, new, flexible forms of work, co-determination) should be safeguarded and promoted in the entire sector of energy generation and energy use as part of the overall development.

(99) Growing importance should be attached to sustainable forms of energy generation and energy use in the training provided by general universities, universities of applied science and craft training institutions, and in further education programmes available at all levels of energy supply and energy use.

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[1] Dissenting opinion by Professor Dr. Paul Laufs:
The objectives listed here with regard to energy costs are in blatant conflict with the measures proposed earlier on.

**Economic objectives**

(100) Energy productivity (the ratio of real economic performance to primary energy consumption) is expected to increase by a factor of 2.5 between 1990 and 2020, and by a factor of 4 by the year 2050. This is equivalent to an average annual energy productivity growth rate of 3.1 per cent (by the year 2020) and 2.4 per cent (by the year 2050). This ambitious goal seems achievable if the demand side can be included more consistently in the strategies designed to increase efficiency. Energy efficiency activities will also reduce the external costs of the energy supply system.[1]

(101) Because of the high capital requirements and the long investment cycles in the energy sector, it is indispensable for the energy industry to adopt a long-term and sustainable approach. The high standards in terms of reliability and safety that currently apply in Germany's energy sector must be preserved; for this reason, any new plants that will be built in Germany in the course of the reinvestment cycle of German power stations will have to be based on the most efficient technology. To this end, particular efforts should be made to increase the use of combined heat and power generation and to introduce renewable energy sources in the market.

(102) The general environment for German industry must be designed in such a way that it can become an innovative driving force for new technologies and for energy efficiency along the entire conversion chain. Such innovations can also help improve German industry's international competitive position (first-mover advantage).

(103) It is necessary to preserve and increase the competitiveness of German industry as well as small and medium-sized enterprises (SMEs). In order to improve supply reliability and to protect Germany against unpredictable price developments – especially in the world oil markets – it is necessary to reduce Germany's dependence on imports of energy sources, to pursue a stockpiling policy and to diversify the structure of energy sources, especially in the field of road transport, which currently is fully dependent on petroleum.[2]

(104) Contrary to all the targets set, the transport sector is the source of growing greenhouse gas emissions worldwide. Currently, the industrialised nations account for the

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
These growth rates have been chosen arbitrarily. In view of the fact that the average growth rate amounted to 1.4 per cent between 1991 and 2001, these targets are unrealistic. Reality is being replaced by wishful thinking.

[2] Dissenting opinion by Professor Dr. Paul Laufs, MP:
Regrettably, the role of the EU is completely ignored. This renders the statements useless.

largest proportion of the global transport volume, which is why a reduction of $CO_2$ emissions in the transport sector continues to be a challenge primarily for the industrialised nations. It will be necessary to find solutions that decouple transport services from fuel consumption much more than in the past. The Commission recommends that measures should be introduced to stabilise the total mileage in the fields of motor vehicle road transport and in aviation by the year 2010. To this end, it seems necessary to limit the increase in the volume of road freight traffic and air traffic.[1]

(105) The developing countries and the countries in transition must be given scope to increase their standard of living. In order to ensure that this will not lead to high – and thus unsustainable – growth rates of world energy consumption, the industrialised nations will have to make sure that the know-how, plants, machinery and vehicles they export are in keeping with state-of-the-art technology. This can help to achieve a development effect that is referred to as “leap frogging”. Such an effect will enable developing countries and countries in transition to “leap” across certain technological development stages and to accelerate the use of state-of-the-art technologies for a sustainable energy supply system while the development process is still ongoing.

## 1.3 Geopolitical, international and European trends

(106) Chapter 3 outlines the global and European conditions required for a future sustainable energy supply system and the prospects for such a system. In this Chapter, the Commission begins by describing global and regional economic and demographic trends and their effects on political stability and geopolitics. The key factors that will influence specific developments in Germany in the next few decades are the trends and changes that are emerging at the level of the European Union. These trends are described at the end of the Chapter.

(107) According to various projections, the world population will increase to between 9 and 11 billion people by the middle of this century. This overall trend is composed of a wide variety of very different regional trends: Europe, including the Central and Eastern European countries, as well as the former Soviet Union and Japan will have to reckon with an ageing

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[1] Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
In an open society, the objective cannot be to adopt measures that will limit the transport volume; instead, ways will have to be found to reduce emissions. Transport activities are a consequence of economic activities; they cannot be limited separately without having adverse repercussions on the economy.

and shrinking population, while the population of many of today's developing countries and that of North America will grow. The population of China will probably stabilise, while the Indian population will continue to grow substantially. Particularly dramatic trends are expected for sub-Saharan Africa, where the population is expected to decrease, perhaps even substantially so. The population trends in the OPEC countries are particularly relevant for the energy supply situation. In these countries, the population is expected to grow – in some cases even so much so that there will be a growing risk of social and political instability. Worldwide – however especially in the countries of the South – the urbanisation trend will persist: In the year 2050, approximately 5 billion people will live in mega-cities, compared with 2.4 billion today.

(108) The assumptions made in the various scenarios with regard to future global economic growth vary widely; they range from 0.9 to 2.6 per cent annually. On a global average, these estimates will lead to a per-capita gross domestic product of between US$ 7,000 and US$ 20,000 per inhabitant by the year 2050. Most of the projections predict that the economic imbalances in the distribution between North and South will tend to persist, even if some countries in Asia and Latin America will be able to catch up with the OECD. In some countries, the income differences are likely to become even more pronounced. The growing social and political polarisation associated with such a development is not in keeping with the principles of an equitable world economic order. In addition, it could also lead to greater risks of terrorism, and in the final analysis, to global destabilisation.[1] For this reason, engaging in development co-operation and combating poverty are eminently important for a global policy of sustainable development because they help defuse potential conflicts.

(109) Geopolitically, the number of strategically important countries will increase as the current bipolar world is replaced by a multipolar world. Such countries will include India, China and the large Latin American countries, for instance, and not least, Russia will also play a more powerful role again. International and domestic conflicts – especially in the Middle East and in the Gulf region – could hamper oil and gas production and transport, which could destabilise the world energy market. Relative to this potential problem, the problem of the growing physical shortage of energy raw materials in the periods under review tends to be less relevant. In order to build up a sustainable global energy supply system, it will therefore be necessary to adopt foreign policy initiatives – also for the sake of securing

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[1] Dissenting opinion by the expert Dr. Hans-Jörg Henne:
The latest experience with terrorism does not corroborate the alleged effects of a so-called equitable world economic order.

peace – in the Middle East and in the Caspian region, in Iran and in North Africa, also with a view to Russia.

(110) "Integrative globalisation" that is oriented towards sustainable development provides an opportunity to integrate currently underprivileged countries into global economic cycles and more sustainable development prospects, and thus to stabilise them. This could help contain polarisation and confrontation in an economically more interdependent world which can lead to re-nationalisation, new forms of protectionism and isolationism. In order to utilise the advantages and opportunities of integrative globalisation, it will be necessary to make greater use of new and established forms of international co-operation (WTO, Rio follow-up process, etc.) and to focus them on the overriding objective of sustainable development. International environmental policy is an important field for action in this context.

(111) Long-term projections of energy consumption and greenhouse gas emissions provide some clues as to the developments that can be expected or influenced in terms of environmental problems and energy supply security under trend conditions. To this end, the Commission examines the scenarios of the IPCC, the scenarios of the World Energy Conference, the "Factor-4" scenario of the Wuppertal Institute, as well as the projections of the US Energy Information Agency and the OECD/IEA. Because of different scenario paths and assumptions, the predicted results vary widely. Depending on the underlying growth assumptions, for instance, primary energy demand varies by a factor of three; demand predictions for various regions – also in the OECD countries – differ by a factor of four, especially due to different assumptions with regard to the future development of efficiency. There are even greater uncertainties when it comes to the developing regions. As a result, predicted greenhouse gas concentrations vary widely; however, there are only very few scenario paths that can lead to a stabilisation of atmospheric greenhouse gas concentrations at a level that would still be tolerable (450 to 500 ppm). The Commission feels that these scenario predictions suggest that a deliberate global warming management policy will have to be pursued and a fundamental change in the energy supply systems will have to brought about – not only in the OECD region, but in future also in the countries of the South – if we want to stabilise atmospheric greenhouse gas concentrations as postulated in the UN Framework Convention on Climate Change at a level that can help avoid dangerous consequences of climate change for human societies.

(112) However, despite all the differences, it is possible to derive some robust strategies from the various scenarios: All scenarios that lead to a stabilisation of greenhouse gas concentrations at a level that is still acceptable, which is a key prerequisite for sustainable

development, share the following strategy elements:[1] Fossil fuels will become less important, and the carbon-intensity of fossil energy sources will decrease on a global average. This means that there will be a trend away from the use of high-carbon fossil fuels. In these scenarios, it is assumed that energy efficiency will improve substantially, in fact on a global average by a factor of between 2.3 and 3.1 in the next 50 years. During the same period of time, the use of renewable energy sources is expected to increase by a factor of between 7 and 8. As far as nuclear energy is concerned, the scenarios are based on different assumptions in terms of fundamental policy decisions taken in society. However, even if one assumes that there will be acceptance of the use of nuclear energy worldwide, its contribution to the overall effect remains limited in most scenarios.[2]

(113) Germany's energy supply system and energy policy is increasingly being influenced by the European Union, especially by the European framework legislation in the fields of competition and environmental policies, and by the leading role that the European Union jointly plays in the global warming management process. Directives designed to establish an internal market for electricity and gas, to promote the use of renewable energy sources, to increase energy efficiency and to limit emissions of harmful substances or the Kyoto Protocol create a growing need for coordinating efforts within the European Union. Current plans to introduce a system of tradable emission permits within the EU as well as measures designed to provide supply security are opening up new dimensions of European policies. Conversely, traditional treaties such as EURATOM[3] will have to be reviewed to decide whether they have become outdated and whether they meet the criteria of sustainable development. The objective is to ensure that these international treaties should be largely free of contradictions with each other and with national legislation. The distribution of responsibilities for fields of action that are relevant to energy policy should be consistent.

(114) Other developments will be triggered by the planned enlargement of the EU to include the countries of Central and Eastern Europe. Although the economic power and the

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1 Dissenting opinion by Franz Obermeier, MP:
The definition of what an acceptable level is remains unclear. Obviously, the intention is to exclude scenarios that include the use of nuclear energy.

2 Dissenting opinion by Kurt-Dieter Grill, MP:
The term "limited contribution to the overall effect" is vague; it is obviously intended to disguise the fact that without the use of nuclear energy, it is impossible to achieve the international global warming management objectives.

3 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
The demand for a review of the EURATOM Treaty is inconsistent with the termination of the Treaty postulated by the majority of the Commission's members in Chapter 1.1 – European Policy Approaches.

purchasing power of these countries are much weaker than in the Western European countries, they will have to implement major structural reforms. This also applies to their energy supply systems. Energy prices and energy markets will be liberalised. At the same time, old facilities will have to be modernised or replaced, inter alia, in order to comply with European environmental and safety standards. It will be particularly necessary to step up efforts in order to increase energy efficiency in the fields of energy generation and energy use because there are particularly substantial shortcomings in these areas.

(115) The outlook with regard to the future developments in Europe is determined by the fact that – despite liberalisation – the electricity and gas markets remain largely nationally oriented and organised, even if the operations of the large utility companies have become more and more international. For this reason, it is necessary to step up efforts at European level in order to reduce this discrepancy by further expanding the internal European market and by creating consistent ecological and competitive conditions for the liberalised energy markets, and in order to remove obstacles that hinder the substitution of efficient technologies for the use of energy.

## 1.4 The development in Germany: Potentials and scenarios

(116) In order to be able to design strategies aimed at developing a sustainable organisation in the future energy industry, it is necessary to develop concepts regarding the possible effects – up to the year 2050 – of a continuation of current trends and future trends to be expected in the development of demographic, social, technological, economic and political variables. These concepts are described in Chapter 4. An analysis of the developments in the past decade with regard to the elements of energy and greenhouse gas accounts shows that energy efficiency indicators have already improved considerably and that the increase in greenhouse gas emissions has been reduced. Nevertheless, there is still substantial scope for further improvements, which must be utilised.

(117) Between 1991 and 2001, for instance, the growth rate of the overall economy (1.5 per cent annually) was nearly identical to that of energy productivity (1.4 per cent annually); however, this also means that efficiency gains and economic growth “cancelled each other out” in terms of emission reductions. On the other hand, the sectoral energy consumption structure changed substantially in the 1990s: While industrial energy consumption – especially in the energy sector (i.e. from an energy balance perspective, in the energy conversion sectors), as well as in the manufacturing sector and in the fields of commerce, trade and services – was lower in the year 2000 than in 1990, it was considerably higher towards the end of this decade in other sectors, especially in the transport sector and also in

private households; furthermore, the consumption of fossil fuels for non-energy purposes also increased.

(118) The sectoral structure of energy consumption is also roughly reflected by the $CO_2$ emission levels: The energy sector was by far the largest source of $CO_2$ emissions, followed by the transport sector, the manufacturing sector, private households, and finally commerce, trade and services. Energy-related $CO_2$ emissions decreased much more rapidly than total primary energy consumption: In the year 2000, the emission level was approximately 15 per cent lower than in 1990. When adjusted for temperatures, $CO_2$ emissions decreased by 3 per cent on an annual average between 1990 and 2001. Between 1990 and 1993, emissions fell by 5.2 per cent annually in the wake of the German unification process; between 1993 and 2001, however, they only decreased by 2.1 per cent.

(119) A reference scenario that was developed on behalf of the Commission by PROGNOS AG in co-operation with the IER in Stuttgart and the Wuppertal Institute extrapolates this trend into the future (cf. Section 4.2). This reference scenario is based on optimistic assumptions with regard to the economic development and – more importantly – also with regard to energy efficiency improvements. In conjunction with the substantial population decline expected in the long term, the result will therefore be a sharp drop in energy use and a considerable increase in macroeconomic energy efficiency. Nevertheless, the energy path described by the reference scenario cannot be portrayed as being sustainable because the limited energy resources are still being used very extensively. More importantly, however, this scenario fails by a wide margin to reach the emission reduction targets that are required for the sake of global warming management; hence, the scenario does not comply with a key element of the sustainable development criteria.

(120) Against this background, the Commission has come to the conclusion that a development as described in the reference scenario is no more sustainable than the current energy supply system and that this scenario is therefore not an acceptable basis for the future. An extrapolation of the current trends in the development of the energy system will not lead to sustainable development. There is considerable need for action in terms of energy and environmental policies.[1]

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[1] Dissenting opinion by Kurt-Dieter Grill, MP:
The work done by the Commission did not produce any evidence that would justify such a lumpsum assessment of the reference scenario. In addition, these statements are inconsistent with the statements made in Chapter 1.1.

(121) In order to be able to assess the future ranges, opportunities, options and development prospects of changes in the energy sector, Section 4.3 thoroughly analyses the demand-side and supply-side opportunities and options of an efficient energy use and energy supply, a more efficient use of materials, and in particular, the opportunities and prospects of the use of renewable energy sources. The discussion is subdivided into sectors and fields of energy use; in this discussion, the Commission also draws attention to specific obstacles that might prevent the full use of the opportunities available, and it identifies actions that can be taken to overcome these obstacles. This analysis of technical opportunities is complemented by comments about a field that has not yet been studied very much, i.e. opportunities provided by behaviour-related changes with a view to sustainable energy use.

(122) For the various sectors analysed, the findings can be reduced to the following key statements:

(123) The energy consumption of private households, which account for nearly 28 per cent of total end-point energy consumption, is dominated by the demand for space heating. Replacing poorly insulated buildings or modernising them in order to achieve a more efficient use of energy can lead to considerable reductions in energy consumption. In this context, four parameters play a key role: the quality and consistency of the implementation of the principles of integral planning and execution (mix of measures consisting of cuts in energy consumption, greater efficiency and use of renewables); the behaviour of the inhabitants; the location of buildings (urban/rural); and finally the costs. State-of-the-art technology available today can help reduce the energy demand for existing buildings by approximately 70 per cent (“3-litre house”), simply by skilfully combining several well-known, proven measures. For new buildings, there are already numerous examples of how the energy efficiency of houses can be increased even further by using solar energy as the predominant or exclusive source of energy. There is also considerable scope to reduce the electricity consumption of private households, e.g. through the use of highly efficient household appliances, new lamps, as well as new heat pumps and heat regulation systems. The possibility to make appropriate use, as a first step, of stand-by circuits and then in future to install new electronic solutions in appliances, provides a substantial energy conservation potential. In addition, such energy-

conserving appliances are in many cases more cost-effective – over the entire product lifetime – than less efficient products.[1] [2]

(124) In the manufacturing sector, which accounts for over 25 per cent of energy consumption in Germany, there are still substantial economic opportunities to reduce energy consumption and greenhouse gas emissions. However, the important question is how these opportunities are utilised, and what methods can be used to devise measures. What is needed is the use of integrated approaches toward reducing energy and material flows, as well as substantial changes in the behaviour and organisational structure of companies, especially in small and medium-sized enterprises. Mobilising these potentials is made more difficult by the considerable technological heterogeneity of the use of energy. The substitution of processes and products is expected to make the greatest contribution toward increasing energy efficiency (between 30 and 80 per cent, depending on the field of application). Another major option is the integral planning and optimisation of industrial heating and cooling systems within companies and by way of co-operation between companies.

(125) The structure of the commerce, trade and services sector (CTS) is extremely heterogeneous, and the statistical data collected on the energy use of this sector are not very differentiated. In energy accounts, the energy consumption of this sector is obtained together with that of private households as the "remaining balance". The CTS sector currently accounts for approximately 16 per cent of total end-point energy demand in Germany, covered in roughly equal parts by gas, electricity and petroleum products. In the year 2000, the predominant use of energy in the CTS sector was for space heating (approx. 47 per cent), followed by mechanical energy (over 22 per cent), other process heat (14.5 per cent), as well as water heating (over 10 per cent) and lighting (approx. 6 per cent). In the CTS sector, there is also considerable scope for reducing energy consumption and $CO_2$ emissions, especially in following five cross-sectional areas that are significant for all segments of this sector: heating, cooling and air-conditioning, water heating, lighting and the use of electrical equipment. In many cases, however, there is a reluctance to utilise the reduction potentials available, e.g. because of a lack of cost-effectiveness in some areas,

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[1] Dissenting opinion by Professor Dr. Paul Laufs, MP:
It is not possible to discuss such substantial utilisation of opportunities on the basis of theoretical or technical reduction potentials. Instead, it is necessary to put forward more differentiated arguments, especially with regard to cost-effectiveness.

[2] Dissenting opinion by the expert Professor Dr. Volker Schindler:
As long as German tenancy law does not allow landlords to allocate the cost of energy efficiency measures to their tenants, these statements are meaningless.

insufficient incentives, or lack of capital, information and motivation of the players involved, and because of insufficient monitoring of the execution of projects. Hence, this would be a promising field for contracting activities.

(126) The transport sector currently accounts for approximately 22 per cent of energy-related $CO_2$ emissions in Germany and for 30 per cent of end-point energy consumption; in both cases, there is an upward trend. The energy consumption and $CO_2$ emissions caused by the transport sector are also rising worldwide. Past and expected future increases in total transport volumes are both the consequence of, and the prerequisite to, social and economic development. The fact that Europe is growing together to become a single economic area promotes the expansion of production and distribution networks. In order to reduce the manufacturing costs of German products, increasing use is being made of vendor parts supplied from, or components manufactured in, countries with lower labour costs.[1]

(127) European standards 4 and 5 are likely to ensure the required environmental quality by reducing emissions of air pollutants, i.e. CO, $NO_x$, non-burned hydrocarbons, particles, $SO_2$, heavy metals (except for very small-diameter waste gas particles). The most important energy sources (fuels) currently used in the German transport system are petrol (accounting for approx. 45 per cent), diesel (accounting for close to 42 per cent) and kerosene used in air traffic (accounting for nearly 11 per cent of total fuel consumption in this sector). Two-thirds of the energy consumption in the transport sector is due to passenger transport (as of 1999), with private motor vehicles accounting for the largest share. However, the trend in energy consumption for private passenger transport will stabilise in the next few years. Traffic volumes and vehicle mileages will then change to a very limited extent only, and vehicles with higher fuel efficiency will then be in use.

(128) In the past few years, considerable efforts have already been made to develop lighter-weight designs. However, most of the progress made in this area has been offset by the trend toward higher active and passive safety standards, reduced damage from minor accidents, greater convenience, etc. It is likely that car manufacturers will continue their efforts in the field of light-weight design in the future. Once a certain saturation with equipment and extras has been reached, the total weight of vehicles might begin to decrease.

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[1] Dissenting opinion by Franz Obermeier, MP:
This statement about a shift of German production plants to other countries is ignored when measures are proposed that will entail subsidies.

(129) In the past decade, the volume of (road) freight traffic has increased substantially. If the general conditions that prevail today stay as they are, it is expected that this disproportionate growth will continue in the future. In air traffic, stabilisation – let alone reduction – of traffic volumes is not to be expected because there is growing trend towards cross-border travel.

(130) One factor that will greatly influence the future development of demand for transport services will be the question to what extent and with what strategies external costs will be internalised. From a macroeconomic perspective, the Commission recommends that external costs should wherever possible be fully internalised by means of taxes and levies in order to prevent a macroeconomically inefficient over-utilisation of the factor "transport".[1]

(131) In addition to improving vehicle efficiency, it is also possible to reduce greenhouse gas emissions by modifying fuel characteristics. Conventional fuels can be further improved, and other primary energy sources can be used to synthesise fuels such as kerosene, petrol and diesel on the basis of renewable raw materials. This will make it possible to find a smooth transition from purely petroleum-based fuel supply to one that is completely independent of petroleum, and the pace of this transition can be freely chosen.[2]

(132) It is assumed that hydrogen – generated on a renewable basis – will have the best prospects in the long term, providing that the necessary infrastructure is built up. Methanol is also believed to offer benefits when used in commercial vehicles. However, when considering the overall system, it currently seems to be more advantageous to use electricity generated from renewable energy sources directly for vehicle drives. This will only change if and when a considerable improvement is achieved in the efficiency of the hydrogen supply chain.

(133) As far as passenger cars are concerned, the energy conservation technologies and the alternative drive/fuel concepts discussed above can help amplify the current trend in terms of expected reductions in energy consumption; in the medium to long term (up to 2050), such technologies and concepts will thus play an important role in energy policy and global warming management. Measures adopted to influence the growth of (road) freight

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[1] Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
In the case of modern passenger cars, the environmentally-related external costs already seem to be far surpassed today by the petroleum tax and the eco-tax; hence, they have already been fully internalised. To a lesser extent, this also applies to lorries.

[2] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
This suggests that it is possible to achieve a fundamental change in the structure of energy sources free of charge. This is not true.

traffic and air traffic volumes will be much more important in the short and medium term.[1] Against the background of the potential efficiency gains, the potential technologies that are foreseeable today, and other problems associated with the transport sector (land use, noise, accidents, etc.), it is absolutely essential to focus more on the development of demand (e.g. due to new settlement structures) and the choice of the mode of transport and to consistently try to find ways to reduce the traffic volume.

(134) Energy efficiency and climate compatibility are two aspects that should be considered by private households and companies whenever decisions are taken that affect transport. To this end, it is necessary to communicate the importance of these two criteria.[2]

(135) On balance, the electricity industry accounts for by far the largest portion of the segment "consumption and losses in the conversion sector". In the 1990s, the amount of energy used for electricity generation declined slightly, whereas the fuel structure changed considerably: While the use of lignite decreased, the use of nuclear energy increased, as did the shares of renewables and natural gas. In the 1990s, the mean efficiency of electricity generation improved from 36.5 per cent (1990) to 38.4 per cent (2000). This was mainly due not only to system optimisation but also – and more importantly – the application of new materials and plant concepts. In future, it will therefore also be possible to achieve additional increases in efficiency in conventional large-scale power plants – notwithstanding additional options to increase heat supply from cogeneration.

(136) In Germany, it will be necessary to create substitute capacity for, or cut electricity consumption by, between 40 and 60 GW in the first quarter of this century in order to replace old power plants that will be decommissioned; this will require an investment volume of over Euro 30 billion by the year 2020 and between Euro 50 billion and Euro 60 billion by the year 2030. Most of these investments should be made in Germany. Because of the substantial investment volume and the plants' long service life, electricity generation will play a key role for the sustainable development of the energy supply system. In addition to an optimisation of the power plant concepts that are extensively used today, several new power plant concepts will play an important role in future, e.g. state-of-the-art gas turbines used primarily in combined-cycle plants, possibly also in conjunction with coal gasification.

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[1] Dissenting opinion by Walter Hirche, MP:
The term "influence" as used here leaves open the degree of the intervention.

[2] Dissenting opinion by the expert Mr Jürgen-Friedrich Hake:
The wording of this paragraph obscures the fact that centrally planned interventions will be inevitable to achieve the objectives described.

(137) The amendment to the German Nuclear Power Act entered into force on 27 April 2002. According to the provisions of this amendment, the lifetime of current nuclear power stations will be limited, and no more permits will be issued for the construction of new nuclear power stations. The critical assessment of nuclear energy in terms of the three aspects "residual risk" (amplified by the current risk of terrorist attacks), "waste disposal and fuel reprocessing" as well as "risk of abuse" does not change in light of currently available technologies and foreseeable technological progress.[1] Despite improvements in fuel utilisation (higher fuel burnup, better plant efficiency, etc.) and in the operating characteristics of reactors that have been optimised in an evolutionary process, in principle the controversial questions regarding reactor safety and waste disposal remain unresolved.[2]

(138) Indisputably, cogeneration of electricity and heat (as well as cold, where applicable) in modern plants helps conserve energy and reduce $CO_2$ emissions.[3] In Germany, there are still considerable untapped potentials in this regard, also with a view to conserving substantial amounts of energy in the heat sector. About half of the overall technical potential is dependent on the availability and the cost-effective operability of very efficient CHP plants for decentralised supply of facilities and buildings (small-scale residential CHP units and fuel cells).

(139) State-of-the-art district heating plants as well as engine-powered and gas-turbine cogeneration systems can rely on sophisticated, perfected technologies for all capacity requirements. In addition, there is a whole series of new technologies (micro gas turbines, Stirling engines, fuel cells) that are currently in the demonstration phase or shortly before their market introduction phase. These new technologies, which are expected to provide further efficiency improvements and (to some extent) better operating characteristics, can be used in particular to broaden the range of applications for low-capacity requirements. As far as the fuel cell is concerned, this applies not only to small-scale CHP systems in the kilowatt range but also up to medium-scale CHP in the range of over 100 MW.

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1 Dissenting opinion by the expert Professor Dr. Volker Schindler:
The fact that other countries such as Finland build nuclear power plants demonstrates that this view is not shared by everyone. In Germany, the waste disposal issue has been "cast in concrete" politically.

2 Dissenting opinion by Professor Dr. Paul Laufs, MP:
The assessment of the benefits and drawbacks of nuclear energy technologies must be continuously reviewed in the light of new developments. It is impossible for this Enquete Commission to anticipate the assessment for a period of fifty years to come.

3 Dissenting opinion by Professor Dr. Paul Laufs, MP:
CHP only makes sense where the heat generated can actually be utilised. It is rare to find large-scale heat consumers with matching load curves.

(140) In view of the current progress being made in the development of various new technologies, major technological and economic improvements can be expected to be achieved in the course of the next 10 to 20 years. At the same time, the state-of-the-art CHP technologies perfectly match the currently emerging trend towards greater decentralisation and networking (cf. Chapter 4.3.7) in energy supply. However, substantial market success will depend in particular on a favourable energy policy setting and on continuous and focused research efforts.

(141) The costs associated with $CO_2$ separation and storage (approx. €40 to €100 per tonne of $CO_2$; depending on the technology applied, this will increase electricity generation costs by between 1.5 cents and 9 cents per kWh) are mainly dominated by the cost of separation and, where necessary, transport. As far as the $CO_2$ storage potential is concerned, there are considerable scientific and technological uncertainties. The maximum emission reduction that can be achieved through $CO_2$ separation and storage in Germany's conversion sector amounts to no more than 10 per cent of the 1990 emissions. For cost reasons, the use of these technologies will have to be limited to locations near the potential $CO_2$ repositories. Hence, $CO_2$ separation and storage are a potential medium-term to long-term option, but they are subject to a number of provisos: considerable technological innovations will have to be made; our current knowledge about the various storage options will have to be substantiated and enhanced; and it will have to be demonstrated that these technologies are ecologically sound and socially acceptable.

(142) Renewables provide an inexhaustible source of energy that surpasses the current level of world energy consumption by several orders of magnitude. From a technological perspective, renewable energy sources – which can be used both directly and indirectly – can in principle cover the entire current and future demand for secondary energy sources or different forms of useful energy. Of the three renewable energy sources – solar radiation, geothermal energy and tidal power – solar energy provides by far the greatest potential.[1]

(143) A wide variety of technologies that have reached varying stages in their development are available to make use of potential renewable energy sources.

(144) There is a historical, technological and an economic answer to the question as to why renewables have not been used overwhelmingly as energy sources for a long time. With the increasing availability of cheap fossil fuels and the development of low-cost and safe

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[1] Dissenting opinion by Kurt-Dieter Grill, MP:
Unfortunately, potentials say nothing about costs. At the end of the day, however, the question as to whether a technology will be applied depends on its cost-effectiveness.

conversion technologies, the originally predominant use of renewable technologies diminished, which had the side-effect that, for a while, no efforts were made to optimise these technologies.

(145) In addition, some of the renewable energy technologies are characterised by two features that have hampered their use in the past: their low power density (relative to their surface area or volume) and the variations in their energy supply. However, this does not apply to biomass and geothermal applications (which provide the greatest potentials); and to some extent, it does not apply to hydropower, either. From a technological perspective, all of these energy sources can be used for base-load generation. Hence, they can be used – also in combination with the other fluctuating, not permanently available renewable energy sources – to create a generation profile that can cover demand. In the medium and long term, the possibilities of using such integrated concepts will be further improved as a result of progress made in information technology ("virtual power plants"), the development of storage systems and the provision of secondary energy sources.

(146) However, the two drawbacks associated with the use of renewables are offset by considerable benefits:

- The greatest benefit today is that the use of renewables for generation purposes does not harm the environment.
- They are inexhaustible.
- From a global perspective, they are much more evenly distributed than fossil fuels or nuclear energy reserves.
- In addition, their supply by Nature is often free of charge, and the foreseeable cost reduction potentials (which in some cases are substantial) provided by conversion technologies – in combination with the internalisation of external costs – will increase the competitiveness of renewables.

(147) The market share of renewable energy technologies has been growing in Germany since 1990. Today, the most commonly used renewable energy source is biomass (accounting for 64 per cent of total renewable energy sources), followed by hydropower. Solar thermal energy and – in the past few years – wind power have made growing contributions to Europe's energy supply. In all European countries, the market share of renewable energy technologies has risen in the past few years.

(148) The target defined for Europe in the European Union's White Paper is to increase the share of renewables in the EU initially to 12 per cent of the EU's gross domestic energy consumption by the year 2010.[1]

(149) The main argument cited against the use of renewables is their "lack of cost-effectiveness". Usually, however, such comments refer only to the microeconomic costs while neglecting the macroeconomic/social costs. For this reason, the principle of internalising external costs plays a key role in any comparison of energy prices. The global energy system will only begin to become sustainable if the energy prices increasingly – at least in terms of the dimension – reflect the "ecological truth".[2] On the other hand, the methodological problems associated with the determination of external costs demonstrate that this approach is no substitute for a political discussion.[3]

(150) $CO_2$ reduction potentials are not limited to specific sectors, conversion or conservation technologies. There are also some cross-sectional areas that can make relevant contributions.

(151) Innovations in automatic control science and technology, for instance, will make it possible to tap considerable efficiency potentials, e.g. by means of "intelligent buildings"[4] and "virtual power plants".

(152) In the field of office buildings and functional buildings, the use of "intelligent building technology" has already become more or less the standard. In the field of residential buildings, efficiency potentials have been viewed from the perspective of architectural and building physics issues. As a general rule, the basis to any intelligent (residential) building is a communication infrastructure (field bus) that makes it possible to control appliances and devices and that allows them to communicate with each other. The interface between the

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1 Dissenting opinion by the expert Dr. Hans Jörg Henne:
This development will only be achieved by means of massive subsidies.

2 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
This statement suggests that the environment-related external costs are greater by several factors than the current tax burden imposed on energy sources. However, this does not apply to many areas.

3 Dissenting opinion by Walter Hirche, MP:
The EU Commission's "EXTERNIE" study is a fundamental paper that provides the first few elements for a definition of external costs. However, there is still considerable need for research, which cannot be replaced by a political discussion.

4 Dissenting opinion by Dr. Ralf Brauksiepe, MP:
The installation of "intelligent technology" in existing buildings will require substantial investments. Hence, it is imperative to distinguish between technological and economic potentials.

external network of a service provider and the in-house network increasingly seems to accelerate and promote internal networking. The target groups for "intelligent building technology" used in functional buildings have so far been industry, trade and public administration. However, there are still substantial potential applications that are not yet utilised in the field of private homes and rental housing, including older buildings.[1]

(153) In the energy supply system of the future, energy generation will be more decentralised:[2] Current energy consumers will to some extent also become energy suppliers. Communication technology and microprocessors installed in energy generation and consumption systems of end users will enable energy service providers to use a much greater variety of methods than currently to manage their load by means of an electronic "interactive process". By intelligently connecting centralised and decentralised energy generation units with the network, it will be possible to reduce primary energy consumption by at least 20 per cent in the course of the next twenty years as the use of decentralised systems increases, without reducing supply reliability. However, there are still some development challenges that will have to be mastered, and it will be necessary to gather operating experience.[3]

(154) The entire field of materials management and control (raw materials and products, as well as their utilisation) provides considerable scope for increasing efficiency. A sectoral analysis of the five technological/organisational options – i.e. recycling, material efficiency, material substitution, more intensive utilisation, and extending the product lifespan – provides a whole host of opportunities to reduce the specific energy requirements of a given service.[4] In addition to the costs, other major obstacles in this area are related to behaviour, attitudes and design. A longer service life is impossible to achieve in the case of many consumer durables because they cannot be repaired, or their obsolescence has been deliberately built

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1 Dissenting opinion by the expert Dr. Hans Jörg Henne:
As long as German tenancy law does not allow landlords to allocate the cost of energy efficiency measures to their tenants, these statements are unrealistic.

2 Dissenting opinion by Professor Dr. Paul Laufs, MP:
The question as to whether more decentralised energy supply structures will develop is completely open. The discussion in the Commission has shown that massive governmental interventions will be required to achieve such a change in our energy system.

3 Dissenting opinion by Walter Hirche, MP:
There is obviously a discrepancy between the ideal, which is portrayed as the alleged reality (without mentioning the costs), and the actual conditions prevailing. This is demonstrated not least by the phrase "it will be necessary to gather operating experience".

4 Dissenting opinion by the expert Dr. Hans Jörg Henne:
A longer service life of products may be incompatible with improvements in energy efficiency. Life-cycle analyses could clarify this point.

in, or because spare parts are no longer available. Moreover, however, the lifestyles of various social milieus are not geared towards long-lived consumer durables. Depreciation periods laid down in fiscal law may also influence the service life of consumer durables, or they may give rise to expectations with regard to short payoff periods which cannot be met by longer-lived investment options because of somewhat higher investment cost; however, these expectations do not have to be met because of the longer service lives of such products.

(155) The behaviour of consumers when they make buying or investment decisions[1] and when they use energy-consuming goods and services (including maintenance and upkeep) is largely determined by consumer preferences, lifestyles and value systems. The development of a sustainable energy system is also influenced by behavioural patterns that are related to changes in the quality of the supply of, and demand for, energy services. In the course of a more decentralised supply of electricity and heat in future, a more conscious use of energy could play a more important role. For this reason, it is important to analyse not only the purely economically related investment and consumption patterns but also to study other socio-psychological and ethical "behaviour" determinants, which are no less important. This also applies to companies, which – without additional motivational incentives and behaviour-modifying boundary conditions – will not invest in even highly profitable energy efficiency measures (so-called "constrained potentials").

(156) The connection between the motivation of individuals, the commitment within companies, and the general discussion on ecological issues in society should be taken into account by conducting extensive debates on sustainable development at all levels of society. Changes in behavioural patterns and a lifestyle oriented towards a new affluence model (a combination between efficiency and sufficiency) do not necessarily have to be perceived as a loss of quality of life. On the contrary: they can even be perceived as an increase in quality of life. Sufficiency in terms of "enjoying a good life instead of owning a lot" is also a question of perception or socially-mediated consumer expectations.[2]

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[1] Dissenting opinion by Walter Hirche, MP:
Buying and investment decisions are always the result of a large number of different factors. A one-sided focus on energy does not seem to be justifiable in connection with sustainable development.

[2] Dissenting opinion by Franz Obermeier, MP:
This passage reflects the ideologically motivated and contradictory views of the majority of the Commission's members.

(157) In all sectors, there are considerable and manifold obstacles that hamper the use of energy conservation potentials. In order to overcome these obstacles, it is also necessary to step up socio-ecological implementation research and to pay more attention to energy-related aspects in initial and further education.[1]

## 1.5 Target scenarios for Germany[2]

(158) The target scenarios calculated by external experts on behalf of the Commission are described in Chapter 5. The consortium of experts – which consisted of PROGNOS AG, the *Institut für Energiewirtschaft and Rationelle Energieanwendung* (IER – Institute of Energy Management and Efficient Energy Use) of the University of Stuttgart and *Wuppertal-Institut für Umwelt, Klima, Energie* (WI – Wuppertal Institute for Environment, Climate, Energy) – largely used the assumptions defined by the Commission (energy expansion objectives, assumptions on investment costs and economic parameters, etc.). However, the consortium also had to define some assumptions of its own, e.g. with regard to the development of energy efficiency in the application sectors. In order to increase the validity of the models and to assess the influence of the modelling approach applied, the scenarios and one variant were calculated in competition with one another: While the IER examined the energy supply system as a whole, using a global cross-sectoral approach to optimisation from an economic perspective, the simulation model of the Wuppertal Institute[3] uses a more sectoral approach to minimising the costs, applying additional decision-making criteria.

(159) Overall, the consortium calculated a total of fourteen scenarios and variants – all of them based on the ambitious global warming management targets that are aimed at reducing greenhouse gas emissions by 80 per cent by the year 2050. Three primary scenarios are representative of the fundamental development lines for future energy supply:

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1 Dissenting opinion by the expert Jürgen-Friedrich Hake:
The wording of this paragraph utterly fails to describe the role of research and development in tapping new potentials or making more intensive use of existing ones for efficient energy supply and efficient energy use.

2 See the end of this Chapter for the dissenting opinion by the expert Professor Dr.-Ing. Alfred Voß on Chapter 1.5.

3 Dissenting opinion by Kurt-Dieter Grill, MP:
The simulation model of the Wuppertal Institute does not minimise the cost of providing energy services. Hence, it does not identify any cost-efficient ways of reducing $CO_2$ emissions.

(160) The strategy chosen in the "Conversion Efficiency" scenario is accelerating the increase in the efficiency of energy conversion and application. This strategy does not include a continuation of the use of nuclear energy. In order to be able to continue to use fossil fuels (especially coal) despite the ambitious global warming management targets, the scenario allows carbon dioxide to be separated and stored in a repository.

(161) The "RES/EEU Initiative" scenario assumes that nuclear power will be phased out completely by the year 2030 and that, by the year 2050, fossil fuels will be phased out as much as is required to attain the global warming management targets. By way of compensation, efforts to increase energy efficiency and to use renewable energy sources will be substantially stepped up. According to the targets, at least 50 per cent of the primary energy consumption should be covered by renewable energy sources by the year 2050. In addition, a variant of this scenario – called "Full Solar Supply" – was modelled in which energy supply is ensured exclusively by renewable energy sources by the year 2050. In response to the events on 11 September, a third variant was examined to find out whether the use of nuclear power can be phased out within a very short period of time.

(162) In the "Fossil-Nuclear Energy Mix" scenario,[1] it is possible to continue and increase the use of nuclear power. Hence, efforts to increase the use of renewables and to increase energy efficiency are not stepped up. In this scenario, it is also possible to separate carbon dioxide and store it in a repository. In addition, restrictions (e.g. with regard to the transport sector and buildings) that apply in the reference scenario and in the other scenarios do not apply in this scenario.

(163) In order to be able to assess the uncertainties that are introduced through the model inputs because of the assumptions made on the future development of costs, the experts calculated a variant for each scenario and also for the reference scenario. This variant was based on a data set that had been developed by the minority of the Commission members. This made it possible to test the sensitivity of the models in terms of the cost assumptions made.

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[1] Dissenting opinion by Kurt-Dieter Grill, MP:
The expression "Fossil-Nuclear Energy Mix", which has been chosen by the majority of the Commission members, is misleading. Instead, this is a scenario that is designed to achieve the defined reduction targets with minimum macroeconomic costs.

*Chart 1-1: Primary Energy Consumption by the Year 2050, According to the Various Scenarios*

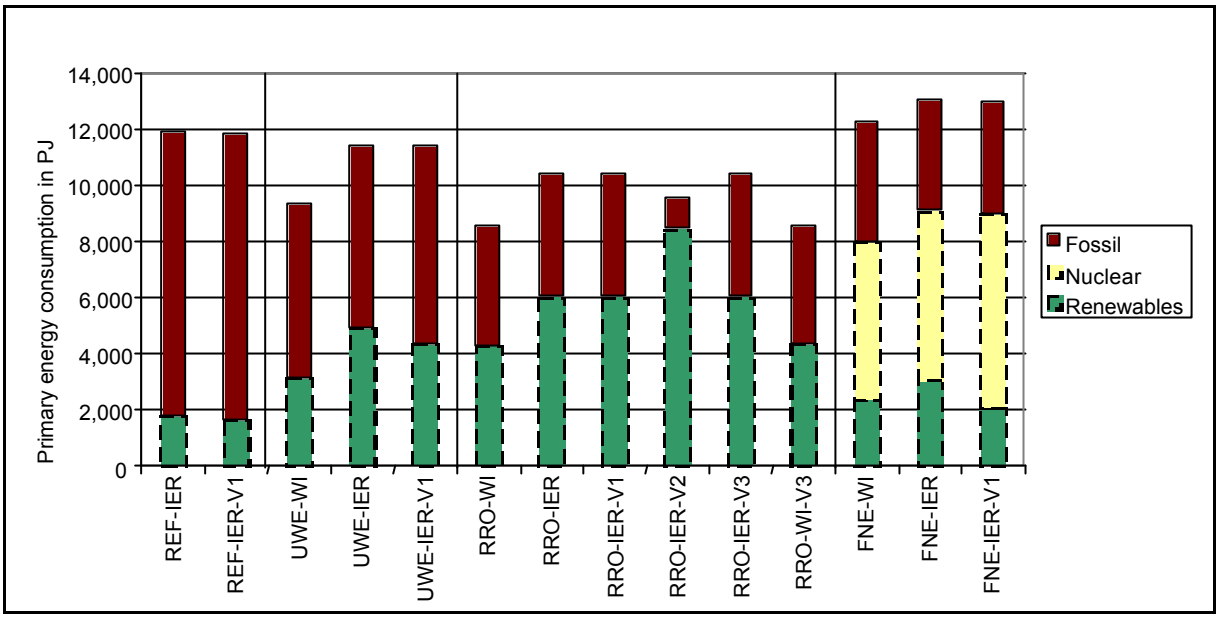
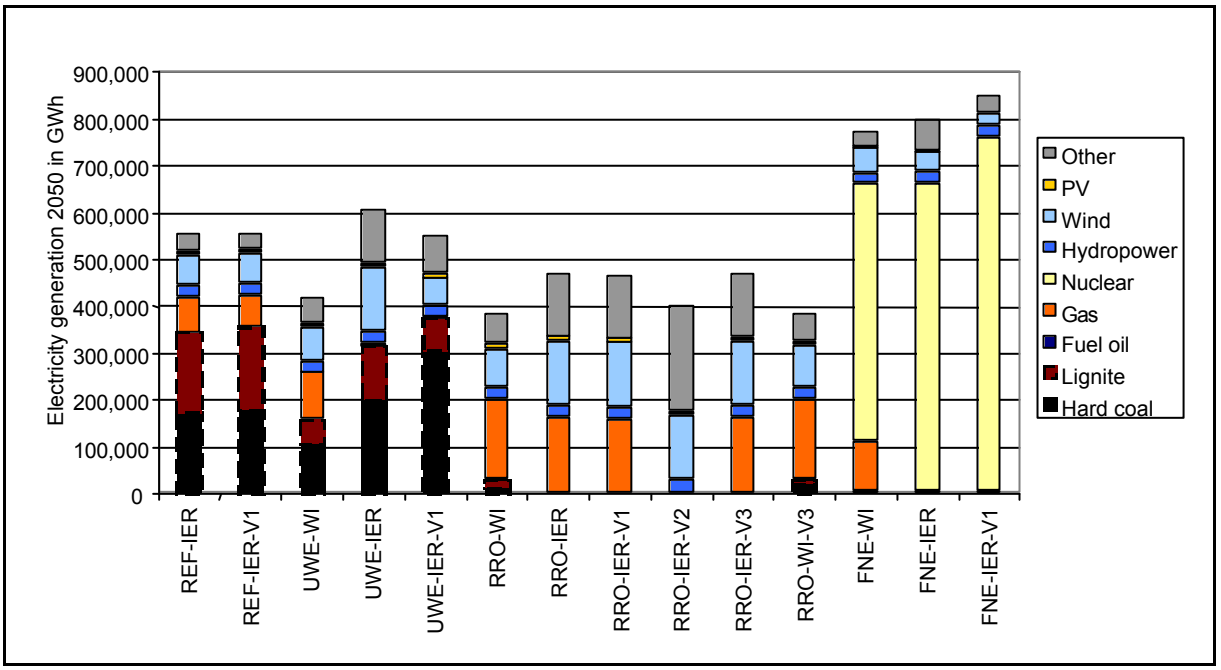



*Chart 1-2: Net Electricity Supply by the Year 2050*



(164) Table 1–3 provides a summary of the scenario results. Chart 1-1 shows the power plant portfolios by the year 2050 as predicted by the simulations. The results of an analysis of the various development paths can be summarised as follows:

a. It is possible to dispense with nuclear power.
b. A major role for hard coal and lignite is only sustainable if a technological and cost-effective solution is found for the separation and permanent storage of $CO_2$.
c. In some scenarios, natural gas has an important bridging function to facilitate the final transition toward $CO_2$-free energy sources.
d. It is possible to cover the total energy demand by means of solar energy.
e. The primary version of the RES/EEU Initiative[1] is a development path that permits other development options, also beyond the time horizon under review in this Report.

**Table 1-3: Overview of the Results of the Various Scenarios**

| | | | REF-IER | UWE-WI | UWE-IER | RRO-WI | RRO-IER | RRO-IER Var. 2* | RRO-IER Var. 3 | RRO-WI Var. 3 | FNE-WI | FNE-IER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| End-point energy | Total | PJ | 8.208 | 5.918 | 6.656 | 5.156 | 5.910 | 5.531 | 5.909 | 5.183 | 6.140 | 7.229 |
| | | GJ/cap | 121 | 100 | 87 | 82 | 87 | 76 | 87 | 91 | 76 | 107 |
| | Transport | PJ | 2.299 | 1.247 | 1.975 | 1.122 | 1.669 | 1.894 | 1.667 | 1.122 | 1.409 | 2.115 |
| | Households | | 2.221 | 1.632 | 1.732 | 1.352 | 1.654 | 1.474 | 1.653 | 1.368 | 1.651 | 1.814 |
| | CTS | | 1.389 | 1.075 | 1.169 | 950 | 1.057 | 1.065 | 1.057 | 952 | 1.093 | 1.275 |
| | Manufacturing | | 2.299 | 1.964 | 1.779 | 1.732 | 1.530 | 1.099 | 1.532 | 1.742 | 1.987 | 2.026 |
| End-point energy by source of energy | Renewables | PJ | 334 | 796 | 1.220 | 1.142 | 1.437 | 2.136 | 1.424 | 1.204 | 690 | 1.065 |
| | | EEC share | 4% | 13% | 18% | 22% | 24% | 39% | 24% | 23% | 11% | 15% |
| | Other | PJ | 152 | 718 | 34 | 252 | 78 | 675 | 81 | 44 | 906 | 7 |
| | | EEC share | 2% | 12% | 1% | 5% | 1% | 12% | 1% | 1% | 15% | 0% |
| | Total renewables | PJ | 486 | 1.514 | 1.254 | 1.394 | 1.515 | 2.811 | 1.504 | 1.247 | 1.596 | 1.072 |
| | | EEC share | 6% | 26% | 19% | 27% | 26% | 51% | 25% | 24% | 26% | 15% |
| | Fossil | PJ | 5.539 | 2.277 | 2.644 | 1.864 | 1.989 | 300 | 1.988 | 1.864 | 2.465 | 2.634 |
| | | EEV share | 67% | 38% | 40% | 36% | 34% | 5% | 34% | 36% | 40% | 36% |
| | Electricity | PJ | 1.816 | 1.542 | 1.935 | 1.368 | 1.563 | 1.495 | 1.564 | 1.368 | 1.793 | 2.628 |
| | | EEC share | 22% | 26% | 29% | 27% | 26% | 27% | 26% | 26% | 29% | 36% |
| | Heat | PJ | 368 | 427 | 823 | 286 | 843 | 925 | 853 | 286 | 240 | 761 |
| | | EEC share | 4% | 7% | 12% | 6% | 14% | 17% | 14% | 6% | 4% | 11% |
| Primary energy | Total | PJ | 11.937 | 9.348 | 11.400 | 8.552 | 10.397 | 9.547 | 10.396 | 8.599 | 12.266 | 13.048 |
| | | EEC share | 176 | 138 | 168 | 126 | 153 | 141 | 153 | 127 | 181 | 192 |
| | Renewable | PJ | 1.765 | 3.130 | 4.896 | 4.266 | 5.998 | 8.420 | 5.993 | 4.318 | 2.381 | 3.041 |
| | | EEC share | 15% | 33% | 43% | 50% | 58% | 88% | 58% | 50% | 19% | 23% |
| | Fossil | PJ | 10.172 | 6.218 | 6.504 | 4.285 | 4.398 | 1.127 | 4.404 | 4.281 | 4.321 | 4.009 |
| | | EEC share | 85% | 67% | 57% | 50% | 42% | 12% | 42% | 50% | 35% | 31% |
| | Nuclear | PJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.563 | 5.997 |
| | | EEC share | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 45% | 46% |
| System costs | Cumulative cost difference vs. reference (€ 19,182.6 billion) | €/cap | 3.333 | 5.134 | 2.966 | 9.106 | 25.383 | 9.954 | | | 2.077 | -4.928 |
| | Cumulative cost difference vs. reference discounted to 1998 (€ 9,280.1 billion) | €/cap | 527 | 1.158 | 596 | 2.094 | 6.136 | 2.560 | | | 227 | -1.345 |
| | Cost difference vs. reference in 2050 (€ 5,201.6 billion) | €/cap for 2050 | 298 | 323 | 170 | 605 | 1.225 | 616 | | | 175 | -144 |
| | Cost difference vs. reference in 2050 discounted to 1998 (€ 676.7 billion) | €/cap für 2050 | 39 | 42 | 22 | 79 | 159 | 80 | | | 23 | -19 |
| External costs | Cost difference vs. reference in 2050 (€ 5,074.8 billion) | €/cap for 2050 | -1.848 | -2.338 | -2.201 | -2.649 | -2.700 | -2.647 | | | 14.717 | 17.515 |
| | Cost difference vs. reference in 2050 discounted to 1998 (€ 660.2 billion) | €/cap for 2050 | -240 | -304 | -286 | -345 | -351 | -344 | | | 1.915 | 2.279 |

Total percentages may be greater than 100 per cent due to rounding errors.
* For reasons inherent in the model, renewables cannot cover full demand. The balance relative to 100 % in the primary energy share is due to the use of energy sources for non-energy purposes.

[1] Dissenting opinion by the expert Dr. Hans Jörg Henne:
The development path described by the RES/EEU Initiative scenario is at best a development path that is technologically feasible, but that is associated with enormous costs for the national economy.

(165) Other conclusions drawn from the study of the scenarios are described below.

**Scope for action in measures designed to achieve the global warming management targets**

(166) Despite the constraints mentioned above – in terms of the uncertainty of the assumptions made with regard to technologies and costs, as well as in terms of the relatively conservative general assumptions made – the Commission has come to the conclusion that it is technically and economically feasible from today's perspective to reduce greenhouse gas emissions by 80 per cent by the year 2050 (relative to the 1990 level). All the technology paths examined in the target scenarios make it possible to achieve the ambitious greenhouse gas reduction targets. In fact, the first few steps have already been taken in Germany to tackle these targets. The development path[1] toward a renewable and more efficient energy supply system is a realistic option for the future, and not a dead-end street: From today's perspective, it is even possible to cover Germany's energy demand largely or fully from renewable energy sources in a highly efficient energy supply system.

(167) The results predicted in the scenarios can only be be achieved if the technological developments assumed in the models – and this applies to all three paths – are supported and promoted by the necessary framework conditions and energy policies. It is important to note in this context that the scenarios vary in their dependence on technologies. The implementation of the Conversion Efficiency (UWE) scenario and the Fossil-Nuclear Energy Mix (FNE) scenario is largely dependent on a key technology in both cases ($CO_2$ separation and storage, and nuclear power, respectively), while the RES/EEU Initiative (RRO) scenario is based on a relatively wide variety of technologies that are relevant for the reduction of emissions. Should a specific technology such as photovoltaics fail to meet the expectations associated with it, another renewable technology could be used instead. This aspect can also prove to make an important contribution towards increasing the reliability of supply.[2]

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[1] Dissenting opinion by the expert Dr. Hans Jörg Henne:
A development path that leads to renewable energy supply is neither compatible with an efficient use of resources nor with the three dimensions of sustainable development.

[2] Dissenting opinion by the expert Jürgen-Friedrich Hake:
This statement is inconsistent with the results of the scenarios. The Energy Conversion and Fossil-Nuclear Energy Mix scenarios also involve the use of a wide variety of efficient energy conservation and application technologies.

(168) Structural changes – such as the transition from an energy supplying industry to a solar energy services industry, or even higher conceivable rates of improvement in resource efficiency (e.g. by a factor of 10) – were either not taken into consideration at all in the scenarios, or only to a very limited extent. It was not possible to quantify, or map the structural and qualitative effects of, changes in behaviour and lifestyles – even significant ones - in the scenarios. It was not possible to adjust demand for energy services in the scenarios relative to the reference scenario. Hence, the scenarios are far from mapping all the options available to society and individuals to reduce $CO_2$ emissions. Because of this and because of the assumed rapid increase in per-capita energy services, the resulting demand for energy services must be seen as the upper end of the range to be expected. The fact that the scenarios still achieve the global warming management targets defined suggests that the switch to an ecologically efficient energy services industry and to an accelerated increase in resource efficiency, along with changes in lifestyles, can make it easier to attain the reduction targets and to reorganise the energy industry.[1]

(169) Beyond all the uncertainty and the political measures proposed, it is possible to identify three robust trends[2] that are common to all scenarios: renewables, efficient energy use and a new secondary energy source will play an important role in the future.

**Robust paths: Energy efficiency**

(170) All scenarios the predict increases in efficiency that go beyond the trend. However, the two models used differ in terms of the time profiles predicted for the efficiency improvements: one model assumes a continuous increase in efficiency (the WI's simulation approach), while the other assumes that efficiency improvements are first delayed by one or two decades, but then accelerated (the IER's optimisation approach). However, in the case of the more discontinuous development variant (IER), the question arises as to whether it will be actually possible to generate the necessary momentum (almost instantaneously) when over decades no greater efforts were made to this effect. From a precautionary perspective and with a view to validating the robustness of the path, it can be stated that in order to attain

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[1] Dissenting opinion by Franz Obermeier, MP:
These statements are wrong. In the RES/EEU Initiative scenario, for instance, it was assumed that, in 2050, each individual would additionally travel 1,180 km per year walking or riding a bicycle, instead of driving a car.

[2] Dissenting opinion by the expert Professor Dr. Volker Schindler:
A proper interpretation of the scenario calculations suggests that there are three robust trends that can be identified: efficient energy use, use of nuclear energy, and more intensive use of electricity and district heating.

the emission reduction targets, it is important to initiate the strategy as early as possible, to tap efficiency potentials consistently, and to have reliable, long-term framework conditions.

(171) Major energy conservation potentials are found in buildings, both of private households and of commercial, trade and service enterprises. Because of the long lives of buildings and the long periods between modernisation measures, energy conservation measures should be introduced immediately in both new and existing buildings and continuously implemented in the course of modernisation measures that must be carried out anyway. Providing that the framework conditions are favourable, it is possible today to achieve the modernisation objectives from a technical perspective and, in most cases, also from a microeconomic perspective. The target energy modernisation rates assumed in the scenarios range between 1.3 and 2.5 per cent by the year 2050, which is considerably higher than today's energy modernisation rate of 0.5 per cent per year. A comparative analysis shows that the quantitative effect (measured in terms of the resulting reduction of heat consumption) that can be achieved by increasing the modernisation rate is much greater than the effect that can be achieved by specifically improving the thermal insulation standard, while the energy modernisation rate remains constant. This shows that measures with a broad impact and supporting incentive structures aimed at activating these efficiency potentials in the course of "normal" modernisation cycles are particularly important and urgent.

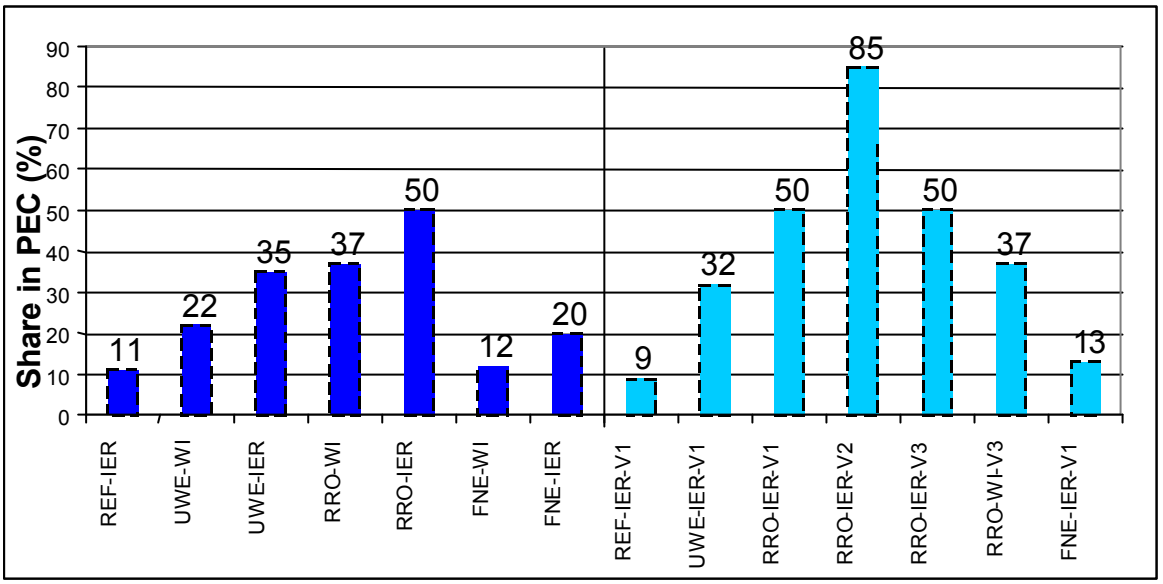
(172) A reduction of electricity consumption also plays a key role. To this end, a large number of technological options are available in all sectors, and there is also considerable potential for reducing electricity consumption by changing behaviour. This applies not only to applications that can be highly standardised (engines, lighting, household appliances) but also to highly heterogeneous applications, e.g. in the manufacturing sector.

(173) At the end of the day, however, all sectors will have to make their contribution to reducing energy demand. A very fast and, in principle, relatively cost-effective utilisation of efficiency potentials in the transport sector can help create room for manoeuvre elsewhere. Because of the enormous growth rates and the almost total dependence on petroleum as the only resource – also in the medium and long term – it will be necessary in the transport

sector to introduce secondary energy sources that are climatically sound.[1] The lower the energy volumes that will then be required in the transport sector, the easier this will be.

**Robust paths: Renewable energy sources**

*Chart 1-3: Share of Renewable Energy Sources in Total Primary Energy Consumption*




Note: In the "Full Solar Supply" scenario, an analysis of the remaining shares shows that these can also be covered by renewable resources.

(174) All the scenarios – including the (fossil) Conversion Efficiency scenario – involve a much greater use of renewable energy sources than the reference scenario. This is also in keeping with the European Union's political agenda, according to which renewables should account for 12.5 per cent of the electricity generated in Germany by the year 2010. However, the "fossil-nuclear" scenario (FNE) also demonstrates that it is indispensable to increase the use of renewable energy sources if we want to achieve the global warming management targets. On the other hand, the FNE scenarios show that if the market introduction of renewable technologies is hampered by the use of nuclear energy with the risks it entails, the renewables will not have the time they need for their development and to achieve sufficient cost reductions; hence, they will not be able to increase their market share. For this reason, the Commission believes that a long-term, adequate continuation of market introduction

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
The term "climatically sound secondary energy sources" is misleading. It is always necessary to consider the entire chain, including the production of primary and secondary energy, and the use of energy in motor cars, aircraft or ships.

programmes (e.g. the Renewables Act and the market incentives programme, regional funding programmes, programmes of the energy industry) is justified in all conceivable development paths for reasons of global warming management and in the interest of innovations.[1]

(175) The mix of the various renewables in the scenarios is either a result of cost-oriented simulations or optimisations or it is due to external inputs based on expert estimates. The Commission feels that an energy industry that is primarily based on renewable energy sources will have to be guided in the determination of its energy mix by the need to ensure a consistently reliable supply of energy services.

**Robust paths: Secondary energy sources**

(176) In all scenarios, hydrogen is introduced as a new secondary energy source by the year 2050 at the latest.[2] In the IER's calculations, hydrogen is produced through electrolysis from the buffer of fluctuating excess electricity generation and is used as a fuel for fuel cells, also in cogeneration plants. This leads to the use of hydrogen also in scenarios that impose neither the use of CHP nor specific rates of renewables (e.g. FNE). According to the Wuppertal Institute (WI), the main advantage of hydrogen is its applicability in the transport sector. As a result, it would be possible to reduce harmful emissions from fossil fuels in the transport sector to the extent required, which will help increase efficiency beyond the assumptions made. In addition, WI sees good and relatively cost-effective (no high initial expenditure on infrastructure) opportunities to introduce hydrogen by adding it to natural gas by way of feeding it proportionately into the gas grid.

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1 Dissenting opinion by the expert Professor Dr. Volker Schindler:
The assessment of the use of renewable energy sources in the scenarios has been mainly the result of external inputs. Even if the assumed cost reductions are correct, renewables can only make minor contributions toward a cost-efficient reduction of $CO_2$ emissions.

2 Dissenting opinion by Franz Obermeier, MP:
The scenarios show that it will only be a distant future (2050) and if $CO_2$ emissions are to be reduced drastically (- 80 per cent) that hydrogen will gain a certain importance as a secondary energy source for sustainable energy supply.

(177) The necessary introduction of a secondary energy source that does not cause any greenhouse gas emissions – either hydrogen,[1] or another (storage) technology that is not yet established today – also shows that considerable efforts will have to be made to develop a sustainable energy supply system in general and to achieve the global warming management targets in particular. If hydrogen is to assume the function of an energy reservoir that will make it possible to achieve the transition to a climatically sound energy management system largely without any additional greenhouse gas emissions, the necessary political decisions will have to be taken early on. As a first step, it seems to be useful to extend the scope of the gas infrastructure to include natural gas powered vehicles as a transitional technology,[2] with the option of steadily increasing the proportion of hydrogen in the gas grid, until it will be finally necessary and possible to convert the infrastructure (because of technical characteristics) at a later point in time.

**Scenarios vary widely in terms of their sustainability**

(178) The scenarios vary as far as the implementation of the principles of sustainable energy supply is concerned. While all scenarios achieve the reduction of emissions by 80 per cent, most of them have shortcomings in other areas.

(179) In the Conversion Efficiency scenario (UWE), there is not enough room in the medium and long term in the well-known, permanently safe storage sites for the total amount of carbon dioxide that would have to be stored in repositories. If one also bears in mind that the technologies required for the large-scale separation and ultimate storage of $CO_2$ are still in their early stages of development, it is very uncertain whether the crucial technological option for these scenarios will be available at all or to a sufficient extent. In addition, although the structure of energy sources would be largely the same as today, this option would lead to considerable restructuring of the energy supply system, especially with regard to the locations of power plants: In order to keep their costs low, many power plants would have to be built close to the ultimate storage sites for carbon dioxide, and they

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1 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
Only if hydrogen is generated from renewables or nuclear energy will it not cause any $CO_2$ emissions. However, Shell assumes that hydrogen will continue to be generated from natural gas in the long term.

2 Dissenting opinion by Walter Hirche, MP:
There is no technological or ecological need to introduce natural gas as a fuel for motor vehicles. It does not make any economic sense unless one assumes that it will be associated with tax waivers.

would have to use imported coal. This means that electricity generation from hard coal would be concentrated in new power plants built near the coast or at other locations in northern German. In view of the required geographical proximity to potential heat consumers, it seems questionable whether cogeneration of electricity and heat or cold in combination with $CO_2$ separation will ever be used on a large scale.

(180) The fossil-nuclear scenario (FNE) predicts that at least 50 new nuclear power plants will have to be built by the year 2050. The IER also studied the concept of an industry-based nuclear heat supply using reactors with a capacity of between 100 and 300 MW. If this concept is implemented, the number of new power plants to be built is expected to be even higher (up to 100). It is not possible to dispose of the radioactive waste of the currently operating nuclear power plants, or of such a large number of new plants, in a way that would be compatible with the principles of sustainable development.[1] It is hardly conceivable that there will be social acceptance for stepping up the use of nuclear energy. The risks that the operation of these plants would pose for Germany – not least due to the new risks of international terrorism – are not tolerable. For this reason, the Commission feels that there is no alternative to the phase-out of nuclear energy that has just recently been initiated.[2]

(181) In the scenario that is based on the assumption of an RES/EEU Initiative (RRO), the use of land for wind power plants and the use of biomass are aspects that limit sustainable development. These drawbacks can be put into perspective by the dual use of wind farm areas, the cultivation of biomass without single-crop farming, and the inclusion of findings obtained in supporting ecological research. The Commission feels that considering the large number of different technologies available to increase efficiency and to utilise renewable energy sources, and considering the decentralised application of many renewable energy technologies, it will be possible to find a mix in the application of these technologies that will keep the adverse effects within acceptable limits[3] and that will ensure lasting stability in the supply of energy services by means of diversification of the energy sources.

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
The solution to the nuclear waste disposal problems is not a fundamental technical problem but a political and social problem.

[2] Dissenting opinion by the expert Jürgen-Friedrich Hake:
The comments made on nuclear energy are political judgements that cannot be justified by the scenario calculations or by any other scientific analyses.

[3] Dissenting opinion by the expert Jürgen-Friedrich Hake:
The major shortcomings of the renewables with regard to sustainable development are due to their high costs that are the result of high material intensity, i.e. high expenditure for non-energy raw materials.

**Greenhouse gas reduction costs tolerable for Germany**

(182) A major criterion for choosing between various development paths is the macroeconomic cost of an energy supply system. However, in scenarios that extend far into the future, this yardstick is fraught with considerable uncertainties due to the quantification problems.

(183) The system costs of the reference scenario and its variant will amount to 12.5 per cent of GDP by the year 2010; and they will then decline to 9.2 or 9.1 per cent by the year 2050. In the target scenarios that do not include the use of nuclear energy, this value will increase by between 0.3 per cent (RRO scenario of WI) and 1.2 per cent (RRO scenario Var. 1 of IER) by the year 2050. In the fossil-nuclear scenarios, the cost differences range between –0.5 and +0.3 percentage points relative to the reference scenario. This means that – as a percentage of GDP – the system costs of the RRO scenario will be about at the same level by the year 2050 as they are today.[1]

(184) With regard to the differences in external costs relative to the reference scenario by the year 2050, the picture that emerges is clearly split into two parts: While the FNE scenario predicts much higher external costs for 2050 than the reference scenario, both the UWE and the RRO scenarios lead to a cost reduction relative to the reference scenario. The most significant reductions are achieved in the RRO scenario calculations made by both institutes. When the external costs are taken into account, the costs calculated in the FNE scenario for the reference year 2050 are between approximately 26 and 31 per cent higher than in the reference scenario. The two other scenarios, on the other hand, lead to a reduction by between about 3 and 5 per cent. Even if estimates of the external costs of nuclear energy generation are used that are lower by a factor of between 20 and 40 than the assumptions made by the majority of the Commission members, the FNE scenario proves to be the scenario with the highest overall cost (direct and external costs).

(185) If one takes into consideration the differences between the external experts' calculations and interpretations as described in Chapter 5.2.3 of this Report, as well as the differences in the sets of data used and the differences in the development paths, the range of additional macroeconomic costs is relatively small. In addition, these figures are very similar to each other, and hence, the results calculated in terms of the additional costs to be

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
The energy-related additional costs of the RES/EEU Initiative scenario relative to the fossil-fuel nuclear energy mix scenario will amount to approximately $Euro_{98}$ 1,340 billion by the year 2050. The additional costs per household will amount to $Euro_{98}$ 2,025 per annum by the year 2050.

borne by the national economy are probably relatively reliable. Against the background of the benefits associated with these additional costs – i.e. the reduction of greenhouse gas emissions by 80 per cent by the year 2050 without the use of nuclear energy, the creation of new jobs, and site-related advantages for promising industries in Germany – the Commission feels that even the maximum costs estimated will be understood and accepted by society. This conclusion applies all the more if the external costs are also included in the calculation.

**Sustainable energy management through efficient energy technologies and renewable energy sources**

(186) On the basis of all these considerations, the Commission has come to the conclusion that only a development path that is oriented toward the RES/EEU Initiative scenario can be qualified as sustainable. Supporting and promoting today's energy industry, as well as new players, in this transformation process will be a key challenge for energy policy in the future. If one also includes aspects of greater conversion efficiency in this RES/EEU Initiative without hampering the expansion of renewable energy technologies, it will be even easier to achieve the desired effect in the field of global warming management.

(187) The RES/EEU Initiative scenario is open in terms of social and technological developments: As variant 2 of this scenario shows, it is also possible to cover energy demand exclusively by means of renewables. However, in view of the high additional costs, this target should not be attained as early as by the year 2050, unless it is possible to achieve additional economies of scale compared with the assumptions. On the other hand, an initiative designed to step up the application of renewable energy technologies as well as efficient technologies will also make it possible, where necessary, to phase out nuclear energy even earlier with the necessary lead time. Hence, this is not only a feasible option with limited negative effects, but it also opens new and significant scope for action by society, policy-makers and industry.

## 1.6 Political strategies and instruments for the development of a sustainable energy management system

(188) Before discussing strategies for the development of a sustainable energy management system by the year 2050, the Commission begins by presenting some fundamental considerations: One major starting point, for instance, is the realisation that the real markets and forms of competition that currently exist will not at all be capable of achieving the objectives pursued with this concept more or less "automatically"; instead, new

tasks will be explicitly assigned to policy-makers to this end.[1] The implementation of a sustainable energy supply system will require the necessary regulatory, organisational and institutional conditions as well as financial transfers and knock-on financing.[2] In addition, national sustainable development strategies will have to be embedded in international strategies against the background of globalisation in its manifold dimensions.

(189) As already mentioned, policies aimed at implementing a sustainable energy supply system are subject to conflicting requirements imposed by environmental protection and global warming management, economic efficiency and social needs. Global warming management requires ecological modernisation[3] by means of pursuing a goal-oriented and long-term environmental policy. In this context, it must be borne in mind that there is global pressure to act due to the geographically uneven distribution of polluters and polluted countries. Competition is a blind instrument without any long-term perspective if it is not backed up by long-term social objectives such as equitable distribution and compatibility with the climate.[4] Hence, it is necessary to define the social and ecological setting for the markets. As a result of the transformation of the energy supply system, entire industries will be restructured, which will require policy-makers to introduce supporting social measures. Liberalisation and competition can promote economic efficiency by providing incentives for developing efficient solutions. However, this requires a diversity of players, equal market opportunities, market transparency and free market access.

(190) The Commission is aware of the fact that meeting all three categories of requirements – ecological, social and economic – can lead to conflicting goals. However, there are also a

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1 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
The function of government in a concept of sustainable energy supply is to define a reliable framework, to internalise any external effects (where such effects exist), and to remove obstacles that hamper the market mechanism.

2 Dissenting opinion by the expert Dr. Hans Jörg Henne:
It is doubtful whether the implementation of a concept requires all the instruments listed. This presupposes not only that there is need for action but also that a decision is taken in favour of the most efficient solution with the least side-effects.

3 Dissenting opinion by Franz Obermeier, MP:
The term “ecological modernisation” is merely an empty phrase!

4 Dissenting opinion by Professor Dr. Paul Laufs, MP:
Competition is neither blind nor clairvoyant; instead, it is a term used to describe the coordination process in markets that leads to the best possible use of scarce resources in the economic process.

large number of win/win options, e.g. measures designed to increase efficiency. Such options should be given priority.[1]

(191) The globalisation of goods, capital and services markets, as well as the liberalisation of the energy markets and the ensuing specific market conditions will have a long-term impact: Globalisation may provide opportunities for transforming the current energy supply system into a sustainable one, due to efficiency increases and cost reductions, the larger share of the developing countries in the transfer of capital, know-how and technologies, and the emergence of new sales markets for suppliers of efficient and renewable technologies. However, there are also problems. These include the current one-sided distribution of efficiency gains among the industrialised nations,[2] the loss of influence of the nation-states,[3] the risk that obsolete technologies[4] may be exported to the developing countries, and the considerable increase in global transport volumes.

(192) Liberalisation provides opportunities due to the emergence of new players in competitive market segments and the associated stronger customer orientation, the development of new product offerings, as well as the utilisation of efficiency potentials. In addition, technological innovations can also lead to decentralised energy supply. Drawbacks of liberalisation include the risks of markets being increasingly dominated by oligopolies[5] and strategic predatory competition, which jeopardises ecologically efficient decentralised plants[6] and sends the wrong price signals to manufacturers and consumers. Research and

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1 Dissenting opinion by the expert Professor Dr. Volker Schindler:
Not all efficiency increases are necessarily efficient. Furthermore, an increase in efficiency could be associated with side-effects that more than offset the benefits derived.

2 Dissenting opinion by Kurt-Dieter Grill, MP:
There is no evidence at all to prove that only the industrialised nations benefit from globalisation. On the contrary: In many countries of the Third World, the economic development process would be inconceivable without globalisation.

3 Dissenting opinion by Kurt-Dieter Grill, MP:
The statement about the loss of influence of nation-states reveals the authors' true views about the European unification process, which they obviously only pretend to support.

4 Dissenting opinion by the expert Dr. Hans Jörg Henne:
Globalisation does not generally promote the export of obsolete technologies. In the interest of their national economies, developing countries have to be particularly prudent in the use of capital, which is their most scarce factor of production.

5 Dissenting opinion by Walter Hirche, MP:
Liberalisation is by no means bound to lead to oligopolies. Moreover, oligopolies that monitor each other can be expected to develop the most intensive form of competition. For this reason, it is crucial that markets are kept open and attackable.

6 Dissenting opinion by Franz Obermeier, MP:
The term "ecologically efficient plants", as well as the question why only decentralised plants – if at all – are jeopardised, need some explanation.

development efforts that are aimed only at short-term cost-effectiveness are equally questionable.

(193) In the context of liberalised energy markets, government has to play a dual role: on the one hand, it acts as a watchdog of competition; and on the other hand, it shapes the transformation process toward a sustainable energy supply system.[1] The functions of government are to protect competition, to internalise external effects as much as possible, to define objectives in the fields of energy policy and global warming management, to achieve these objectives by applying suitable instruments, and to foster innovations.[2]

(194) On the way towards a sustainable energy supply system, the Commission recommends that, as a first step, a no-regrets strategy should be pursued – i.e. a strategy that makes it possible to implement global warming management policies while at the same time reducing costs. This includes in particular the utilisation of cost-effective efficiency potentials, the elimination of ecologically harmful subsidies, and the protection of fair market opportunities for generation plants that do not have an adverse impact on the climate. The only thing that may be controversial about the no-regrets options is the scope of their potential, not their existence.

(195) Another key element of the sustainable development strategy is an innovation-oriented technology policy.[3] Such a policy should be focused on increasing efficiency gains and pursuing ambitious objectives with regard to the use of renewable energy sources. The purpose of technology policy is to help focus the competition for quality and innovations on environmental protection and global warming management. In view of the growing demand for energy services worldwide, it can be assumed that the following rule will apply: Whoever moves first, will win ("first-mover advantage"). An important part of such a strategy is an active education and research policy.

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[1] Dissenting opinion by the expert Professor Dr. Volker Schindler:
Government does not shape the transition to a sustainable energy supply system in a deterministic manner; it only defines the framework in a market economy system, within which a sustainable energy supply concept can develop.

[2] Dissenting opinion by Walter Hirche, MP:
The function of government is not to promote innovations, but to promote research and development.

[3] Dissenting opinion by Kurt-Dieter Grill, MP:
If technology policy is limited to being "innovation-oriented" in pursuing ambitious objectives with regard to the use of renewable energy sources, then this is not compatible with a strategy committed to the objective of sustainable energy supply.

(196) At all political levels, government has a particular responsibility to foster activities in the field of efficient energy use because transaction obstacles in this area pose a crucial problem: Although efficient technologies often provide economic benefits, many of them have not yet achieved satisfactory market diffusion because of specific market obstacles. In many cases, this is also due to the fact that it is more difficult to visualise energy conservation than energy supply technologies. By means of optimisation across all stages of production, energy service providers could provide energy services at minimum costs and encourage demand-side orientation on the part of their customers.

(197) The Commission feels that the use of renewable energy sources, coupled with much greater energy efficiency, is the only alternative in the long term to energy supply based on fossil fuels and nuclear energy. Hence, promoting the use of renewables is logical insofar as it helps avoid external costs caused by conventional energy sources, or insofar as such external costs have not been sufficiently internalised. The type and scope of this support should be adapted to the level of development of the technologies concerned, and it should reflect the future contribution of such technologies to sustainable development.[1]

(198) The Commission feels that the development of a decentralised approach is an important building block in the transformation process toward a sustainable energy supply system.[2] Electricity supply from large-scale power plants and via interconnected national and European systems could first be supplemented by decentralised generation units interconnected in “virtual power plants” and eventually be replaced in terms of their current importance in the medium and long term. The fact that technological innovation requirements and the liberalisation of line-bound energy markets coincide in terms of their timing creates opportunities for a fundamental restructuring of the market, providing that the necessary political environment is created. The advantages of decentralised energy supply structures include greater reliability of the supply of energy services, the diversity of new players who

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[1] Dissenting opinion by the expert Dr. Hans Jörg Henne:
The objective of sustainable energy supply will not be served if one defines in advance – without specifying any assessment criteria – what options are desirable and which ones should be rejected; only the availability of the broadest possible spectrum of options will serve the objective.

[2] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
Developing a decentralised system cannot be the objective of sustainable energy supply! There are no grounds to justify this statement. Demands to that effect are the expression of an ideologically motivated, backward anti-industry attitude.

can counterbalance the currently dominating position of a small number of energy generating companies in the energy industry, and finally the spreading of the investment risk.[1]

(199) The Commission emphasises that any national sustainable energy policy must be embedded in the international context. As far as liberalisation and competition policies are concerned, the Commission recommends that efforts should be made to expedite and harmonise EU-wide provisions for the promotion of sustainable development in order to avoid unacceptable distortion of competition. At global level, international activities designed to further sustainable energy systems should be established in the framework of the various global governance processes and supported by new international framework agreements. Nevertheless, the Commission recommends that Germany should play a pioneering role[2] with its national energy policy because such a policy can trigger international developments by setting best-practice examples: For this reason, the national scope for innovations must not be unreasonably restricted. However, international applicability and long-term comparability of competitive conditions should remain the touchstones of any innovations.

(200) In order to pursue a policy of sustainable development in the energy sector, it is necessary to devise strategies and instruments that are designed for long time horizons, and that, hence, are capable of coping with changing framework conditions and uncertainties. The Commission believes that there are three fundamental principles that should be considered when defining objectives in this regard: the consistency of the various objectives, the priority to be given to binding objectives rather than to a large number of objectives, and the explicit justification of certain technologies, energy sources or sector from a perspective of sustainable development.

(201) Based on these considerations, the Commission has defined a number of energy policy objectives to be pursued in Germany, initially for the time horizon until 2020. They should be seen as interim objectives of a sustainable development of the energy supply system until 2050.

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[1] Dissenting opinion by the expert Jürgen-Friedrich Hake:
All available options should be exposed to competition; an anticipated decision in favour of decentralised systems or virtual power plants cannot be sustainable.

[2] Dissenting opinion by Professor Dr. Paul Laufs, MP:
Individual nations should only take on pioneering roles within the limits of what is economically tolerable. Such pioneering roles can also encourage other countries to benefit from free-rider positions. What is required is solidarity or division of labour, at least among the industrialised nations.

(202) Organising a transfer of capital, technology and know-how in the energy sector from industrialised nations to developing countries, newly industrialised countries and countries in transition in the framework of fair co-operation is a major prerequisite to any sustainable international development. At the same time, this will provide economic opportunities for the industrialised nations and for the solution of global problems such as combating poverty and managing global warming. The strategy to be pursued is a strategy that will link economic and social development opportunities in the developing countries, newly industrialised countries and countries in transition with the energy and environmental policies pursued in the industrialised nations. This strategy can also be justified by the shared responsibility that the industrialised nations have to ensure that their own mistakes will not be repeated during the industrialisation of the South.

(203) In view of the fact that little importance is currently being attached to the energy sector in international development co-operation, it is necessary to refocus the attention of international development policy on sustainable energy supply. Programmes developed to this end will have to be specifically adapted to the concept of sustainable development.

(204) Depending on the target country involved, the strategy pursued with regard to financial and technology transfers and development co-operation should vary in terms of its priorities: in countries in transition, efforts should be focused on increasing energy efficiency, while the primary goal in developing countries should be to improve or develop efficient and affordable energy supply structures that are adapted to local needs and natural resources.

(205) A global energy policy that is compatible with global warming management and that minimises risks is mainly based on giving priority to efficient energy use (EEU), more extensive use of combined generation of heat/cold and power (CH/CP) and the accelerated introduction of renewable energy sources (RES) in the market.[1] These three pillars must be supported by a global policy mix. The Commission supports the development of a world energy strategy that will be focused on a combination of efficiency and solar energy. In addition, the Commission calls for the establishment of an International Agency for Energy Efficiency and Solar Energy, the organisation of world energy conferences and the setting of new priorities for research and development as well as for international funding of projects and loans. Government lending, and the evaluation of the impact of government lending, should be guided by sustainable development criteria. The transfer of know-how and capital

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[1] Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
EEU and RES are important options for a concept of sustainable energy supply. They must be subjected to an unbiased comparison with other problem solutions in terms of their effectiveness and efficiency and any trade-offs to be considered.

designed to support sustainable development in the South should also be geared toward capacity building in order to reduce dependencies and to strengthen all factors affecting a self-supporting economic development process in the South.

(206) In keeping with its mandate, the Commission limits itself to discussing a selection of instruments. The Commission's aim in this context is to provide as concise a classification, description and assessment as possible of only a few instruments which in the medium term it considers to be particularly important and effective for the development of a sustainable energy industry. Before discussing these instruments, the Commission presents a number of fundamental methodological considerations. The type, scope and duration of governmental interventions, for instance, should depend on the degree to which the market and competition have failed in a given case. Major reasons for governmental interventions include the supply of public goods, the elimination of obstacles for competition, and the internalisation of external effects. The specific objectives of intervention and the instruments will be discussed separately, so that even if some of the specific objectives are rejected, a separate discussion and assessment of the various instruments will still be possible.

(207) For the sake of better comparability, the instruments are described wherever possible by means of a standardised characterisation matrix. The instruments are assessed by means of a catalogue of criteria, including only the assessment criteria that, from the perspective of the Commission, are of major importance. These instruments should be used systematically in order to overcome obstacles that hamper progress on the way toward developing a sustainable energy supply system.

(208) Globalisation should be supported by the use of international instruments. In particular, this will require the further development of international framework agreements and the use of flexible mechanisms in the framework of the Kyoto Protocol. The project-based instruments JI and CDM can play a particularly significant role in the context of a technology transfer and an involvement of companies. For this reason, the Commission feels that the establishment of a specific fund is a particularly suitable means to support the introduction of the project-based mechanisms of the Kyoto Protocol (DUFIeM-Fonds) in the field of sustainable technologies.

(209) At EU level, it is necessary to introduce a European system of tradable emission permits that will also be accessible for individual economic players. However, the Commission draws attention to the fact that some questions have not yet been resolved with a view to implementing a fair system. The tradable permits system should be introduced as a mandatory system no later than as of the beginning of the first commitment period of the Kyoto Protocol. In view of the high target contribution, the high conformity with competition,

and the high degree of flexibility, the Commission feels that the trading of $CO_2$ emission permits is a particularly suitable global warming management instrument, especially for the industrial sector.[1] [2]

(210) Since the decision was taken to phase out nuclear energy, the EURATOM Treaty is considered to be anachronistic in many EU Member States.[3] After the termination of the EURATOM Treaty, the remaining areas that need to be regulated can be dealt with in the EC Treaty or the future EU Treaty. In the field of safety, it is necessary to harmonise standards across the European Union and to approximate the participation and decision-making mechanisms to the procedures applying in the non-nuclear sector. In the framework of the reform of the EC Treaty, a separate chapter on "Sustainable Energy Policy" [4] should be introduced in order to anchor this policy at EU level as other policy fields are increasingly being integrated. This new chapter should be focused on renewable energy sources and energy efficiency, while leaving enough scope for innovation to national energy policies.

(211) The main purpose of the use of general instruments at national level is to create reliable long-term framework conditions for all players, in particular in industry. In this context, it is necessary to distinguish between general instruments and specific global warming management instruments.

(212) A more consistent and goal-oriented liberalisation of electricity and gas markets, for instance, should help prepare the ground for increasing the variety of players, reducing market access barriers and cutting transaction costs. In view of the large number of shortcomings and inadequacies involved in Germany's special approach to liberalisation, the

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1 Dissenting opinion by Dr. Ralf Brauksiepe, MP:
As a result of the EU Commission's current proposal, plants will be decommissioned and moved to non-EU countries. The Member States should be free to choose other instruments such as voluntary commitments.

2 Dissenting opinion by Franz Obermeier, MP:
A tradable permit system should at least be introduced in all Member States of the EU; it should not discriminate; it should make allowance for advance inputs, and it should be compatible with the Kyoto instruments. It would be unjustifiable to abandon the voluntary commitment model too easily.

3 Dissenting opinion by the expert Jürgen-Friedrich Hake:
The EURATOM Treaty has proven to be extremely effective and should definitely not be terminated.

4 Dissenting opinion by Kurt-Dieter Grill, MP:
I am opposed to introducing a separate chapter on "Sustainable Energy Policy" in the framework of the reform of the EU Treaty.

current Energy Management Act (*Energiewirtschaftsgesetz*) should be amended to remedy these shortcomings.[1]

(213) It is also important to reduce subsidies for energy sources that harm the climate and involve risks (reducing subsidies for domestic hard coal and for gas oil used in agriculture, abolishing the reduced tax rate for diesel fuel, etc.).[2] Furthermore, it is also necessary to remove the competitive advantages enjoyed by the operators of nuclear power plants because of their provisions for the disposal and decommissioning of nuclear power plants. Instead, the provisions should be earmarked for their intended purpose by transferring them to a pubic-law decommissioning and disposal fund.[3]

(214) The Commission feels that there are other general instruments that are specifically designed to manage global warming. These include pursuing the ecological tax reform and developing it into an ecological fiscal reform as well as supporting local and regional global warming management activities.[4] The high degree of willingness of many German local governments, as well as some state-level governments, to carry out global warming management activities must be financially supported.[5]

(215) For various reasons, there are limits to the application of general instruments: First of all, markets in general and markets for energy services in particular are not perfect, but beyond external costs, they have shortcomings such as asymmetrical information and

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1 Dissenting opinion by Kurt-Dieter Grill, MP:
The wholesale criticism of liberalisation in Germany must be rejected. It is neither substantiated, nor is it logical.

2 Dissenting opinion by the expert Professor Dr. Volker Schindler:
In the case of petrol and diesel, the external environmental costs are already excessive. Adjusting taxes in both cases to a medium level would be useful. Aspects concerning the competitiveness of German motor vehicle operators relative to foreign competitors should be taken into consideration in this context.

3 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
A transfer of the provisions for the disposal and decommissioning of nuclear plants to a public-law fund must be rejected because this may severely jeopardise the operators' ability to comply with their disposal obligations.

4 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
The suggestion that the "eco-tax" should continue to be levied is blatantly inconsistent with the prevailing view among financial experts. This would mean accepting an increase in the public sector's share in GNP and extensive redistribution effects at the expense of low-income earners.

5 Dissenting opinion by the expert Dr. Hans Jörg Henne :
It is not understandable why sustainable energy supply objectives are mixed up with local objectives, or why local governments are particularly suitable for implementing these objectives.

market power.[1] In addition, such general instruments tend to lead to more short-term adjustment reactions, so that they often do not set sufficient price signals in sectors that are mainly characterised by a long-term perspective. Furthermore, the spectrum of sustainable energy supply objectives is multidimensional; it is not limited to one pollutant (e.g. $CO_2$) or one risk area (e.g. nuclear energy), so that incentives that only concern one aspect to be regulated are not sufficient. Unlike instruments that are related to specific players, sectors or technologies, general instruments also tend to trigger political problems and acceptance problems more often.

(216) In the electricity market, the Commission feels that it is indispensable to apply additional specific instruments in order to pursue the following three specific objectives: First of all, the share of renewable energy sources should be increased. Secondly, the Commission believes that the share of CHP in electricity generation should be substantially increased, and thirdly, the efficiency of the use of electricity by the consumer should be increased[2] because energy conservation efforts[3] on the part of the consumer have slackened because of the liberalisation of the electricity market.

(217) Other instruments that can be applied to continue to promote the use of renewables in the electricity sector include further development of the proven Electricity Feed Act (*Stromeinspeisegesetz*) and of the lending and funding programmes for the use of renewable energy sources[4], and the introduction of compulsory electricity labelling.

(218) In order to prevent the use of CHP from being driven back by the liberalisation process, the CHP Act entered into force on 1 April 2002. Should the envisaged reduction of $CO_2$ emissions by 10 million tonnes by the year 2005 not be achieved, the Commission feels that it is necessary and useful to introduce as a follow-up a quota system to promote the use

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1 Dissenting opinion by Kurt-Dieter Grill, MP:
It is an old and unproven prejudice to say that markets are “more shortsighted” than political players. There are good reasons to assume that – with a view to vote maximisation – the opposite is probably the case.

2 Dissenting opinion by Franz Obermeier, MP:
The definition of specific measures in such an apodictic form is entirely unfounded. It will first have to be demonstrate that these options are more effective than other options.

3 Dissenting opinion by Walter Hirche, MP:
This is empirical evidence demonstrating that the consumer’s “energy conservation efforts” have been pushed into the background by liberalisation. Consumer prices have not fallen at all, not least due to cost-intensive governmental interventions.

4 Dissenting opinion by the expert Hans Jörg Henne:
So far, the “Electricity Feed Act” has only proven its worth for plant builders and investors – at the expense of electricity consumers. No mention is made here of the criteria underlying this assessment or of the possibilities available to label electricity!

of CHP. The purpose of such a system is to facilitate market access for CHP plants and to enable them to become competitive after the reduction of current overcapacity and once the competitive market has become more mature.[1]

(219) An important part of the strategy designed to achieve a stronger demand orientation by means of efficient energy use is improving the efficiency of electricity use by the consumer because there is considerable scope to improve efficiency in this area. The Commission feels that a particularly suitable means to achieve this objective is promoting the accelerated market diffusion of efficient technologies by means of an integrated research, demonstration and further education programme (RAWINE) and the establishment of an Energy Efficiency Fund. This Fund should be designed as an independent institution under public law; its purpose will be in particular to reduce market obstacles for efficient technologies in electricity applications and to lower the transaction costs for the various players involved. Another highly effective means would be a more extensive application of labelling and standards to appliances that are currently not covered. This can be achieved by amending the Energy Consumption Labelling Act (*Energieverbrauchskennzeichnungsgesetz*) and the Maximum Energy Consumption Regulation (*Energieverbrauchshöchstwerteverord-nung*) to this effect.

(220) In the heat market, the Commission feels that there is need for action in two key fields: On the one hand, the Commission believes that it is necessary to reduce energy consumption by improving the thermal insulation of buildings in combination with improving the efficiency of energy converting units. Thermal insulation can be improved by upgrading the Energy Conservation Ordinance (*Energieeinsparverordnung*); in this context, it seems necessary continuously to tighten the requirements in terms of the primary energy consumption to be conserved. Another promising approach is the provision of funding for measures designed to reduce energy consumption. This can be done by granting interest-subsidised loans for upgrading the energy efficiency of buildings or by granting tax privileges in the form of special or accelerated depreciation. Furthermore, organisational and tenancy law improvements with regard to contracting measures and their applicability in the field of rental housing should also be promoted. This will help utilise energy conservation potentials that are currently not utilised because of current barriers to investment.[2]

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
No reason is given for introducing a quota system in the case of CHP.

[2] Dissenting opinion by the expert Jürgen-Friedrich Hake:
Unfortunately, no concrete, viable proposal has been made on how to utilise the scope for increasing efficiency which is likely to be substantial, especially in older buildings.

(221) A major contribution to reducing greenhouse gas emissions caused by the heat market can also be expected from a more extensive use of renewable energy sources. This applies first and foremost to the use of solar collector systems for water heating purposes, biomass-fired heating systems, heat pump systems, as well as local solar heating systems. As far as smaller decentralised systems are concerned, the Commission feels that a funding system similar to the current market incentive programme for renewable energy sources would be a particularly suitable instrument, while it proposes not only direct funding for local systems but also a quota-based system designed to support the use of renewables in the heat market.

(222) In the transport sector, an adequate contribution toward attaining global warming management objectives is being prevented by the fact that passenger car traffic continues to be responsible for by far the highest transport-related $CO_2$ emissions, and both road freight traffic and air traffic are growing substantially. The Commission feels that reducing the average consumption of the passenger car fleet to below 4.5 litres per 100 km by the year 2020 and to below 2 litres per 100 km by the year 2050 is an achievable target.[1] To this end, it will be necessary to define suitable targets at national level or at the level of the EU, where possible in the framework of agreements with the car manufacturing industry. Efficient passenger cars should be promoted by means of differentiated taxation. Speed limits for passenger cars and light commercial vehicles will help avoid the disproportionately high output of pollutants at high speeds. The tax deductibility of passenger cars used for business purposes should be reduced to the level of use actually required for business purposes. The external costs created by commercial vehicles should be covered, as much as possible, by means of tolls. Aircraft, railway and buses should be treated equally with regard to the petroleum tax.[2] In the field of freight traffic, the objective should be to transport more freight across the EU by rail and by ship.

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[1] Dissenting opinion by Professor Dr. Paul Laufs, MP:
It seems impossible to reduce the fuel consumption of the currently active fleet to these levels; this target can at best be discussed for the fleet of new cars registered.

[2] Dissenting opinion by the expert Professor Dr. Volker Schindler:
Just like passenger cars and commercial vehicles, aircraft, railways, buses and ships should also be charged with their attributable external environmental costs.

At national level, this should be supported by the internalisation of external costs in road freight traffic.[1] In the field of air traffic, the preferential tax treatment of aviation fuel should be dropped. It would also be desirable to limit the maximum expansion of air traffic to a level which can be offset by efficiency gains due to aircraft improvements.[2] [3] Because of the complexity of the transport sector, the Commission recommends that an enquete commission on "Sustainable Mobility" should be established in the next legislative period.

(223) In view of the important role played by technological, economic and social innovations in the development of a sustainable energy supply system, the Commission feels that it will not be possible to implement a sustainable energy supply system unless priorities in the funding of energy research are changed soon. The Commission endorses the criteria for a sustainable research and development policy that have emanated from the international discussion (e.g. in the Netherlands). In addition to these points, the Commission feels that it is also important to include an analysis of the obstacles to an accelerated market introduction, as well as the instruments and measures for a successful market transformation, and an evaluation of the effects of new technologies in interdisciplinary research programmes.

(224) The key function of educational and research policies is to stimulate technological and social innovations in all energy-related sectors by creating the appropriate setting, so that the competition for quality and innovations can be focused on sustainable development objectives.

(225) In addition, the Commission proposes an integrated sociological/technological research programme which will also deal with the interface between efficiency and sufficiency.[4] It will be necessary to have a differentiated policy mix in order to implement the

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[1] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
Even if the current organisational and infrastructural limitations are overcome, it will not be possible to transfer a major share of the current road freight transport volume to rail or waterway transport because of the differences in technical possibilities.

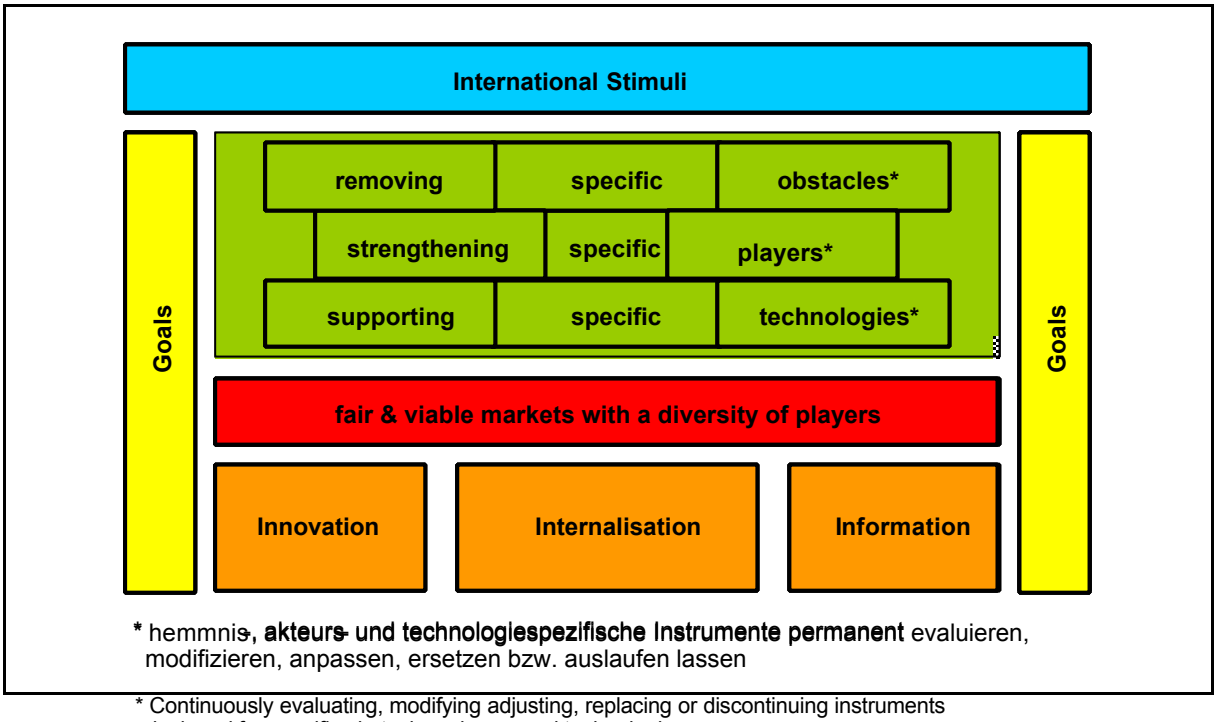
[2] Dissenting opinion by Dr. Ralf Brauksiepe, MP:
National administrative restrictions imposed on air traffic would lead to severe competitive disadvantages for major sectors of German industry.

[3] Dissenting opinion by the expert Dr. Hans Jörg Henne:
The internalisation of external costs is a general requirement of/in any sustainable energy supply concept. However, it must be examined whether this requirement is met by the current taxation practice, in particular in the transport sector.

[4] Dissenting opinion by Walter Hirche, MP:
The integration of the humanities into energy policy in the form of research programmes is currently seen with scepticism because findings are not to be expected.

various strategy elements. This mix contains some elements that are constituent for a sustainable energy supply system; but there are also elements that may change or be replaced in the course of time:

*Chart 1-4: Elements of the Policy Mix for the Development of a Sustainable Energy Supply System*[1]




* Continuously evaluating, modifying adjusting, replacing or discontinuing instruments designed for specific obstacles, players and technologies

(226) Continuously adjusting and optimising the policy mix is a challenge that government has to face with the objective of developing a sustainable energy supply system. The use of a set of effective instruments promotes the viability of the markets. Viable markets for energy are the basis and provide the setting for the development of a sustainable energy supply system. To this end, it is necessary to apply the entire spectrum of instruments in order to establish and protect liberalised energy markets with a great diversity of players. It is also indispensable to apply general market management instruments to internalise external costs, to pursue a systematic innovation policy, and to use informational and motivational instruments that are designed to help obtain social acceptance and social viability for sustainable development strategies in the energy sector, while at the same time removing asymmetrical information, creating market transparency and reducing transaction costs. Such instruments should be complemented by instruments for specific sectors, target groups

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[1] Dissenting opinion by the expert Jürgen-Friedrich Hake:
The purpose of supporting “technology-specific instruments” is to perpetuate subsidies. Instead, it is necessary to be open to a variety of technologies in order to attain the envisaged objectives.

and technologies that are designed to address specific market imperfections and obstacles, especially with a view to the substitution of efficient technologies for energy consumption. All instruments must be regularly subjected to a monitoring process in order to find out whether the addressed obstacles still exist and whether the instruments used are still adequate and effective.

(227) The definition of general and sectoral objectives is a crucial connecting element between clear-cut strategies or development objectives and the most flexible use of instruments possible. Hence, the definition, evaluation and updating of objectives is a constituent element of the policy mix.

(228) Finally, the international level is an indispensable dimension in any policy aimed at sustainable development in the energy sector. This applies both to the development of global governance regimes and to the systematic transfer of technologies and policies to other countries, e.g. by means of the flexible instruments specified in the Kyoto Protocol.

(229) It should be possible to apply the instrument mix in a flexible manner when defining clear-cut objectives. Frequent changes in instruments should be avoided. Where voluntary commitments that complement governmental instruments obviously fail to attain their objectives, they must be accompanied by the option to apply alternative instruments – that are ready to be used – in order to attain the same objectives.

## 1.7 Recommendations for action

(230) In its final recommendations for action, the Commission – based on a systematic analysis of sustainable development strategies and instruments – proposes a policy mix that seems to be particularly suitable to initiate the structural change needed to develop a sustainable energy supply system. The Commission limited the time horizon in its recommendations for action to a medium-term perspective of 10 to 15 years. In this context, top priority is given in the energy sector to the development, strengthening and implementation of sustainable development strategies that can be operationalised.

(231) The process of liberalisation should be backed by regulations that facilitate and safeguard competition[1] in order to counteract the concentration of market power and the development of oligopolies that are emerging, and in order to ensure a greater diversity of players.[2] In addition, efforts must be made to ensure that liberalisation will not put into question the guiding principle of sustainable development; hence, the implementation of sustainable development requires a strong government[3] that can enforce the primacy of policy-making.

**Future development of liberalisation:**

(232) In order to make sure that ongoing market concentration processes and the abuse of existing dominant market positions will not de facto prevent effective competition in the energy markets, the current rules on negotiated network access and the lack of an independent national regulatory authority should soon be reviewed with a view to the objective of providing non-discriminatory network access.[4] The Commission recommends

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1 Dissenting opinion by Franz Obermeier, MP:
Liberalisation has cleared the way from regional monopolies to a larger number of players. So-called competition-facilitating regulations create the false impression that they promote competition. The opposite is the case.

2 Dissenting opinion by Franz Obermeier, MP:
What is needed is not regulation, but the development and protection of a "competition framework". Government should limit itself to playing its proper role.

3 Dissenting opinion by the expert Jürgen-Friedrich Hake:
The postulate of a "strong government" is being abused to justify arbitrary and unbounded governmental interventions.

4 Dissenting opinion by Kurt-Dieter Grill, MP:
There is no reason to abandon the negotiated network access approach in favour of more regulation or network access imposed by law.

that – if no progress is made in the field of liberalisation, or if insufficient progress is made in the development of a more sustainable energy supply system – liberalisation should be codified by means of a network access ordinance, and that a competition authority should be established that would act ex ante.[1] In the interest of a greater diversity of players, the rules on merger control should be tightened and the exemptions granted for reasons of public interest, which may continue to be necessary, should be made more transparent and democratised[2] through the involvement of Parliament.

(233) In view of the growing market risks (as illustrated, for instance, by the bankruptcy of ENRON, the U.S. utility company), it is necessary to reassess the use of the provisions[3] [4] made by the energy industry for the decommissioning of nuclear power plants: These provisions should be transferred to a fund under public law.[5]

**Sustainable energy management:**

(234) Without clearly quantified targets, there are no sufficient yardsticks for assessing the implementation of global warming management measures: The Federal Republic of Germany should commit itself to reducing national greenhouse gas emissions – relative to 1990 – by 40 per cent by the year 2020, even if other countries may be more hesitant in their global warming management policies. In a longer-term perspective, the Commission recommends that efforts in Germany should be geared toward a reduction of greenhouse

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1 Dissenting opinion by Franz Obermeier, MP:
I am against the establishment of a national regulatory authority. Instead, I am in favour of further developing the industry association agreements.

2 Dissenting opinion by the expert Dr. Hans Jörg Henne:
So-called “democratisation” will not solve the problem of taking the right decisions. Exemptions should be used restrictively, as required by the legislator.

3 Dissenting opinion by Professor Dr. Paul Laufs, MP:
Accounting changes with regard to the treatment of nuclear provisions should be rejected because they are not a proper solution. This is an attempt to impose the shutdown of nuclear power stations “through the back door”.

4 Dissenting opinion by Walter Hirche, MP:
Transferring the provisions for the disposal and decommissioning of nuclear plants to a fund would jeopardise disposal, and it would be tantamount to expropriation.

5 Dissenting opinion by the expert Professor Dr. Volker Schindler:
The decommissioning of nuclear power plants and the necessary financial provisions made for this purpose must remain under the unconditional control of the operator concerned.

gas emissions by 50 per cent by the year 2030 and by 80 per cent by the year 2050.[1] As the scenario calculations have shown, this will not lead to unacceptable costs for the national economy.[2] [3]

(235) The Commission is convinced that the decentralisation of energy supply structures is an important building block for a sustainable energy supply system.[4] For this reason, the centralised supply structures should be complemented by decentralised options; and in a longer-term perspective, the centralised structures should be largely replaced by decentralised supply and network configurations. By means of state-of-the-art information and communication technology, these options can be combined to form "virtual power plants".[5] However, this will only be possible if the regulatory framework for decentralised options is improved. In addition, it is necessary to support and expedite the development of the necessary infrastructure by means of systematic market introduction programmes.[6]

(236) In view of the upcoming investment and replacement cycles of the German power plant park (2005-2025), there will be a time window that should be used to provide stronger incentives temporarily in order to achieve a breakthrough in the fields of energy efficiency and solar energy.[7] [8] Greater efforts should be made to ensure fair market access for

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1 Dissenting opinion by the expert Dr. Hans Jörg Henne:
In view of the remaining uncertainties in terms of the actual shortage of resources and the risk to the climate and in terms of the future market development and the options available, it is not useful to define quantitative targets.

2 Dissenting opinion by Kurt-Dieter Grill, MP:
The term "unacceptable costs" suggests that the macroeconomic costs associated with these targets are not substantial. The contrary is true, as demonstrated in the non-nuclear scenarios.

3 Dissenting opinion by the expert Jürgen-Friedrich Hake:
Scenario calculations only reflect the results of the assumptions upon which they are based. They can certainly not claim to make absolutely correct predictions about future developments.

4 Dissenting opinion by Franz Obermeier, MP:
The decentralisation degree cannot be a good target for sustainable energy supply. Ideological targets lead to high costs for the parties concerned without being democratically legitimised.

5 Dissenting opinion by Walter Hirche, MP:
Considering their costs and pollution, general decentralised generation and network management structures are not necessarily more sustainable than centralised structures.

6 Dissenting opinion by Kurt-Dieter Grill, MP:
I am against the one-sided concentration on decentralised energy supply structures.

7 Dissenting opinion by Franz Obermeier, MP:
I am against more political interventionism in support of decentralised energy supply structures and the solar energy sector.

8 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
A long-term interventionist and technology-focused approach leads to permanent subsidies and inefficiency.

combined heat and power (CHP) in order to promote the market penetration of this technology. The CHP Act should be consistently optimised – depending primarily on its evaluation in 2004 – if necessary by introducing a quota system.[1] In order to continue to promote the use of renewable energy sources in the electricity sector, there is no alternative in the current market phase to optimising the Renewables Act (EEG – *Erneuerbare-Energien-Gesetz*)[2] and continuing the necessary lending programmes. As far as the heat sector is concerned, the Commission recommends extending the scope of the funding programmes for the time being until the establishment of a quota system that will impose environmental protection obligations on the various players in the fossil fuel distribution chain.

(237) In view of the current market obstacles, the Commission also advocates much more determined efforts to increase energy efficiency on the demand side. Viable competition for energy services must be organised and supported. To this end, the current energy supply system, which is predominantly supply-oriented, should be complemented by a much more demand-oriented efficiency improvement system and the provision of energy services for the consumer at reasonable cost for the national economy. Efforts should be made to remove the wide variety of obstacles that hamper the competition of substitution between energy efficiency technologies and energy supply.

(238) The Commission feels that the following instruments are particularly suitable for the development of a sustainable energy management system:

(239) Since the eco-tax does not affect total tax revenues, it should be further developed as an instrument designed to internalise external costs.[3] The real tax rate should be continuously increased. The purpose of steady and long-term follow-up regulations should be to reduce the gross labour costs and to use part of the tax revenues systematically to

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1 Dissenting opinion by Dr. Ralf Brauksiepe, MP:
As a matter of principle, I am against quota systems imposed by government. They lead to permanent subsidies. Competition in the market efficiently controls quantities.

2 Dissenting opinion by the expert Dr. Hans Jörg Henne:
Tightening of the CHP Act and of the Renewables Act is counterproductive interventionism, which I reject.

3 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
The demand for a continuation of the eco-tax is inconsistent with the negative experience gained with this instrument. The clear advice of public finance experts not to use this instrument is disregarded. The weaker members of society will be the ones who will be affected.

promote the ecological structural change, so that this will lead to a comprehensive ecological fiscal reform.[1]

(240) A concept for the implementation of a system of tradable emission permits should swiftly be developed in Germany, too; the implementation of this system should be integrated into the policy mix described by the Commission.[2] [3]

(241) The Commission recommends the establishment of an Energy Efficiency Fund which should be financed from a levy imposed on the revenues of electricity and gas network operators (which will not bias competition) and/or from part of the revenues of the eco-tax. The purpose of this Fund will be to finance competitive campaigns, measures and programmes designed to support efficient technologies and services in the market, and to finance motivational and informational campaigns.[4] The implementing institution would be an Efficiency Agency, which – modelled after the British or Danish example – would operate in close proximity to the market.[5]

(242) Following the Swiss RAVEL programme and the successful activities of German state-level governments (in Hesse and North-Rhine Westphalia), an integrated research, demonstration and further education programme on "Efficient and Cost-Effective Electricity Use" (RAWINE – *Rationelle und wirtschaftliche Verwendung von Elektrizität*) should be developed by the German Federal Government and by Germany's state-level governments.

(243) There is a particularly urgent need to adopt a set of measures designed to promote the retrofitting of existing buildings with thermal insulation materials and to introduce efficient

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[1] Dissenting opinion by Walter Hirche, MP:
It is not true that the eco-tax does not affect total tax revenues; I am against the eco-tax because it increases costs. This also applies to any future increases in the eco-tax. It is not suited to serve as a basis for a comprehensive ecological fiscal reform.

[2] Dissenting opinion by the expert Jürgen-Friedrich Hake:
I am against implementing the EU's proposal for a directive without a critical assessment. In principle, I welcome the instrument as such.

[3] Dissenting opinion by the expert Dr. Hans Jörg Henne:
A system of tradable permits should be designed to cover at least all of Europe; it should not discriminate; it should make allowance for advance inputs, especially those made by German industry; and it should be combinable with the flexible Kyoto instruments.

[4] Dissenting opinion by Professor Dr. Paul Laufs, MP:
I am categorically opposed to imposing any new levies and taxes on utility companies to finance public campaigns.

[5] Dissenting opinion by the expert Professor Dr. Volker Schindler:
I am against establishing a so-called "Energy Efficiency Fund" because this would lead to the emergence of shadow budgets, and the necessary transparency of the use of funds would not be guaranteed.

space heating and water heating technologies (increasingly based on renewable energy sources)[1] in the course of modernisation measures that are scheduled to be carried out anyway because this sector holds a cost-effective $CO_2$ reduction potential of up to 50 per cent.[2]

(244) The Commission believes that it is desirable to have a variety of regional energy generation sources that should be fostered by keeping the access barriers to energy and technology markets low for these generators. To this end, it is necessary to promote regional players and their coordination within decentralised network structures, so that they can establish themselves on a long-term basis. For this purpose, small-scale generators and self-supplying operators should be strengthened legally and economically vis-à-vis the established players in the energy market.[3]

(245) The Commission recommends that a research and education initiative should be launched, centred around energy efficiency aspects and renewable energy sources. In this context, an integrated research and development programme, which will combine socio-ecological with technical aspects (i.e. also questions of efficiency and sufficiency) should explore the $CO_2$ reduction potentials that can be influenced by changes in behaviour and life-styles.[4]

**Transport:**

(246) The Commission recommends that an enquete commission should be established in the next legislative period to deal with the topic of “Sustainable Mobility”.

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1 Dissenting opinion by Walter Hirche, MP:
Giving preference to renewable energy sources can lead to inefficient structures that are not really sustainable.

2 Dissenting opinion by Franz Obermeier, MP:
I am opposed to imposing the use of certain renewable energy sources when carrying out thermal insulation measures in existing buildings.

3 Dissenting opinion by Kurt-Dieter Grill, MP:
The so-called “legal strengthening” of smaller-scale generators and self-supplying operators constitutes another intervention in the energy market, which is not acceptable. Such a requirement cannot be derived from the objective of sustainable development, either.

4 Dissenting opinion by the expert Professor Dr. Dieter Schmitt:
I do not share the views of the majority of the Commission members with regard to the life-styles that they envisage for the population. I doubt that such life-styles can be brought about without an invasion of the individual’s privacy.

**European policies:**

(247) At European level, it is necessary to create energy markets with transparent and equal framework conditions and systematically to remove obstacles that impede the substitution of efficient technologies for energy. A separate Energy Chapter[1] should be included in the EC Treaty or the future EU Treaty in order to anchor the acceleration of efforts to increase energy efficiency and to promote renewable energy technologies in EU legislation. Germany should advocate the termination of the EURATOM Treaty.[2] Some countries will have to play pioneering roles[3] and conduct a wide variety of experiments in order to test the innovations that are required to develop a sustainable energy supply system and to make them applicable on a large scale. The preservation or creation of such scope for national innovations is a separate element of European energy policy.

(248) The Commission feels that actively supporting the EU's eastern enlargement in the fields of energy policy and global warming management is a priority task of German EU policies. The candidate countries should be given legal, political-structural and technological support in the implementation of energy policy measures and the introduction of viable pricing and billing systems, with the objective of enabling them to develop sustainable energy supply systems. In the new Member States, the goal should also be to phase out the use of nuclear energy.

**International policies:**

(249) The industrialised nations should develop a special partnership with developing countries, newly industrialised countries and countries in transition; the industrialised countries should set an example and play a pioneering role in the design and development of future energy supply systems.

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1 Dissenting opinion by Dr. Ralf Brauksiepe, MP:
I am opposed to the introduction of a separate Energy Chapter because this would be inconsistent with the principle of subsidiarity.

2 Dissenting opinion by the expert Dr. Hans Jörg Henne:
It is absurd to believe that the EU with Member States like France, Finland or – in future – the Czech Republic can be pressed to phase out nuclear energy. In addition, the EURATOM Treaty has proven its worth.

3 Dissenting opinion by Professor Dr. Paul Laufs, MP:
I am opposed to playing pioneering roles and allowing scope for national innovations. They are used to justify isolated national interventionist efforts whose success in terms of global warming management is negligible.

(250) National efforts should be supported by a transfer of funds, technology and know-how to developing countries, newly industrialised countries and countries in transition. This will also help develop export markets. For this reason, the Enquete Commission recommends that an initiative should be launched to export renewable energy and efficiency technologies to developing and newly industrialised countries.[1] Renewables and efficient technologies should also play a greater role in the framework of development co-operation and project funding programmes.

(251) At any rate, co-operation with today's and future energy-supplying countries and regions will play an important role. Due to the global energy markets, the world has become highly interdependent. As a result, political instabilities in energy-supplying countries and regions can have major economic and political repercussions on a global scale. The primary concern in this context is not so much the physical shortage of energy raw materials but the consequences of price turbulences for the increasingly integrated world energy markets. The promotion of co-operation in a spirit of partnership to preserve economic and political stability and to foster a sustainable development in the energy-supplying regions, as well as helping countries (such as the OPEC countries) cope with the economic and political consequences of a global transition to more efficient and renewable energy supply systems give rise to a new foreign-policy dimension in energy policy.

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[1] Dissenting opinion by the expert Professor Dr. Volker Schindler:
It is not in the interest of the developed countries to export expensive wind power plants and photovoltaic systems for which energy storage facilities are locally not available anyway.