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Security of Supply - A challenge for Energy policy in Europe

Freiburg, October 2001

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Contents

Tables

Illustrations

Introduction

On November 29th, 2000, the European Commission adopted the Green Paper, *Towards a European strategy for the security of energy supply*, and called for a broad process of discussion. To structure the debate, the Commission presented a questionnaire comprising 13 questions. The Green Paper and the questionnaire both focus on the security of energy supply as their starting point, but can also be regarded as a rough outline for a common European energy policy. In addition to the basic issue of extensive energy policy responsibilities for the European Union, the debate centres on further issues concerning reappraisal of nuclear energy and interaction with the areas of liberalization and climate protection policies.

Against this background, four key issues concerning the security of energy supply and European energy policy have emerged in this study. The author has declined to deal explicitly with certain passages in the Green Paper, on which, on principle or in detail, he holds a contrary opinion.

Rather has the attempt been made, taking the undisputed objective of security of energy supply as starting point, to examine links, common interests and inconsistencies with the areas of climate protection and liberalization policies. Of prime importance was the question, which particular problems and priorities might arise in the overall view of these three areas of policy. Especially within the context of the questionnaire, an opinion on the implicitly and explicitly formulated thesis, whether and in what manner a common European energy policy is sensible and necessary, was of course inevitable.

With the events of September 11th, 2001, the debate on the security of energy supply also experienced a turning point. In the meantime, a huge number of discussions and political measures have been set in motion at a national, European and international level, whose consequences have yet to emerge. All that is certain, is that far-reaching consequences for energy policy can be expected, on account of the relationship to important regions of oil and gas supply, and against the background of an inevitable re-evaluation of the vulnerability of modern and open industrial societies.

The preparation and discussion of this study covers the period both before and after September 11th, 2001. As far as possible, references to this political turning point have been made but, in view of the advanced stage of preparation, only rudimentarily.

I would like to thank Michaele Hustedt, Hans-Joachim Ziesing, Friedemann Müller, Hans-Josef Fell, Jörg Schindler, Antony Frogatt and Claude Turmes for the at times controversial discussion on the first version of this study. The responsibility for the content, for all errors and imperfections, lies of course entirely with the author.

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Theses

1. The core of the debate on the security of energy supply – besides the risks of politically motivated *physical disruption of supply* or disruption resulting from criminal or terrorist action – is the short- and long-term capacity of energy markets to direct and adapt to changes in the sphere of energy prices.

2. Physical disruption of supply due to political or technical factors may lead to unacceptable economic and societal effects, which justify and necessitate preemptive action. Given the changed global balance of power and the increasing integration of the global economy, the potential impact of politically motivated disruption of supply appears, however, to become less of a problem. With regard to physical disruption of supply, the *infrastructural safeguarding* of supply security – also against disruption resulting from criminal or terrorist action – is most important.

3. As to economic risks, intervention appears to be sensible, especially to mitigate the consequences of erratic *price fluctuations* on the world market. Given the considerably integrated world market, the risk of such price fluctuation relates by no means only to imported fuels, but also to *total consumption* of oil and gas as well as to a substantial share of coal input. A debate on the security of supply, which concentrates solely on the share of imported fuels, is therefore *not* adequate to the problem.

4. The long-term – and, concerning the time-frame, highly disputed – *physical shortage* of energy sources, coupled with corresponding effects on prices, justifies intervention *with a view towards supply security* only in those – exceptional – cases, where adaptational reactions to shortages expected in the medium to long term, appear implausible for certain parts of the capital stock (for example, buildings).

5. For many areas, the pressure to adapt, due to *ecological challenges*, appears to be *greater* and the period of adaptation *shorter* than from the physical shortage of fossil or nuclear fuels. Different aspects of supply security (see below) can, however, justify the choice of certain options for ecological relief (for example, energy saving and renewable energy sources).

6. For sustainable energy supply, the further – or even increased – use of *nuclear energy* cannot be an option, because of the risk of accident, the unresolved question of waste as well as the adverse ecological effects of plant operation. The use of nuclear energy presents a particularly serious problem with regard to the *security of waste disposal*. As for supply security, nuclear energy causes *additional* risks; for the danger exists that, through accidents or catastrophes resulting from criminal or terrorist action, industry-wide security problems will result in a further decline in public acceptance, such that large nuclear power plant capacities might have to be shut down at very short notice. A climate protection

policy, which relies on nuclear energy, runs into the problem of considerable instabilities. Finally, it is not clear, how nuclear fusion – apart from all its unresolved problems – could contribute early enough to easing the ecological burden highlighted by the climate protection problem.

7. With regard to fossil fuel markets, supply security analyses must differentiate. For *oil supply*, the endangerment of supply security due to the unstable political situation in the Middle East is of prime importance, for *gas and electricity supply*, it is primarily the guaranteeing of the infrastructural security of supply (within *and* outside the European Union). Particularly in the case of *natural gas supplies from Russia*, the provision of finance for the development of new gas deposits is an important element of supply security.

8. For the greatest possible diversification of supplies of crude oil and natural gas, and in view of the future declining role of European deposits, the development of *new supply relationships*, especially for natural gas (North Africa, Iran), and the creation of the appropriate infrastructure, represent a new and by no means easy challenge.

9. The *most important challenge facing all energy markets* is the mitigation of the consequences of price fluctuations resulting from developments on the markets for crude oil.

10. In this context, the *fuel stocking policy* currently implemented within the framework of the IEA has proved its worth. The extension of this policy to cover natural gas does not appear to be really necessary; it can also be achieved through participation in the costs of extended oil stocking. Regarding coal reserves, there appears to be no need for further action. In any case, the involvement of new large-scale consumers of mineral oil (China, India) in strategies for oil reserves is of top priority.

11. A *change in the proportion* of fossil and nuclear fuels exploited within the EU compared to those imported into the EU, at a constant level of consumption of these fuels, does *not* in the end contribute to an increase in supply security. Endangerment from the physical disruption of imported supplies is only of minor importance, fuel markets are to a large extent integrated into the world market, and the costs of exploitation (especially in the case of coal) within the EU lie well above expected erratic price fluctuations. From the viewpoint of security of supply, the introduction of so-called national energy production socles does *not* appear to be justified under prevailing conditions in the EU.

12. The greatest effects concerning the economic consequences of sudden price fluctuations are created by the *reduction in the use of oil and natural gas*. The *replacement* of oil and natural gas with coal would not preclude those price effects rippling through the world market, but it could dampen them. If such coal input is realized in the EU through non-competitive production, additional costs would be *disproportionate* in comparison to the effects of curbing the costs of imports.

Increased use of imported coal is – similar to the use of domestic coal supplies – very much inconsistent, however, with the ecological goals of the Community.

13. The decisive contributions towards increasing the security of supply – that is, for containing the economic effects and long-term focusing on energy sources that do not carry the risk of erratic price fluctuations – can only be provided through *greatly increased improvement in energy efficiency* in the area of end use and energy transformation (above all, combined heat and power), and through the *accelerated introduction of renewable energy sources*, which is also ecologically indispensable. From the viewpoint of supply security, the potential for energy saving and the replacement of mineral oil and natural gas are of particular significance. If long-distance supplies of electricity or hydrogen from regenerative sources were to gain in importance in the long run, other *new* problems of supply security would emerge.

14. Strategies for thus improved security of supply can – in addition to the requirements of the European internal market – only be implemented through a *more consistent policy at the European level*, comprising, besides competition and environment policies, specific energy policy elements. Strategies for expanding competition and for increased environmental relief, even when they are markedly better co-ordinated than today, can lead to restrictions of the security of supply (huge fuel switching to natural gas, without a reduction in the level of consumption). The inclusion of specific energy policy aspects of supply security can in this instance lead – with the same level of target fulfilment – to changed priorities, also with regard to the timing of implementation (priority for energy saving and renewable energy sources). New EU responsibilities should be explicitly directed at increasing energy efficiency and introducing renewable energy sources.

15. The *central areas of action* for energy policy at a European level are *firstly*, the resolute eradication of distortions in competition favouring some fossil and nuclear fuels or particular energy markets (state aid, incomplete market opening); secondly, measures for environment policy backing of liberalized energy markets must be created quickly (energy / CO_2 taxes, trading in emission rights, market transparency, support of renewable energy sources); thirdly, framework regulations should be established for those areas of action that are prioritized in the joint view of environment policy and supply security (various modes of energy saving, combined heat and power, renewable energies). Traffic and the buildings sector play an important role in this respect. The large number of energy saving possibilities in other sectors should be systematically exploited, also for reasons of supply security,. And here, a consistent and co-ordinated policy at the European level could also play a major part.

16. The infrastructural element of supply security represents an important challenge, especially in the context of the opening up of markets to competition for grid-bound energy sources. The establishing of minimum standards for supply de-

pendability, and the protection of appropriate investment in the transmission network, require more de-concentration and more effective regulation. State-aided network expansion for long-distance energy transmission can be justified only when thereby disadvantages are not created for decentralized energy generation, which can make a decisive contribution to the security and dependability of supply.

17. Issues concerning the security of energy supply must be more strongly reflected in all foreign-policy areas. Attempts to substantially influence price levels and developments through direct political pressure appear, however, to be unrealistic. Stronger economic integration, and support for economic and political reform processes, contribute to enhancing supply security. In this respect, close co-operation with Russia, also in the area of energy supplies, represents an opportunity rather than a problem. A particular challenge with regard to Russia arises with the provision of investment capital for the further exploitation of deposits. In view of continuing difficulties with the ratification of the Energy Charter by the Russian Parliament, bilateral agreements between the EU and Russia could lay the foundations for the participation of Western capital. Important transit states – above all, the Ukraine – must become a point of focus in the international process of understanding. For the wise and, in the long term, necessary diversification of energy deliveries to Europe, and especially with regard to gas supplies from the Middle East and the Caspian Sea basin, sensitive clarification processes (sanctions, investment security) are necessary between the EU and the USA.

1 Security of supply – a new and old topic of energy policy

The secure, reasonably-priced and environment-compatible supply of energy services belongs to the fundamental prerequisites for sustainable societies. These three dimensions are by definition inter-related, and have overlapping areas, but they also lead to conflicts regarding objectives. While the relationship between environment compatibility and economic efficiency, with their manifold demarcations, has occupied for many years a large part of the energy and environment policy discourse, the question of the security of energy supply has only moved to the centre of debate in recent times. An important reason for this, is that the debate on the security of supply has very much changed in the course of the last 30 years.

Strong state intervention in the area of energy supply, triggered off in particular by the energy price crises of the 1970s, has in the meantime been superseded by liberalization and globalization processes in the energy sector. The new debate on the security of energy supply has to be seen, in particular, against this background. In their report to the Trilateral Commission, Martin/Imai/Steeg (1996, p.5) made the point:

"At the same time ... questions remain about how much markets can achieve. Each of the three faces of energy security provides a perspective from which doubts can be expressed. How can markets on their own take care of our societies' vulnerability to disruptions in an emergency due to heavy dependence on imported oil from an unstable Middle East? How can markets, notoriously short-term on their own, reliably take care of our societies' long term interest in adequate energy supplies for rising demand at reasonable prices? How can short-term markets take care of the long-term challenge of "sustainable development"?"

If one considers, that in the area of ecological challenges, state-determined limits on the use of the common good "environment" are undisputed, and that market-economy mechanisms – with extensive compensation of market imperfections – are appropriate for the achievement of the most reasonably priced solutions, then in the final analysis two key questions are raised with regard to the security of energy supply:

- Concerning which problems, in the specific context of security of supply, are market failure or market imperfections to be ascertained; do market processes therefore have to be excluded or accompanied by appropriate support?
- Concerning which aspects do the effects of unavoidable and unsuccessful attempts in the market-economy process of trial and error exceed an economically, ecologically and socially acceptable level?

On these questions there is of course – also on account of a lack of empirical findings in the long-term perspective – highly-varied positioning. The following considerations should serve to articulate different problem areas and to allow appropriately differentiated opinions.

In contrast to the very broadly based differentiation of the problem of security of supply in the Green Paper (EC 2000), for the problems discussed here two areas in particular are of specific significance:

1. The risks due to the physical disruption of energy source supplies
   a) of an immediate nature, through technical, political, ecological or other security-related incidents (from sabotage and terrorist attacks to major accidents or catastrophes, including the consequences of such incidents for public acceptance), as well as
   b) of a long-term nature, above all through the exhaustion of (certain) energy sources or long-term ecological restrictions on energy use.
2. The economic and societal risks that can accompany high price fluctuations on energy markets – caused in part by physical bottlenecks in availability (see below) – and fuel prices increasing greatly in the long term.

Both areas are naturally linked, but they have, so far as those energy markets that are relevant for Europe are concerned, a different relevance and thus require differentiated assessment. In the final analysis, security of supply is also about risk management, that is, the weighing up of the advantages and disadvantages of corresponding political intervention. The results of this assessment form, where applicable, the legitimization for political intervention on the grounds of security of supply.

There have been *sudden physical disruptions* of energy supplies time and again in the past. The spectrum of possibilities ranges from politically-motivated disruptions of supply (for example, in the Middle East), to large-scale infrastructure failure or transport obstructions (through terrorism or technical breakdowns) and ecological catastrophes. Such disturbances are by no means restricted to incidents outside the EU. Extensive societal upheavals in the Middle East can have far-reaching and above all long-lasting consequences for a large proportion of crude oil supplies. These are by no means more likely than the possible necessity of the widespread shutdown of nuclear power plants on account of the occurrence of massive security problems due to increasing technical life, or a nuclear catastrophe in central Europe. Such sudden and far-reaching endangerment of security of energy supply can doubtless justify political intervention.

The long-term exhaustion of energy sources is, on a global scale, in principle undisputed, but fundamental differences in assessment prevail on the period of time involved. Much more relevant than this point, however, is the question, whether energy markets will transmit appropriate signals of shortage long enough in advance to induce corresponding adaptation processes on the supply and, above all, the demand side. A special problem – especially in the case of natural gas – concerns the question, to what extent adequate efforts on the exploration and exploitation of deposits can be undertaken and financed.

Another perspective emerges from the *pressure of ecological problems*, in particular against the background of global climate problems, which will compel a clear restric-

tion on the emission of greenhouse gases into the atmosphere. It is above all the climate gas carbon dioxide (CO_2), brought about for the most past in the combustion of fossil fuels, which in this case will be of emphatic significance.

The assessment of *economic risks* of price volatility induced by the energy markets, and of possible long-term price increases, is primarily dependent on the evaluation of precautionary measures. If it can be foreseen, that with *erratic price fluctuations* economic or societal distortions will be triggered off, which cannot be compensated or are intolerable for other reasons, pre-emptive measures for the limitation of the economic effects of such incidents will prove to be sensible and necessary. With regard to long-term price increases, and in view of all the uncertainties concerning the consequences and scope of pre-emptive measures, the reduction and compensation of market failures (see above) and other market imperfections (other political interventions) would have priority. The ecological perspective also acquires, in this context, considerable significance, for nature's limited assimilation and adaptability will lead inevitably, in the medium to long term, to corresponding price reactions.

In so far as political intervention appears to be justified, especially for the improvement of security of supply, it could be directed at the following areas:

- Improvement of *energy efficiency* to mitigate the economic effects of price fluctuations as well as for the conservation of energy sources threatened by physical disruptions of supply.
- *Substitution* of energy sources burdened with the risk of physical disruption of supplies, or price fluctuations that can no longer be compensated or tolerated, with energy sources that are not affected by such risks.
- *Diversification* of *sources of energy supply* outside the EU, in order that the risk and consequences of physical disruptions of supply can be reduced.
- *Diversification* of *energy transformation plants* inside and outside the EU, in order that physical disruptions of supply can be minimized.
- Guaranteeing of technical *infrastructure standards* and creating *decentralized structures* for energy provision, which held to avoid sudden physical disruptions of supply due to infrastructure failure.
- Creation of *strategic reserves* to compensate sudden disruptions of supply.

The relevance of various elements of strategy differs according to the, in part strongly varying initial situation in different regions of the world. It necessitates parallel analysis differentiated according to the markets for energy sources.

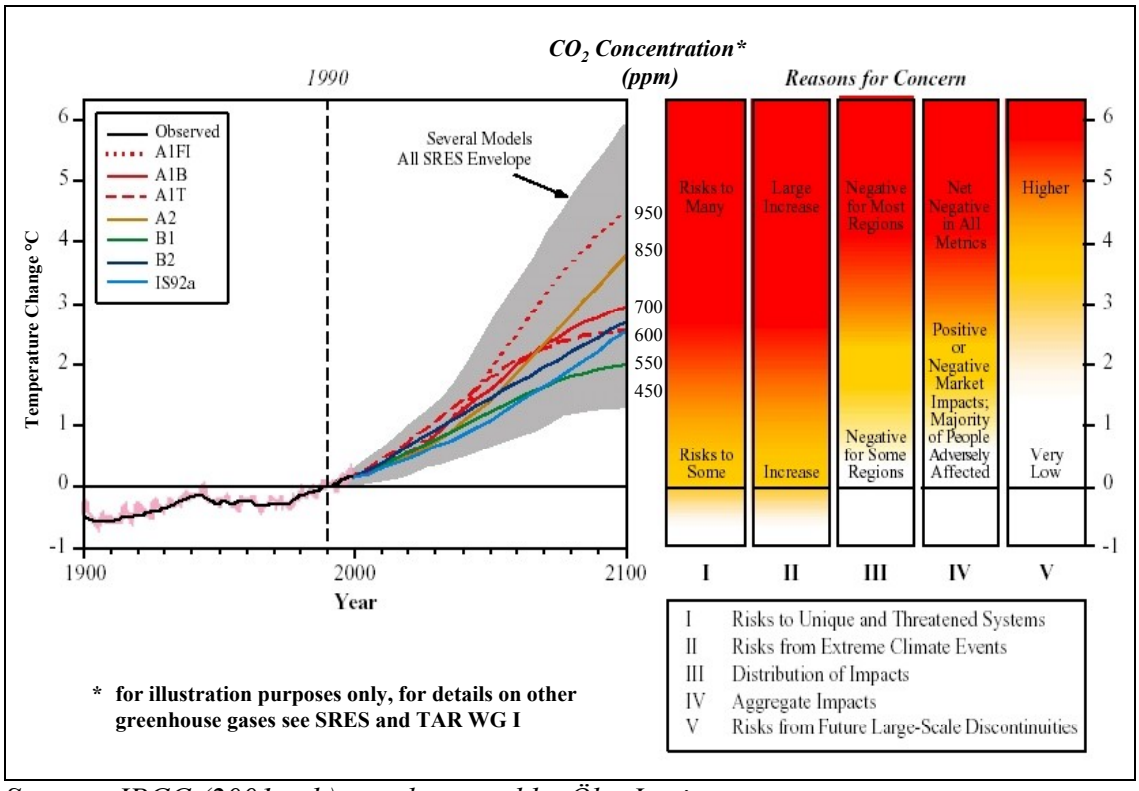
At the same time, it is sensible – also in view of the challenges of environment compatibility and favourable costs – to provide universal strategic recommendations for risk management with respect to security of energy supply. Particularly with a glance at alternative options for the fulfilment of defined ecological goals, certain priorities can be derived from problems of security of energy supply.

2 Ecological restrictions for energy markets and security of supply

The decisive restriction on the use of fossil fuels derives from anthropogenic-related climate change. In order to limit the effects of global changes on the climate system to a level tolerable for human beings, societies and nature, stabilization of the atmospheric concentration of greenhouse gases in the course of this century is indispensable.

If, on the basis of an integrated impact assessment for climate warming, the rise in global mean temperature up to the year 2100 is to be limited to 1-1.5° C, it will be necessary to stabilize concentrations of the most important anthopogenic greenhouse gas, carbon dioxide (CO_2), at a level of 450-550 ppm (Illustration 1).

Illustration 1 Integrated impact assessment for anthropogenic climate warming



Source: IPCC (2001a+b) supplemented by Öko-Institut

It will be absolutely vital to reduce world-wide CO_2 emissions by 40% to 50% by the middle of this century. Based on this requirement, limitations on the quantities of fossil fuels can be established, whose combustion may be allowed to have an effect on the climate. Up to the middle of the century, only 30% – to the end of the century around 45% – of potential CO_2 emissions linked to reserves of fossil fuels (cf. Chapter 3.1) ought to have an effect on the climate (Matthes 1999). The time-window for climate policy processes of adaptation may therefore be considerably smaller than the action required, due to the exhaustion of energy resources

Even when developing and newly industrializing countries will have to make a medium-term contribution to emission reduction, in view of current levels of emission and their economic and technological strength a particular responsibility lies with the industrialized states of Europe, North America and the Pacific area, where, in the next 50 years, emission reductions of up to 80% will have to have to be achieved.

The European Union has achieved a change in the trend of greenhouse gas emissions. Up to now, however, only one-third of EU Member States have accomplished a reduction in emissions compared with 1990, and here the major contributions have come from Great Britain and Germany (Table 1).

But also the European Union will be faced in the medium to long term – that is, far beyond the commitment period of the Kyoto Protocol – with the necessity of far-reaching greenhouse gas reductions.

A particular challenge with respect to security of supply arises, first of all, with the securing supplies of essential energy services to the European Union, despite drastic medium- and long-term restrictions on the emission of climate gases through the combustion of fossil fuels.

Table 1: Greenhouse gas emissions in the European Union, 1990-1999

	1990	1999	1990-1999		Kyoto target 1990-2008/12	Share of growth[c]	Share of reduction[d]
	kt CO_2 equivalent			%			
Austria	76,422	78,494	2,073	3%	-13%	1%	-
Belgium[a]	136,526	145,166	8,640	6%	-7.5%	5%	-
Denmark	69,910	72,889	2,979	4%	-21%	2%	-
Finland	77,022	76,211	-811	-1%	±0%	-	0.2%
France	551,067	549,798	-1,269	-0.2%	±0%	-	0.4%
Germany	1,202,741	976,934	-225,807	-19%	-21%	-	66%
Greece	106,738	123,432	16,694	16%	+25%	10%	-
Ireland	53,497	65,337	11,840	22%	+13%	7%	-
Italy	518,263	540,741	22,479	4%	-6.5%	13%	-
Luxembourg[a]	10,858	5,894	-4,964	-46%	-28%	-	1%
Netherlands	215,653	229,949	14,295	7%	-6%	8%	-
Portugal	64,644	79,303	14,659	23%	+27%	9%	-
Spain	305,754	379,968	74,214	24%	+15%	44%	-
Sweden	69,466	70,575	1,109	2%	+4%	1%	-
United Kingdom	749,949	641,282	-108,667	-14%	-12.5%	-	32%
EU-15[b]	4,198,797	4,026,342	-172,455	-4%	-8%	100%	100%

Notes: [a] latest available data for 1998 - [b] divergence from totals due to estimated data for Belgium and Luxembourg - [c] as share of the sum of all growth - [d] as share of the sum of all reductions

Source: Emission inventories of EU Member States; Öko-Institut calculations

3 Analysis of security of supply for different energy markets

3.1 Long-term availability of resources

The debate on the long-term situation regarding the supply of fossil fuels has become considerably more intense in recent years.

Whereas the majority of analysts foresee no far-reaching scarcity of fossil fuels in the next two or three decades, and assume wide-ranging substitution possibilities among different fuels, or between conventional and unconventional energy sources, a minority assesses[1] the situation with regard to reserves, particular of oil and gas deposits, as being so critical, that maximum world-wide production will be attained already in the first decade of this century[2].

Table 2 Consumption, reserves and resources of fossil fuels

		Consumption[a]			Reserves	Resources	
		1860-2000	2000	2050[b]		low	High
		million PJ					
Oil	Conventional	5.3	0.1	0.2	6.0	1.6	5.9
	Unconventional				5.9	0.9	20.3
Gas	Conventional	2.4	0.1	0.2	5.5	7.8	22.7
	Unconventional[c]				0.5	6.8	9.4
	Hydrates						>50
	Aquifers						>50
Coal		5.8	0.1	0.2	22.9	14.9	>180

Notes: [a] with oil and gas the use of unconventional deposits is included in the respective figures for conventional raw materials - [b] "Middle Course" Scenario IIASA/WEC (1998) - [c] without natural gas from hydrates and aquifers

Source: Matthes (1999); BP(2001); Marland et al (2001); IIASA/WEC (1998); Öko-Institut calculations

Table 2 provides an impression of the situation regarding reserves[3] and resources[4] of fossil fuels. Considering just conventional reserves, it is in particular the exploitation of reserves of crude oil that is most advanced. However, if one assumes – initially without considering ecological restriction on the use of fossil fuels – that unconventional reserves and a proportion of resources can be exploited economically, there is considerable relief from the point of view of timing. A similar situation arises, when one considers that substitution among individual energy products is possible (switching of energy products, conversion of gas or coal into liquid fuels, coal gasification).

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1 *Cf. BGR, USGS (2000); Odell (2001); Lynch (1998+2001a+b); Adelman/Lynch (1997).*

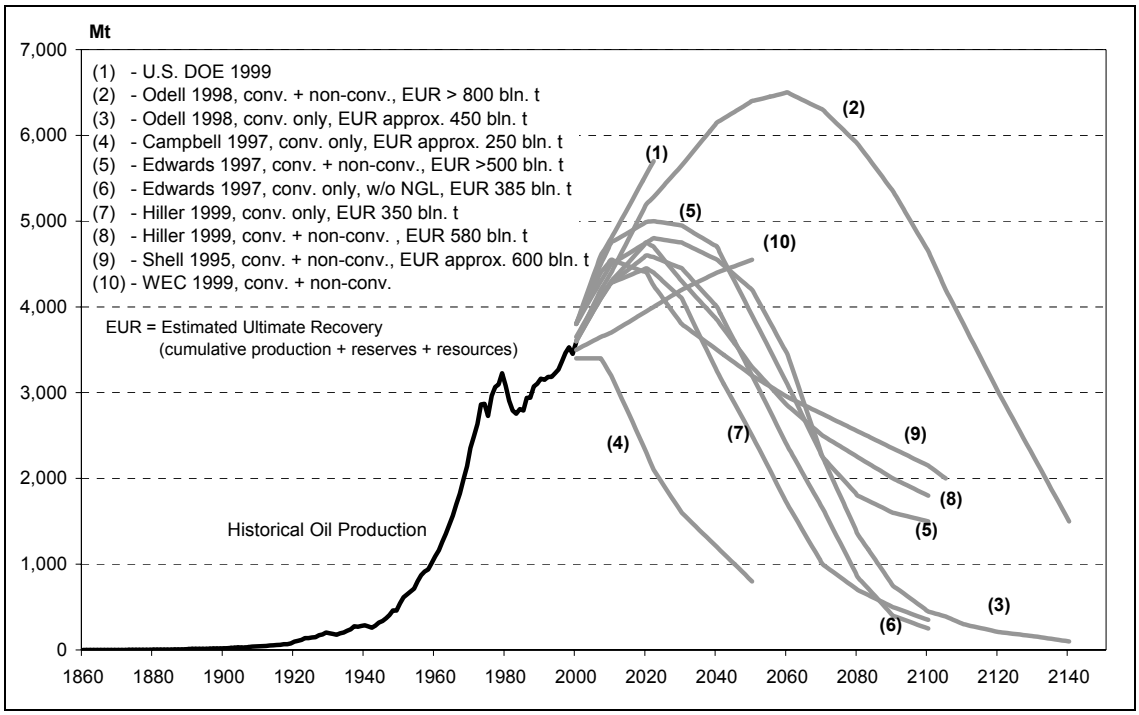
2 *Cf. Campbell (1998); Zittel/Schindler (2000), Laherrere (2001).*

3 *Reserves are described – following BGR (1998) – as that part of total resources of fossil fuels, which is proven and recorded, and which can be exploited economically with available technical means.*

4 *Resources describe here the part or total resources that is still undiscovered, for whose exploitation substantial technological progress will have to be made, or which are not exploitable economically at current price levels.*

Illustration 2 highlights the very wide range of opinions on the subject of crude oil production. This presentation makes clear, firstly, that representatives of the "Oil Crisis" or "Energy Crisis" school of thought[5], grouped around Campbell, indicate a clearly extreme position in assumptions of availability of reserves, but that, secondly, crude oil production will very likely reach its peak in this century.

Illustration 2 Projections of crude oil production



Source: Marland et al (2001); Kehrer (2000); Öko-Institut calculations

For the largest part of the energy system, the 20-to 30-year period for decisions on such processes of adaptation, on both the supply and the demand side, is calculated in such a way, that in principle – initially omitting ecological necessities – political intervention beyond the remedying of market malfunctioning (external effects, market power, incomplete information) and other market imperfections can today hardly be justified, on account of the long-term availability of energy sources. For individual segments of the energy system with a very long useful life (for example, in the buildings sector) another picture can be presented.

[5] Campbell et al present their position under www.oilcrisis.com, German representatives of this school of thought do likewise under www.energiekrise.de. For explicit criticism of these positions cf. Lynch (1998+2991a), as well as Adelman/Lynch (1997).

3.2 Oil markets

Around 58% of world-wide consumption of oil is traded across national borders. The oil market, characterized by the strong position of the OPEC cartel, is, on close analysis, the only *fully integrated global market* in the energy sector. Leaving aside exchange rate influences, prices on the oil market, which are heavily dependent on the cartel's production-fixing agreements, demonstrate in different regions of the world an almost identical dynamic force. At the same time, refinery capacity as well as stocks also have a not inconsiderable influence on price developments on regional markets for mineral oil products.

The special role of OPEC, as a group of States with a dominant share of proven oil reserves (at the moment around 78%), a large contribution to world-wide production of mineral oil (41%), but only a negligible share of global consumption (around 7%), results above all from three factors:

- The OPEC-induced prices also set the price level, at least for regions with open market economies, for respective domestic production.
- With the traffic sector there exists an area of consumption that, in practically all states, is almost completely based on mineral oil.
- The price of oil provides a key indicator for large parts of the gas market, as well as for international trading in hard coal.

Little is likely to change in this outstanding role on account of production cost advantages in the Middle East, but also because of new developments, for instance in the Caspian Sea basin (ECSS 2001), even if the exploitation of Caspian oil reserves can provide an important contribution to the maintenance of diversified oil supply.

Because of the unstable political situation in the Middle East, there have been repeated disruptions in supply in the past, which brought with them severe price reactions on the mineral oil markets.[6] At times, supply shortfalls amounted to approximately 10% of world-wide crude oil production and 20% of OPEC production. Up to now, these supply shortfalls have spanned a maximum period of seven months (Table 3). However, the residual capacity of oil-producing countries amounted in the 1980s to over 6 million barrels a day (bbl/d); today it amounts to just 1-2 million bbl/d (Morse/Jaffe 2001).

To safeguard against physical disruption of oil supplies, the member countries of the International Energy Agency have committed themselves to maintain oil reserves equivalent to 90 days' imports. These reserves were successfully employed, for instance, during the Golf War. Considerable problems arise in this connection, however, due to the strong share of the world market held by countries such as India or China, which up to now have not pursued such a policy on reserves.

[6] *Estimates of the price increasing effects of supply shortfalls amount, according to information from the USA, to 3-5 $/bbl for each million bbl of failing supplies (CSIS 1999) .*

Table 3 Supply shortfalls as a result of crises in the Middle East, 1973-1990

	Supply decrease		Total oil production
	Period	Volume	
First oil crisis *(October 1973: Fourth Middle East war, Embargo by Arab oil producers)*	approx. 6 months	4.3 – 4.5 Mill. bbl/d (2 months) 2.2 – 2.6 Mill. bbl/d (2 months)	58 Mill. bbl/d (world-wide) 31 Mill. bbl/d (OPEC)
Second oil crisis *(December 1978/October 1980: Iranian revolution, Rapid oil production decreases in Iran, Iran-Iraq War)*	approx. 4 months	5.3 – 5.6 Mill. bbl/d (2 months) 3.8 Mill. bbl/d (2 months)	63 Mill. bbl/d (world-wide) 30 Mill. bbl/d (OPEC)
War between Iran and Iraq *(Iraq attacks Iran)*	approx. 5 months	3.7 – 4.1 Mill. bbl/d (2 months) 2.5 – 3.0 Mill. bbl/d (3 months)	57 Mill. bbl/d (world-wide) 18 Mill. bbl/d (OPEC)
Golf Crisis *(August 1990: Iraq invades Kuwait)*	approx. 7 months	5.0 – 5.3 Mill. bbl/d (2 months) 4.0 – 4.7 Mill. bbl/d (3 months)	66 Mill. bbl/d (world-wide) 25 Mill. bbl/d (OPEC)
Year 2000 Markets *(1999 OPEC Agreement and Low Investment)*	More than 12 months	over 1 billion bbl/d sustained OPEC production cuts	75 Mill. bbl/d (world-wide) 31 Mill. bbl/d (OPEC)

Source: Morse/Jaffe (2001); OPEC (2001); Öko-Institut compilation

With the re-concentration of oil exploitation in the Middle East that is expected in the coming decades, the danger of political instability in the region – also affecting important transportation routes – could increase the risk not only of politically-motivated physical disruptions of supply, but also of price fluctuations due to scarcity. Oil production is of special significance in Saudi Arabia, which is the largest single producer among OPEC states. In view of strong population growth (doubled during the last twenty years), heavy dependence on oil exports, a chronic budget deficit, as well as the possibility of increasing political, ethnic and religious tensions, situations can be imagined in which supply shortfalls could occur, of a dimension not yet experienced (CSIS 1998a+b+1999+2000). The probability of such supply shortfalls remains negligible for the time being; whether they appear on the short-term horizon is more than questionable, however, in view of considerable dependence on oil exports.

It is a different question regarding the regained market power of the OPEC cartel in the period since 1999, as a result of which crude oil prices – possible for the long term – have stabilized at a high level. The effects for oil price development of the re-

consolidation of the OPEC cartel might therefore represent the most important aspect with respect to security of supply.

Another challenge arises, however, regarding transportation routes. Oil supplies of over 15 million bbl/d – this corresponds to almost one-third of world-wide oil exports – are today shipped through the Straits of Hormus. Were this transit route to be lost, alternative routes could provide nowhere near the capacity required (EIA 1999, CSIS 1999).

Other ecological restrictions on seaborne transportation– to preclude oil tanker accidents – can arise in the Bosphorus (major relevance for Caspian oil reserves) and in the Suez Canal.

3.3 Natural gas

The international gas markets have up to now basically kept in step with price developments on the oil market. The three large regional markets of Europe, North America and South East Asia have in fact demonstrated different market structures and price dynamics. In North America, only 14% of demand for natural gas is covered with cross-border supplies. In Europe the equivalent figure is approximately two-thirds, of which 40% comes from Russia. Whereas the supply of liquid natural gas (LNG) in North America plays practically no role whatsoever (contribution margin: 1%), certain European countries cover large proportions of their consumption primarily with LNG imports from North Africa (Spain 50%, Belgium and France 28%, Greece 17% and Italy 7%). Japan, South Korea and Taiwan are wholly dependent on LNG imports.

In all, 22% of world-wide gas consumption is covered by cross-border trade.

In contrast to the North American market, the European gas market is characterized by fewer suppliers and long-running contracts (predominantly with *take or pay* clauses). For the European Union in the next twenty years, internal deposits (the Netherlands, UK), as well as Norwegian output, are of particular importance; in the long term (from 2020), however, European gas supplies will concentrate above all on Russia and, to a lesser extent, the North African region (Heinrich 1999). Beyond that, supplies from the Caspian region basin and the Middle East (Iran) could also gain in significance in the long-term.

In contrast to the oil market, there have not yet been long disruptions to supplies of natural gas. Significant differences to the oil markets result from dependence on capital-intensive infrastructure and comparatively tight state regulation. Gas supply companies have undertaken supply diversification – also for reasons of customer acceptance – to a considerable extent on a voluntary basis. (IEA 1995).

Economic and political integration, as well as the interdependence of the European Union and Russia, form a stabilising framework. To what extent this situation could be substantially changed by

- increasingly strong demand for natural gas in Russia
- growing demand for gas on the part of other countries in economic transition
- Russian plans to open up of the Far East market by means of natural gas deposits in Eastern Siberia

is not yet foreseeable. Diversification of natural gas supplies for Europe, even in the long term, is thus an important point on the political agenda. In this connection, infrastructure development (pipelines or LNG infrastructure) for the exploitation of gas deposits in the southern Caspian region appears to be an important challenge. Against a backdrop of US sanctions against Iran, the creation of general conditions for such investment is also an important aspect of relations between the EU and the USA. To what extent the events of September 11, 2001 can bring about a relaxation or aggravation of conflicting interests, remains to be seen.

Particular circumstances could possibly arise with the exploitation of new deposits in Russia, if financing bottlenecks occur as a result of the domestic situation (continuing budget problems, persistently high consumption in the absence of energy saving, high barriers for foreign investors, substantial outflow of money from the gas sector into the Russian national budget). Whether this problem will in fact prove to be of long-term relevance, however, remains contentious. The financing situation is made more difficult by the continuing refusal of the Russian Parliament to ratify the Energy Charter. Should this deadlock not be overcome, bilateral discussions or agreements between Russia and the European Union ("energy partnership") will in this respect assume considerable importance, in order to provide possibilities for the participation of international capital in the opening up of new deposits and the development of the required infrastructure.

Short-term price volatility in the gas sector is much lower than on the mineral oil market. Oil price control in long-running supply contracts with oil producing countries has often been the subject of negotiation in the past, but a break with these price adjustment practices is not yet foreseeable.

Against this background, and especially regarding the European aspect of supply security for natural gas, the following specific aspects have to be considered:

- the guaranteeing of infrastructural security of supply inside and outside the European Union;
- the guaranteeing of natural gas transit, especially from Russian regions of supply;
- the provision of adequate financing for the exploitation of new deposits in Russia; and
- the development of new regions of supply to secure diversification of natural gas supply (North Africa, Iran), and the development of the necessary infrastructure (pipelines, LNG infrastructure).

Protection against the effects of price increases induced by price fluctuations on the oil markets is also in the case of natural gas an important element of supply security, and here energy saving also assumes particular importance.

3.4 Hard coal

The international cross-border market for hard coal covers around 15% of total coal requirements and is represented for the most part (13%) by sea-borne trade. Of the highly industrialized regions, only Europe and Japan depend on imports. North America is a net exporter of hard coal.

Pricing mechanisms differ accordingly. Whereas in Europe and Japan, prices for imported hard coal – with less elasticity than natural gas – follow oil prices, hard coal prices in North America are to a great extent decoupled from the oil market. The price of coal exported to Europe is influenced above all by production costs in South Africa; the price level in South East Asia is primarily influenced by production costs in Australia (Rheinbraun 2000).

In the past, there have not been far-reaching disruptions to the supply of hard coal. Bearing in mind the structure of the dominant regions of origin (North America, Australia, South Africa), disruptions are also not to be expected.

Against the background of realizable production costs in Europe (with the exception of the UK), which, in part, are several times the level of prices on the international market, the question of supply security with regard to hard coal imports can be limited to the effects of price fluctuations on the markets for imported coal deriving from oil price developments. The same additional, ecology-related restrictions arise for the use of imported hard coal as for hard coal mined in Europe, especially with regard to climate problems.

3.5 Nuclear energy

Deliveries of uranium in Europe are comparatively well diversified and, in this respect, the subject of international regulation (EURATOM Supply Agency).

In view of the low share of fuel costs in electricity generation in nuclear power plants, the limited availability of uranium at costs of up to 40 $/kg does not in the end represent a significant medium-term restriction on supply, because considerable additional reserves are still available, which can be extracted at costs of up to 80 $/kg (BGR 1998). With Australia and Canada, two OECD countries dominate the market, that are economically and politically stable.

Additional nuclear fuels can be obtained through the use of radioactive materials[7] employed by the armed forces, as well as – at least in principle – through the reprocessing of used fuel rods.

The main restrictions on the contribution of nuclear energy to satisfying energy demand thus arise not from the viewpoint of supply security, but rather – in addition to the risk of plant operation – from ecological and security problems related to the nuclear fuel cycle, that is, above all, *waste disposal security*. However, in this context it has to be considered that, because of special demands regarding plant security, security culture and public acceptance, the situation can arise, that a large proportion of nuclear power plant capacity will have to be shut down at very short notice, which could also result in problems of supply security. The probability of such incidents occurring, does not substantially differ from risk scenarios in the political area.

3.6 Electricity

Electricity is traded within the European Union on a large scale only in special circumstances. With electricity and gas market liberalization investor appraisal will, to a large extent, be similar, the resource structures of Member States will not vary substantially, and special political arrangements in favour of individual fossil or nuclear energy sources will in future have to be dismantled. The situation will therefore arise, at the latest following the initial phase of the liberalization process, that the transport of primary energy products might be more attractive than the long-distance transport of electricity.

With progressive division of labour, and with the introduction of new technologies and services, the costs of supply disruptions, in particular in the case of electricity, will increase considerably (Table 4)

Supply risks in the case of electricity might well lie more in the area of dependability than in physical supply bottlenecks. The infrastructural safeguarding of supply dependability is of growing significance. This concerns – especially in the context of liberalized markets – not only the securing of technical standards and adequate investment in transmission networks, but also the guaranteeing of sufficient decentralization of generation.[8]

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[7] Already today, a not inconsiderable proportion of fuel element production is based on highly enriched uranium (HEU) from stocks previously intended for military use (ESA 2000). Beyond that, large quantities of MOX fuel elements could still be manufactured from stocks of nuclear weapon materials, which on the other hand, however, would cause considerable problems of technical security.

[8] In the debate in the USA, the obligatory stocking of important infrastructure components (large transformers, etc.) has also been discussed (OTA 1990).

Table 4 Costs of disruptions in electricity supply

Sector	Costs of disruptions in supply	
Mobile telephones	41,000 $	per hour
Ticket sales by telephone	72,000 $	per hour
Flight reservations	90,000 $	per hour
Credit card operations	2,580,000 $	per hour
Financial services	6,480,000 $	per hour
Average in small-scale industries	7,500 $	per day

Source: Weinberg (2001)

In the assessment of electricity imports from countries, which for the foreseeable future will not become Members of the European Union (for example, Russia), distinctions must be made. With regard to political instability or infrastructural security of supply, in principle the considerations raised for natural gas are also applicable to electricity. Because, on account of growing integration on the world market for energy sources, electricity production in the countries concerned, can only attain cost benefits if significant cutbacks in ecological or security standards are pursued, physical disruptions of supply (large accidents, growing opposition among the population) can of course also occur.

3.7 Renewable energy sources

Cross-border trade in renewable energy products is presently – and for the medium term –conducted to only a limited extent, in terms of scope and distance, with biomass and electricity from renewable sources. For the future, however, concepts are being discussed for an energy sector with long-distance energy supplies (for example, hydrogen and electricity from regenerative energy sources) (Langniß et al 1997). Even when such variations could play an important role only in a long-term perspective – and their necessity is very much the subject of scientific dispute – challenges are presented for supply security.

These result above all from the infrastructural risks of such systems (for the most part grid-bound transportation over long distances), but also from questions of political stability, in the relevant countries of North Africa for instance.

All in all, serious questions of supply security in the case of such energy transactions, arise only in a perspective far beyond periods of time influenced by political decisions taken today.

The use of renewable energy gives rise to not inconsiderable challenges with regard to supply dependability, which have to be treated with appropriate system services to compensate fluctuating capacity or appropriate storage technology or media, if a significant proportion of energy supply is to be covered by renewable energy sources.

4 Summary and conclusions

Problems of supply security face fuel markets and the European energy market in a differentiated manner:

- *Disruptions of supply caused by political instability* appear at all events to be plausible for that share of oil supply that comes from the Middle East. In the course of the re-concentration of oil exploitation in this region that is expected in coming decades, this risk could increase. In the long term, a similar problem could arise with long-distance electricity or hydrogen imports, supplied, for instance, from renewable energy sources in North Africa. In view of economic connections between supply and recipient countries, the probability of such problems occurring is likely, however, to be negligible.
- *Infrastructural endangerment* of supply security – both from technical failures and criminal or terrorist action – arises above all in the case of natural gas (within and outside the European Union), but also with electricity (at present within the European Union, but. in the case of a sharp increase in imports, possibly also outside the Community). With regard to the physical disruption of supply, this problem might be of the greatest relevance.
- Long-term supply bottlenecks and price effects could possibly also arise from *inadequate financing* for the development of new deposits in Russia.
- A general problem is presented by the effects of *price fluctuations on the international oil market* and – with delays and diminished elasticity – subsequent price changes on the European gas and coal markets. These price effects occur not only with imported energy products but – at least for oil and natural gas – also for total production within the European Union.
- *Diversification of regions of supply* for fuel imports is sensible, but it is limited in the long-term by the availability of reserves, and is linked to the overcoming of other political obstacles (sanctions against Middle East countries) to the establishing and financing of necessary infrastructure as well as to exposure to new risks of political instability.
- Due to the availability of reserves, *greater substitution of imports of fossil and nuclear fuels through increased production within the European Union* is limited. It also appears to be less sensible, because price developments on the international market will in future also determine prices of fossil and nuclear fuels produced within the European Union, and a weakening of the effects of price changes on international markets will in the end not take place.
- *Diversification among fossil and nuclear fuels* also faces considerable ecological and security-related restrictions. Focusing on the use of nuclear energy can, for reasons of risk and acceptance, also lead to additional risks for supply and, above all, for waste disposal security.

As a whole, the economic aspects of the markets for fossil and nuclear fuels – linked through the international oil market – prove to be the *key aspect* of supply security. Problems of physical security of supply appear, in the context of political instabilities, to be plausible for Europe with regard to oil supplies from the Middle East. In the case of natural gas and electricity, infrastructural risks – within and outside the European Union – are of prime importance. Apart from all other ecological and security-related problems, the use of nuclear energy can even lead to additional risks for supply security.

Against this background, the relation between internal energy resources and energy imports appears to be an *inappropriate* measure of supply security. The remedy of national energy production socles is, in the final analysis, not a sensible measure for increasing supply security. The quantities of crude oil and natural gas that are produced in the EU, will in future only be available at world market prices; and the creation of protection zones for non-competitive coal production in the EU could be considerable more costly than any price fluctuations on the international market for imported energy products.

The chief way to modify possible effects of price fluctuations on the international energy markets is the development of favourably priced energy efficiency possibilities in the European Union. Beyond that, increasing the share of renewable energy sources – required above all for reasons of climate protection – can contribute towards increasing supply security.

Furthermore, important spheres of action derive from infrastructural supply security and supply dependability, which should above all include appropriate mechanisms for competitive regulation of electricity and natural gas markets, with which adequate investment in network infrastructure can be ensured. Specific measures for extensive infrastructural development – especially in the case of electricity – that implicitly disadvantage decentralized energy production, should be critically assessed. Finally, measures to safeguard the financing of the development of natural gas deposits in Russia and to protect natural gas transit, represent sensible contributions to the infrastructural security of supply.

5 Comments on the Questionnaire

Question 1

Can the European Union accept an increase in its dependence on external energy sources without compromising its security of supply and European competitiveness? For which sources of energy would it be appropriate, if this were the case, to foresee a framework policy for imports? In this context, is it appropriate to favour an economic approach: energy cost; or geopolitical approach: risk of disruption?

According to available BAU (business as usual) projections, not only will the share of imported energy sources increase from 50 to 70 per cent, but also the quantity of those energy sources, whose prices are closely coupled to oil prices. Their share might grow from 60 to 80 per cent (E3M-Lab 1999). The reason for this is less the decline in coal and oil production in the Community than the massive growth in consumption of mineral oil and natural gas.

Risks of sudden physical disruptions of supply appears, besides infrastructural disturbances in electricity and gas supply, founded at most in the case of oil supplies from the Middle East, but sufficiently manageable by means of fuel stocking policy instruments. The main problem lies in the economic and societal effects of sudden price fluctuations on the international oil market, which have a direct effect on the level of prices for oil supply from production within the EU as well as on the total natural gas and hard coal market, in the form of delays and diminished elasticity. The situation in the traffic sector, which up to now has been based almost exclusively on mineral oil, proves to be particularly critical.

From a geopolitical viewpoint, and bearing in mind other restrictions (climate problem, nuclear risks), the substitution of mineral oil with natural gas or renewable energy sources should be aimed at. Against the background of the economic and societal effects of sudden price fluctuations, the simple substitution of mineral oil with natural gas provides no benefits, though also no disadvantages.

The only realistic way to modify the economic effects mentioned – including ecological and security-related restrictions – is the extensive *saving of energy*, from the viewpoint of supply risks preferably in those sectors and by those applications for which mineral oil and natural gas play a major role. This includes, in particular, the traffic sector, but also private households and industry. With the expected threefold expansion of gas-based electricity generation, considerable gains in efficiency can and must be achieved through the utilization of combined heat and power.

The necessity of a (massive) extension of energy provision from *renewable energy sources* arises from the *viewpoint of supply security* primarily in the context of the substitution of oil and natural gas.

Question 2

Does not Europe's increasingly integrated internal market, where decisions taken in one country have an impact on the others, call for a consistent and co-ordinated policy at Community level?

A European internal energy market will only develop on a long term basis if

- the same overall conditions of competition apply to all segments,
- ecological support of the market is sufficiently secured, and
- aspects of supply security are taken account of.

Considering these three aspects the situation then arises, that the internal market and rules of competition in the energy sector are provided with a far-reaching European framework and relatively strict implementation. The nuclear sector provides the exception, for which, up to now, extensive state aid has been tolerated. By contrast, European Union responsibilities for a common environment policy are provided for in the Amsterdam Treaty, but the integration of environment policy into other policy areas demonstrates considerable gaps. Particularly in a key area of environment policy, a common climate protection policy, EU policy is at best in its infancy.

In all areas, for which no fundamental problems of responsibility exist (competition policy, environment policy), previous EU policy has therefore by no means been free of contradiction. Demonstrating that such contradictions are being tackled and resolved, is surely a major prerequisite for the attainment of further responsibilities in the area of environment policy.

The general necessity of a common energy policy is highlighted in particular at such time as environment policy, competition policy and also measures for increasing the security of energy supply are intended to be created free of contradiction. Even when, with considerable effort, adequate environment policy support of competition policy, as well as the eradication of existing distortions in competition that favour specific energy sources or markets at a European level are achieved, in the absence of a co-ordinated policy on the security of energy supply, counter-productive or obstructive effects can occur, due to divergent approaches on the part of Member States. This applies in particular to the areas of energy saving and renewable energy sources, which – especially from the point of view of supply security (above all, modifying the economic and societal effects of sharp fluctuations on the international energy markets) – must be given priority in environment policy strategies.

The above-mentioned gaps in a consistent policy at the European level have clearly emerged in the process of EU enlargement. An argument against a common European energy policy, which is often put forward, is that the formulation and implementation of such a policy in a group of closely associated states including energy exporters and energy importers will be extraordinarily difficult. In view of the medium-term availability of resources in the European Union, the renunciation of a common energy policy would be extremely short-sighted.

Furthermore, and against a backdrop of integrated markets for goods and services in Europe, in particular for the efficient use of energy, only common political approaches are possible, or already in practice (for example, for electrical appliances). This applies especially, in the context of supply security, to the traffic sector.

The main characteristics of a consistent policy for the energy sector in the field of competition, environment policy and supply security can be outlined as follows:

1. The eradication of distortions in competition in favour of particular energy sources or markets:
   a) identification and eradication of state aid, above all for the nuclear industry and the coal sector;
   b) adjustment of processes for opening up the market for electricity and natural gas in Member States with regard to speed of transition and higher minimum standards of regulation, but also in respect of the safeguarding of investment in infrastructure;
   c) establishment of binding standards of regulation for cross-border trading in electricity at the EU level.
2. The rapid creation of environment policy support for energy markets:
   a) consistent internalization of external effects, in so far as this is possible (for instance, through energy/CO2 taxes, emissions trading systems, but also minimum standards for emissions, plant security or energy consumption);
   b) enhancement of market transparency concerning the ecological quality of energy sources traded on the energy markets (certification, declaration).
3. The creation of common regulations for energy sector areas of action prioritised in the review of environment policy and supply security:
   a) common regulations with regard to increasing the energy efficiency of goods and services, which, against the background of the internal market, are only sensible at the EU level (highly-standardized appliances, vehicles etc.)
   b) creation of guidelines for those measures for increasing energy efficiency and extending the use of renewable energy sources, for which the consideration of national and geographic circumstances are decisive and EU-wide market integration does not exist (for instance, in the buildings sector, the provision of heating from renewable energy sources, decentralized forms of electricity and fuel saving);
   c) setting up of guidelines for the increased use of environment-friendly and resource-saving energy generation technologies in the context of common electricity and gas markets (electricity generation from renewable energy sources, combined heat and power).

Question 3

Are tax and state aid policies in the energy sector an obstacle to competitiveness in the European Union or not? Given the failure of attempts to harmonise indirect taxation, should not the whole issue of energy taxation be re-examined taking account of energy and environmental objectives?

The question of the influence of state tax and aid policies cannot only be addressed with a glance at competition in the common internal market; it must be primarily directed at competition backed by environment policy. So long as adequate attempts are not made at a European level to incorporate the environmental dimension as well as issues of supply security into a sufficiently consistent common framework for competition, less than optimal policies will be the result.

- The setting up, at a national level, of an adequate environmental framework for the common internal energy market, often appears to be in contradiction of common rules of competition, and is thereby obstructed or requires prolonged processes of understanding.
- The large number and variableness of national political approaches contributes to the situation, that the setting up of a common framework becomes increasingly difficult; and as a result of this variety, even in environmental terms, unnecessary restrictions on competition arise.

With regard to state aid, the following areas must be distinguished:

- It is incomprehensible, that for the generation of nuclear energy there exists only an incomplete overall view of the scope of state aid (accrued reserves, questions of liability, etc.). These obstruct competition. Given the ecological and, from the viewpoint of technical security, counter-productive character of this aid, it must be disclosed and discontinued.
- State aid in the area of fossil fuels is, in part, ecologically counter-productive, and serves in Europe not so much environmental as above all regional policy objectives. In the interest of transparent policy, it should be channelled into an appropriate framework.
- Much state aid in the areas of energy saving and renewable energy sources is, in many areas (for example, climate policy), a substitute for the failing common environment policy.

Without doubt, the harmonization of energy taxes, directed at environmental objectives, remains a major task of common policy. Should this not be achieved in the future, the same effects can be achieved, however, by means of other environmental mechanisms (for example, an allowance trading system for greenhouse gas emissions) combined with specific technological measures (for example, energy saving, renewable energy sources). For this, however, extensive EU responsibility for environment policy is a prerequisite.

Question 4

In the framework of an ongoing dialogue with producer countries, what should supply and investment promotion agreements contain? Given the importance of a partnership with Russian in particular, how can stable quantities, prices and investments be guaranteed?

The possibilities of exercising influence on producer countries must be limited. With the exception of Russia, all important producer countries have sufficient funds at their disposal for necessary investment. For those countries, in which there is a certain probability of political instability, the inclusion of supply security for deliveries of fuel is a topic that must be included in all areas of foreign policy. The same applies to economic integration and the support of plans for economic and political reform, which tend to have a stabilising effect. Given the full integration of oil and gas exports on the international market, it must be hardly possible to influence prices through political regulations.

In the special case of Russia, the key point is less the endangerment of supply security through political instability, than the question of financing new deposits and infrastructure development. A key role in safeguarding investments in Russia is played by the Energy Charter, whose ratification by Russia is uncertain, however, primarily because of reservations regarding free access to electricity and natural gas infrastructure. Should ratification of the Energy Charter by Russia come to nothing, alternative methods of protecting the participation of international investors in the development of new deposits will have to be sought. Here bilateral solutions between the EU and Russia are conceivable, possible and sensible. With such agreements between the EU and Russia ("energy partnership") the conditions for western investment could be gradually improved.

Should deliveries of natural gas from Russia increase distinctly above the current level, the question of western participation in additional export infrastructure will be raised.

Intensive co-operation in the realization of natural gas savings and environmental protection measures in Russia could also contribute towards relieving bottlenecks in the financing of new developments in the natural gas sector and, at the same time, to easing the burden on the environment.

Within the framework of co-operation, Russian fears regarding the effects of gas market liberalization in the EU on Russian exports of natural gas should also be remedied through intensive consultations.

Especially in terms of co-operation between Russia and the EU, deliveries of energy sources from Russia represent less of a problem and more of a chance for stabilization.

Besides co-operation with Russia, a particular problem arises concerning those countries that are important for the transit of Russian natural gas, but will not become a Member of the EU in the foreseeable future. Among these countries, the Ukraine plays an important role. Economic and political co-operation with the Ukraine, as well as support of reforms in this country, must be constantly seen in the context of the security

of natural gas transit – even after the JAMAL pipeline, which bypasses the Ukraine, comes into service – and continued and intensified accordingly.

Question 5

Should more reserves be stockpiled – as already done for oil – and should other energy sources be included, such as gas or coal? Should the community take on a greater role in stock management and, if so, what should the objectives and modalities be? Does the risk of physical disruption to energy supplies justify more onerous measures for access to resources?

Stockpiling to the order of 90 days' imports, within the framework of IEA rules, has proved its worth. However, the possibilities of using these reserves to influence the level of prices on a long-term basis is limited, as experiences in the USA in the year 2000 showed. In the future, however, those countries will play a major part on the international oil markets that, at least up to now, have not implemented a corresponding stockpiling policy (China, India). Given world-wide oil market integration, it appears to be advisable to make every effort to involve the new large-scale consumers in corresponding stockpiling systems.

Gas suppliers in Europe have established considerable storage capacities to compensate seasonal fluctuations and to optimize prices. At present, there are 85 underground storage facilities for natural gas in operation in the European Union, with an exploitable capacity of approximately 55 billion cubic metres (IGU 2001). The maximum storage capacity corresponds to around 15% of current annual natural gas consumption in Europe, and appears to suffice for stockpiling purposes. To what extent the setting up, maintenance and utilization of such storage capacity can also be continued under the omen of a liberalized gas market is very difficult to assess at the present time. In any case, the use of natural gas storage facilities plays an important role in setting a regulative framework on the liberalized market for natural gas. With regard to binding provisions for stockpiling, in addition to the stockpiling of natural gas, expansion of the stockpiling of oil would also be conceivable, with gas consumers participating in the costs, for a large number of natural gas plants are also equipped for operation with light heating oil.

Given the quite unproblematic supply situation on the world market for hard coal, an arrangement on the stockpiling of hard coal at a European level, going beyond the normal practice of energy supply companies, does not appear to be necessary.

Having recourse to more expensive energy sources for reasons of supply security can be justified on three grounds:

- The costs of such a precautionary step are, on the basis of plausible assumptions, less than the costs resulting from supply disruption or restriction.

- The disruption or restriction of supply leads to societal distortions that cannot be compensated and are not acceptable.
- Falling back on more expensive energy sources would also be advisable on other grounds, in particular for environmental reasons.

Because the first two points – with the exception of conventional stockpiling – seem to be rather improbable within the realm of the European Union, it is above all intensive co-operation between (large) importing countries on fuel stocking policy that will be of particular importance in the future. Recourse to currently more expensive energy sources, explicitly justified on the grounds of supply security, seems to be sensible only for those areas in which the use of these fuels appears to be wise and necessary on account of other, primarily ecological demands.

Concepts for *national energy production socles* largely free of state aid restrictions, which are currently being debated, are aimed primarily at the subsidy of largely non-competitive national coal production. From the point of view of supply security, such national energy socles are justifiable on none of the above grounds.

Question 6

How can we develop and ensure better operation of energy transport networks in the European Union and neighbouring countries so as to enable the internal market to function properly and guarantee security of supply.

Transmission networks for electricity and gas supply form an important element of the common market. Against this background, but also with reference to the breaking up of national monopolies, promotion of infrastructural development in the area of electricity networks *within the Community* is demanded.

Such promotion is not, however, without problems, for it represents a direct or indirect support of electricity produced for long-distance supplies. If expansion of transmission networks cannot be realized through market forces, corresponding measures of support would amount to impermissible disadvantaging of decentralized power generation, which itself can also offer benefits from the point of view of supply security. This is all the more relevant, as the breaking up of existing monopolies can be realized – and has already been realized – not only through expansion of networks for the introduction of competitors, but also through regulative measures (relinquishment of a portion of generation, etc.).

The main objective of the European internal market must be the determination of uniform overall conditions and appropriate starting positions for EU-wide competition. Cross-border physical electricity trading is not itself such a central objective.

The demanded development of network infrastructure for electricity supplies from *outside the European Union* should also be critically assessed. Electricity delivered over long distances will only then enjoy a competitive advantage, when fuel resources and

geographic conditions themselves provide distinct advantages, or capital costs are considerably below European standards due to low environmental and security standards, or cross-subsidies are available.

Against the background of the trend towards open fuel markets, advantages in fuel prices are to be expected in the medium term in none of the potential supply countries outside the European Union, including possible Member States. The same applies to favourable geographic conditions, for instance in the use of hydropower. EU support of infrastructures, with which cost benefits for the internal market should be achieved, is not acceptable if decentralized structures are threatened This applies particularly in the context of supply security. Corresponding imports are aimed exclusively at the cheapest possible supply of electricity; and supply security in the European Union is more likely to diminish.

The situation for possible long-term electricity supplies from regions (for example, North Africa), in which electricity production can occur on a *regenerative basis*, is somewhat more differentiated. In this case, the physical security of supply would likewise diminish (political instability, infrastructural risks), but at the same time substantial environmental relief would be achieved. This area will be of practical relevance, however, only in a medium- to long-term perspective.

Already in the short- to medium-term view, in liberalized markets compliance with minimum standards must be guaranteed for transmission networks, in particular for the safeguarding of supply security and dependability. This can only be realized, however, with much stronger demands concerning deconcentration and regulation, and corresponding approaches will gain considerably in significance in the future. This is particularly so, when renewable energy sources contribute increasingly to satisfying electricity demand, and a new type of system service is necessary.

An important element of the physical security of supply is the infrastructural safeguarding of natural gas imports. Of particular importance in this respect are import pipelines from Russia and North Africa and, if necessary, the extension of infrastructure for liquid natural gas (LNG) in the Mediterranean area. This infrastructure is of importance above all for the long-term diversification of natural gas supplies. Forms of financing involving western investors can play an important role, especially for Russia, in guaranteeing security of supply.

Question 7

The development of some renewable energy sources calls for major efforts in terms of research and technological development, investment aid and operational aid. Should co-financing of this aid include a contribution from sectors which received substantial initial development aid and which are now highly profitable (gas, oil, nuclear)?

Financial transfers for a number of renewable energy sources – not necessarily through state aid or the support of research and development – that will be required for the foreseeable future, must be viewed with regard to two dimensions, which in the case of specific political instruments often overlap:

- In some areas they are more likely attributable to innovation policy, that is, support for technologies relevant to the future. This can occur through the support of research and development, as well as through early market introduction and penetration of technologies that lead to innovation.
- For the most part, however, they serve to compensate avoided external effects, compared to conventional energy generation.

In the area of innovation support, cross-subsidies in the form of financial transfers from other energy sectors are conceivable, but they appear to be difficult to implement. *Of top priority* in the area of fossil and nuclear fuels appears to be, initially, the eradication of continuing distortions of competition in favour of these energy sources (cf. comment on Question 3).

Innovation and technology support is traditionally a task for the community as a whole. Concerning mechanisms, it can also be considered, how the sectors that profit from this support – especially for market introduction – can provide the general public with a greater share in future profits. This could be effected through financial transfers, but also through special conditions (for example, in the area of technology transfers in development co-operation). Given the long-term time-frame, this area is probably of less priority.

With respect to transfers for the benefit of renewable energy sources, as compensation for failing internalization of external costs, the polluter-pays principle should be strictly adhered to. As a consequence, energy consumers become financially liable and thus the focus of attention. Alternatively, taxpayers as a whole could be called upon to finance such compensation.

Specifically, in formulating appropriate instruments a large number of technical and legal questions – many of them within a European context – have to be resolved. Within the framework of a common environment *and* energy policy, the European Union could focus greater concerted attention on the polluter-pays principle.

Question 8

Seeing that nuclear energy is one of the elements in the debate on tackling climate change and energy autonomy, how can the Community find a solution to the problem of nuclear waste, reinforcing nuclear safety and developing research into reactors of the future, in particular fusion technology?

An increasing number of EU Member States have decided, for good reasons, to renounce, or end the use of nuclear energy.

The reasons lie above all in the lack of public acceptance, which derives from the constant risk of accidents at nuclear plants with massive damage, radioactive contamination especially in the course of fuel production and processing, as well as the largely unresolved questions concerning the final disposal of highly contaminated materials. With the accession of a number of Central and Eastern European states, this problem will become still more critical.

But the use of nuclear energy does not represent a stable option for a sustainable climate protection policy. In the case of a nuclear catastrophe, which with increasing use becomes even more likely, but also against the background of the possible industry-wide safety problems of ageing power plants and the related issue of public acceptance, it is to be assumed that, should the situation arise, large power plant capacities will have to be shut down at short notice.

Also in the case of currently foreseeable future reactor concepts, proof of a cost-efficient reduction in emissions, concomitant with the exclusion of risks of extensive release of radioactivity, has not been produced. In particular, the European pressurized-water reactor (EPR) – developed under the pressure of cost minimization resulting from competition – does not fulfil the demand for the definitive preclusion of core meltdown with resultant extensive release of radioactivity.

Against this background, emission reductions achieved with nuclear power plants are not of a sustainable nature, and the massive use of nuclear energy must also be regarded as a risk in terms of the physical security of supply. Given the, in part slow processes of adjustment concerning other climate protection options (huge increase in energy efficiency, introduction of renewable energy), focusing on nuclear energy can even have counter-productive effects on sustainable emission reduction paths.

Proof of the fundamental technical feasibility of mass production of energy from nuclear fusion has not up to now been produced. Despite considerable research efforts, answers to this question – initially unaffected by economic issues – will only be provided in several decades. At this point of time, far-reaching processes of adjustment on a fundamentally different technological basis, and according to other structures, will have to be accomplished in the energy sector for reasons of climate protection. Against the background of the decision spectrum available for climate protection strategies – irrespective of all further problems associated with this technology – nuclear fusion does not represent a relevant option, and the pursuance of this technology leads in terms of climate policy to a dead end.

To solve the problem of the final disposal of highly contaminated waste, the European Union should come to an agreement, analogous to the concept of supply security, on the principle of European waste disposal security. This means in particular, that highly-contaminated waste produced in the European Union should remain consistently in the country of origin, or in the EU, and that external sites of final disposal or external re-processing (for example in Russia), should not be taken into consideration, for reasons both of safety and proliferation.

Question 9

Which policies should permit the European Union to fulfil its obligations under the Kyoto protocol? What measures could be taken in order to exploit fully potential energy savings which would help to reduce both our external dependence and CO2 emissions?

The commitments of the Kyoto Protocol are a first step towards achieving a change in the trend of greenhouse gas emissions. In the medium and long term it is a question of much more ambitious emissions reductions, which will have to be of the order of up to 80% in the case of industrialized countries by the middle of this century.

Solely from the viewpoint of climate protection policy – bearing in mind risk abatement in the area of nuclear energy – four basic elements of a long-term strategy emerge:

- increasing energy efficiency in the end user sector,
- increasing energy efficiency in energy supply (energy transformation sector),
- transition to fossil fuels with a lower carbon content,
- transition to renewable energy sources.

The transition to energy sources with lower carbon content represents one of the most inexpensive options for the reduction of greenhouse gases. In the context of supply security, this strategy is, however, not without problems. In this respect, an increase in energy efficiency and the introduction or renewable energy sources obtain a distinctly higher priority.

Consequently, at the European level globally effective instruments should

- harmonize or introduce a EU-wide energy/CO2 tax, or
- introduce a system of tradable rights for greenhouse gas emissions from the energy sector and industry

be supplemented by a number of regulations specifically directed at an increase in energy efficiency and the introduction of renewable energy (Matthes/Timpe 2000):

- a framework directive for the efficient use of energy in buildings,
- agreements and decrees laying down minimum efficiency standards for appliances and vehicles,

- framework directives for the classification of energy consumption of appliances, as well as for energy audits in industry,
- framework directives for the promotion of electricity and heating services orientated towards energy saving,
- a framework directive on increasing the share of combined heat and power, and
- a framework directive on expanding the use of renewable energy sources in the heat and power sector.

In particular, regulations concerning the area of electricity and gas must be utilized in the further development of electricity and gas market liberalization.

Against the background of the partly overlapping challenges of supply security and climate protection, a common European strategy for climate protection and energy policy appears to be necessary. Whereas corresponding EU responsibilities for climate protection exist in principle, though an effective and co-ordinated climate protection policy is still awaited, the bases establishing responsibility for a co-ordinated European energy policy have yet to be created.

Question 10

Can an ambitious programme to promote biofuels and other substitute fuels, including hydrogen, geared to 20% of total fuel consumption by 2020, continue to be implemented via national initiatives, or are co-ordinated decisions required on taxation, distribution and prospects for agricultural production?

National programmes demonstrate their limitations when far-reaching decisions on infrastructure have to be taken, and basic agricultural issues are touched upon. Concerning the taxation of new fuels, and against a backdrop of considerable problems of harmonization of energy taxes, for the time being no significant advantages from Community-level action can be identified. Apart from the issue of infrastructure decisions, a Community policy approach will only be inevitable with the introduction of new fuel, propulsion and vehicle concepts orientated towards the mass market.

Different concepts regarding the changeover of traffic systems to renewable energy sources (cf. comment on Question 12) should at first be thoroughly debated and put to the test, for which purpose decentralized and national approaches will prove to be advantageous.

Question 11

Should energy saving in buildings (40% of energy consumption), whether public or private, new or under renovation, be promoted through incentives such as tax breaks, or are regulatory measures required along the lines of those adopted for major industrial installations?

The buildings sector represents an area for which, due to long service life, special political measures are required for a reduction of energy demand. Firstly, it has to be accepted, that markets cannot provide signals of scarcity in a perspective of 50 years and more. Secondly, specific obstacles are to be found especially in the buildings sector (user-investor-dilemma, short amortization requirements compared to service life). Thirdly, mineral oil and natural gas fuels, which have a sensitive effect on the security of supply, play an outstanding role particularly in the buildings sector.

For *new buildings*, experience shows that in particular the laying down of standards is an appropriate instrument; for the renovation of *existing buildings*, the whole spectrum of incentives (tax allowances, investment grants, etc.) is to be considered.

The points of departure concerning energy savings in buildings vary widely among Member States.

At the European level, it is above all general guidelines for targeted standards for new buildings and buildings under renovation, and the tightening up of such guidelines at prescribed intervals, which should be aimed at. Beyond that, uniform systems for labelling consumption, as well as for the certification of the energy consumption of buildings, can contribute towards greater transparency of energy costs. In view of widely differing settlement structures and climatic and social conditions, Member States should enjoy a maximum of flexibility in the formulation of regulatory measures.

EU-wide measures on the simplification and standardization of contracting models can play an important role in the perspective creation of completely new services in energy saving not only in the buildings sector.

Question 12

Energy saving in the transport sector (32% of energy consumption) depends on redressing the growing imbalance between road and rail. Is this imbalance inevitable, or could corrective action be taken, however unpopular, notably to encourage lower use of cars in urban areas? How can the aims of opening up the sector to competition, investment in infrastructure to remove bottlenecks and intermodality be reconciled?

The transport sector is, with regard to the security of supply, the most sensitive area of energy consumption. In this context, the following three strategic elements are of particular importance:

- recovery of considerable shares of the passenger and freight traffic market for public transport and rail traffic;

- achievement of significant energy savings not only in road traffic, but also in railway vehicles and air traffic;
- introduction of new vehicle, propulsion and fuel concepts.

In order to reverse the imbalance between *road and rail traffic*, unjustified cost benefits enjoyed by road traffic must be compensated for with duties and charges (road tolls, heavy vehicle duties, etc.). Given the increasing importance of cross-border traffic, EU harmonisation and minimum standards are both sensible and necessary. The same applies to air traffic, in the case of which the taxation of aviation fuel should be of top priority. At the same time, with the structured introduction of competition in public transport considerable improvements in comfort can be achieved and potential efficiency exploited. Key elements of these reforms are consistent de-concentration, non-discriminatory access to routes as well as precisely targeted regionalization. In this respect, a consistent overall EU policy is very important.

In the area of more *economical energy consumption*, new efforts towards market transformation should be undertaken, by obliging manufacturers and importers to adhere to certain standards of maximum consumption. This is the most effective and efficient way to achieve a speedy and sustainable reduction in the steadily increasing consumption of mineral oil. At the same time, precisely targeted incentives (tax allowances, direct grants) can support the sale of energy-saving and environment-friendly motor cars. New approaches are also necessary for the reduction of the energy consumption of commercial and railway vehicles, and here the precise promotion of research and development is of great importance.

The transition to *new fuels and propulsion concepts* on the basis of renewable energy sources represents the most demanding long-term challenge facing the traffic sector. In this connection, very different paths are possible, concerning not only certain special applications (vegetable oil, biogas, electric vehicles), but also for the mass market (hydrogen in fuel cells or gas motors, methanol for fuel cells or combustion engines). Apart from considerable efforts in research and development, especially in the case of hydrogen and methanol concepts, the development of an infrastructure based on renewable energy sources is of particular importance. With the support of this infrastructure, there emerges in the medium term an original task for EU policy.

Question 13

How can we develop more collaborative visions and integrate the long-term dimension into deliberation and actions undertaken by public authorities and other involved parties in order to evolve a sustainable system of energy supply? How are we to prepare the energy options for the future?

The necessary reorientation of energy policy – also against the background of the security of supply – away from the exclusive management of energy supply and towards the exploitation of the potential for energy saving on the demand side, as well as the broad market introduction and penetration of renewable energy sources, represents a paradigm shift.

This concerns not only technologies, but also the activation and involvement of completely new groups of actors and types of regulation.

Research and development, but also information, motivation and communication, as well as a better understanding of social processes, all represent special points of focus as well as challenges.

Assuming that market-economy processes of trial and error, with appropriate established frameworks, lead to a high level of efficiency, then, particularly in the area of energy saving, a variety of challenges will ensue. The establishment of a new branch of industry, the energy services sector, must in the end form an important target for new energy policy initiatives.

The same applies to the liberalization and regulation of markets for grid-bound energy sources. For this, two premises must be set: the transition to environment-friendly, energy-saving, decentralized and regenerative technologies, as well as the exploitation of varied development options through an ecologically-backed opening of the markets for processes of competition that will function for a long time to come.

In the area of policy formulation, a key task will be overcoming the highly fragmented and thus often contradictory, or at least apparently contradictory policy at the EU level. The increasing integration of the energy markets makes the establishment of energy policy responsibility at the EU level essential, especially when aspects of supply security are to be more strongly considered. The aims of opening up the market and competition, as well as environmental protection, can be attained in principle without specific energy policy at the EU level; but energy industry developments based solely on this basis will tend to diminish the security of supply, and could lead to blockades of all facets of the policy areas mentioned.

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