

Brussels, 17 July 2002

OPINION
of the
Economic and Social Committee
on
Research needs for a safe and sustainable energy supply
(Additional opinion)

On 19 March 2002, the European Economic and Social Committee, acting under Rule 23(2) of its Rules of Procedure, decided to draw up an additional opinion on

Research needs for a safe and sustainable energy supply.

The Section for the Single Market, Production and Consumption, which was responsible for preparing the Committee's work on the subject, adopted its opinion on 26 June 2002. The rapporteur was **Mr Wolf**.

At its 392nd plenary session of 17 and 18 July 2002 (meeting of 17 July), the European Economic and Social Committee adopted the following opinion by 117 votes in favour, with four abstentions:

1. Preamble

1.1 The Gothenburg European Council¹ agreed a strategy for sustainable development which completes the Union's political commitment to economic and social renewal and adds a third, environmental dimension to the Lisbon strategy. The Barcelona European Council² confirmed the objective of sustainable development and made the point that economic, social and environmental considerations must receive equal attention in policymaking and decision-taking processes.

1.2 This also links in with the warnings about EU security of energy supply set out in the Commission Green Paper.³ In particular, the Green Paper notes Europe's alarmingly high dependence on imports of necessary primary energies, which will rise to almost 70% by 2030.

1.3 To build an effective review of the sustainable development strategy, the Gothenburg European Council asked the Council to take due account of energy, transport and environment in the sixth framework programme for research and development. The Gothenburg European Council also noted that sustainable development requires global solutions. The Union will seek to reach a "global deal" at the Johannesburg World Summit on Sustainable Development.

1.4 In the light of these considerations, the Committee feels that the need for a secure, low-price, environmentally sound and sustainable supply of usable energy stands at the confluence of the objectives set out at Lisbon, Gothenburg and Barcelona. That said, it is by no means certain that this need can be met. There is an energy problem that has to be tackled without delay. The key to potential solutions may lie above all in intensive research and development.

1 Gothenburg European Council, June 2001, presidency conclusions - SN 200/1/01 REV 1

2 Barcelona European Council, March 2002, presidency conclusions - SN 100/02 ADD 1

3 Green Paper COM (2000) 769 final

1.5 For that reason, the Committee, building on its opinions on the Green Paper⁴ and the sixth framework programme⁵ has adopted the present opinion, in which it recommends that the Commission draw up an integrated European energy research strategy, from which a future European energy research programme will be derived. This programme should, if possible, be launched during the lifespan of the sixth framework programme, but at the latest during the following period.

1.6 The Barcelona European Council agreed "*that overall spending on R&D and innovation in the Union should be increased with the aim of approaching 3% of GDP by 2010. Two-thirds of this new investment should come from the private sector.*" As part of that, the Committee feels that the additional resources needed for a comprehensive energy research programme should also be available (see also point 2.4.3).

2. Point of departure and Committee opinions to date

2.1 The energy issue

2.1.1 Usable energy is the mainstay of our contemporary industrial society. Its ready availability was the prerequisite for our present-day standard of living. Unprecedented progress has been made in terms of life expectancy, food supply, social security and personal freedom. Without energy, there is no prosperity, no dynamism. Thanks to economic and technical efficiency, and a consistent economic climate, it has so far been possible – in contrast to places such as California – to provide EU consumers with a broadly adequate and secure supply of acceptably priced energy.

2.1.2 However, the picture is not all rosy. Supplying and using energy puts a strain on the environment. It presents risks and is a drain on resources. It involves the problem of external dependence and imponderables. The situation is exacerbated by the fact that, in the longer term, demand for useable energy is set to rise dramatically given the two - if not threefold rise in world energy consumption expected by 2060 as a result of population growth and the pent-up demand of less developed countries.

2.1.3 Fossil fuels, i.e. coal, natural gas and oil, make up by far the largest share of the EU's primary energy consumption (some 79%). Stocks of these fuels are - to varying degrees - limited, and their combustion produces emissions (in particular of carbon dioxide) that impact on the climate and the environment. The Kyoto protocol seeks not only to abate increases in these emissions, but even to cut them.

2.1.4 Nuclear fission makes up some 15% of primary energy consumption and produces no climate-relevant gases. Its use, however, is controversial because of concerns about radioactive contamination – either through operational accidents or final disposal – and attitudes vary from Member State to Member State.

⁴ OJ C 221, 7.8.2001

⁵ OJ C 260, 17.9.2001.

2.1.5 Renewables account for some 6%, of which hydropower enjoys the largest share. The main problems with other renewables (mostly derived from biomass combustion and waste incineration) are that (i) their availability is naturally variable, (ii) they are not storable (with the exception of biomass and waste) and (iii) their primary energy density is low, which in turn means that costs are still very high.

2.1.6 None of the potential future energy supply options and technologies is perfect and none is sufficient to cover all needs. There is no secure, long-term, environmentally sound and economically viable energy supply – either in Europe or at a global level. Moreover, there could be a conflict of aims between (i) the need (driven by competition) for particularly cheap energy supplies and (ii) the development of new technologies and long-term preparedness, including the requisite research activities. Hence, the strategy designed to resolve the problem must not adopt a piecemeal approach. It is vital to discuss the matter fully and in its long-term, global context, and tackle it on a broad front. Resolving the energy issue is the key element and definitive touchstone of any global sustainability partnership.

2.1.7 These points are not, however, adequately reflected in either the public's perceptions or in open debate. Rather, there are a broad range of opinions that veer between over- and under-estimating the risks and opportunities involved, and which change from time to time amid news of oil crises, climate incidents, supply bottlenecks (California) or radioactive waste transports. Some people take the view that there is no energy problem at all – i.e. that things have always worked out so far and that new reserves could be explored should the need arise (since, for many years now, there have been predictions of forest dieback and claims that oil and gas stocks are set to run out in just 40 years). At the other end of the spectrum is the belief that renewables could easily meet the world's entire energy needs if only all research funding were channelled into them. Hence, the energy issue must become an integral part of the necessary debate⁶ among scientists, industry, policymakers and the public, and also involving schools, the media and the vocational training sector.

2.2 The Commission Green Paper

2.2.1 The Commission Green Paper⁷ set out the issue very clearly. In particular, it noted Europe's alarmingly high dependence on imports of necessary primary energies, which will rise to almost 70% by 2030. The Commission also drew attention to the risk that the Kyoto commitments may become impossible to meet, and stressed the role of nuclear energy in meeting those same commitments.

2.2.2 The Committee has issued a detailed and largely very favourable opinion⁸ on this subject. Among other things, the Committee felt that the Commission's analysis should be more global in scope and that the timeframe of the study should be longer, as problems will further come to a head

⁶ See also the Committee's own-initiative opinion CES 724/2001 of May 2001 on *Science, society and the citizen in Europe*, OJ C 221, 7.8.2001

⁷ See footnote 3

⁸ OJ C 221, 7.8.2001

in the second half of the century. The Committee stressed the particular importance of research and development in resolving this issue.

2.2.3 The Consultative Committee of the European Coal and Steel Community (ECSC)⁹ notes the potential for energy-saving in transport, private households and the tertiary sector, and the development potential of coal use.

2.3 Energy research – the state of play to date

2.3.1 At EU level, energy research is an integral part of the ongoing fifth framework programme for research, technological development and demonstration activities (RTDD) and the framework programme of the European Atomic Energy Community (Euratom). Under this scheme, some **□510 million are spent on energy research each year. This represents less than one thousandth** of primary-energy expenditure within the EU.

2.3.2 In February 2001, the Commission, in preparation for the sixth framework programme, published a Proposal for a Decision of the European Parliament and of the Council concerning the multiannual framework programme 2002-2006 of the European Community for research, technological development and demonstration activities aimed at contributing towards the creation of the European Research Area and a Proposal for a Council Decision concerning the multiannual framework programme 2002-2006 of the European Atomic Energy Community (Euratom) for research and training activities aimed at contributing towards the creation of the European Research Area.¹⁰

2.3.3 In January 2002, the Commission also submitted (amended) proposals¹¹ concerning the specific programmes implementing the sixth framework programme of the European Community for research, technological development and demonstration activities (2002-2006) and the specific programmes implementing the sixth framework programme of the European Atomic Energy Community for research and training activities (2002-2006).

2.3.4 All the documents set out under point 2.3 above cover energy-related R&D activities. In fact, the programme of the European Atomic Energy Community is devoted exclusively to this issue.

2.3.5 Moreover, publicly funded energy research in the Member States is carried out under national research schemes.

2.3.6 Another point to stress is that all technological development and related research is, to a quite considerable degree, carried out by industry, largely using its own resources. Examples include

⁹ Bulletin EU 6 - 2001

¹⁰ COM(2001) 94 final

¹¹ COM(2002) 43 final

oil and gas companies (including transport and processing), the coal industry, plant builders, the energy distribution sector, the car industry, the aircraft industry, their suppliers, SMEs and many others, including the banks involved.

2.3.7 In July 2001, the Committee adopted a detailed opinion¹² on the first of the Commission proposals mentioned above (2.3.2)¹³. Among other things, the Committee opinion recommends:

- *setting an increase of about 50% in the overall Community RTDD Budget as a medium-term political goal for the period beyond FP6 (6th Framework Programme) and appealing to Member States and industry to act likewise on their part;*
- *introducing a specific heading "ENERGY and TRANSPORT" in the thematic actions to give more emphasis and visibility to the energy and transport problem, and particularly - in view of sustainable development - to renewable energy systems (including storage and distribution) and to energy savings (□1,500 million);*
- *strengthening the Euratom programme accordingly by aiming at safer nuclear energy, including production, transport and storage of nuclear waste, and by enhancing the development of the fusion option (fission □350 million, fusion □950 million).*

2.3.8 In May 2002 the Committee adopted an opinion¹⁴ on the second Commission document (2.3.3) mentioned above (COM(2002) 43 final). This opinion largely reiterated the key points the Committee made about energy research in its earlier opinion, modified to reflect Council decisions and parliamentary opinions that have been submitted in the meantime.

2.3.9 With regard, in particular, to the objective of global sustainability, the Committee opinion on preparations for the World Summit on Sustainable Development in Johannesburg drew attention to the key importance of intensive research in the fields of energy and transport.¹⁵

2.3.10 The Committee is also currently working on an opinion on the Commission's "Intelligent Energy for Europe" programme¹⁶.

¹² OJ C 260, 17.9.2001

¹³ COM(2001) 94 final

¹⁴ CES 693/2002

¹⁵ CES 692/2002

¹⁶ COM(2002) 162 final, 9.4.2002

2.4 Case for this additional opinion

2.4.1 The Committee opinion mentioned in points 2.3.7 and 2.3.8 above says relatively little about energy research, given that this is just one of a very wide range of issues and procedures addressed by the sixth RTDD framework programme. That was also the reason why, in its above-mentioned opinions on the sixth framework programme as a whole, the Committee did not consider it appropriate to devote as much space, importance and detail to energy research as the issue should, in itself, warrant.

2.4.2 Energy research also occupies a special position, however, in that it is the only element of the thematic actions to straddle two separate Treaties: (i) the multiannual framework programme of the European Community for research, technological development and demonstration activities (RTDD) and (ii) the multiannual framework programme of the European Atomic Energy Community (Euratom) for research and training activities.

2.4.3 A particular new factor is also emerging with the expiry of the Treaty establishing the European Coal and Steel Community (ECSC) in July 2002, as a result of which the Commission will take on the management of a common research fund for coal and steel.¹⁷ The Committee considers that this fund should above all benefit energy issues.

2.4.4 Also of relevance to the issue at hand are various Commission support schemes as part of the first energy framework programme, that are being conducted outside the framework programme for research and development (see also 2.3.4).

2.4.5 Thus, EU energy research activities remain somewhat disjointed: the sixth RTDD framework programme, Euratom, energy sector measures, as well as¹⁸ Eureka, Cost, CERN, JRC etc. The Committee feels that a key task for the Commission – in conjunction with those responsible for and involved in the various schemes and bodies – is to establish a joint, coherent energy research strategy as part of the European Research Area (see also 3.6).

2.4.6 The Committee has therefore decided to follow up the opinions mentioned in 2.3.7 and 2.3.8 with an additional opinion devoted specifically to the overall issue of energy research. This also reflects the Committee's view that energy research should be given a much sharper focus and a higher profile, and should be presented in a uniform, coherent way. This is also consistent with the urgency of the issue.

3. Strategy for a future European energy research programme

3.1 Energy research is the strategic element and essential mainstay of any long-term, successful energy policy. Energy requires as much scientific research and technological development as possible. R&D investments are the current generation's way of making amends to future

¹⁷ Council paper 5650/02 + ADD 1 - Council 28.2. 2002 provisional version 6533/02 (press 43 - G) page VII EN.

¹⁸ Some of the organisations and programmes mentioned here go further than the EU framework.

generations for present-day consumption of energy resources and for loading the atmosphere with greenhouse gases.

3.2 R&D is carried out by science and industry. Within the EU, the skills and scientific expertise needed for excellence are on hand. The EU also has the facilities to train specialists of the future in order to ensure the success of the joint science and industry research strategy, which is needed.

3.3 Member States and the EU must support this strategy, particularly given the long-term considerations and risk factors involved in R&D. Competition would be seriously distorted - to the detriment of European businesses and research establishments – should such support fall substantially short of the public funding provided for this purpose in rival markets.

3.4 Industry, science and politics thus have a joint task, namely (i) to safeguard long-term energy supply for the Community and its people, (ii) to develop the strategy needed to achieve that objective and (iii) to provide the requisite resources.

3.5 This applies in particular to EU tasks, since energy supply, trans-European energy networks etc. are typical features of a single European market.

3.6 Thus, major importance is attached to the European Research Area - and the policy tools available under it. However, the Committee would also urge governments, industry and Member States' research establishments to become involved in any European strategy of this kind, and thus to play a part in the European energy research programme that is to be developed as a result (as already happens in the case of fusion).

3.7 The Committee is fully aware that many of these (and the following) recommendations are already reflected in the Commission proposal for the sixth framework programme, the Euratom programme and other Commission schemes. They are, however, incomplete and somewhat disjointed (see also point 2.4.5). What the EU clearly needs, however, is a balanced, sufficiently diverse and durably reliable overall strategy arising out of a broad-based analysis of economic and ecological requirements on the one hand, and possible solutions and their potential for development on the other. Although underpinned by different Treaties, the result should be a coherent, consistent, long-term European energy research programme that clearly has the dedicated resources it needs for implementation, is transparent to the public and enjoys strong backing vis-à-vis political decision-makers.

3.8 The situation outside current EU borders is another consideration.

- First, there are the EU candidate countries and their energy supplies. At issue are the safety and environmental standards of the technologies available in these countries and the difficulties they present. It is also important to press ahead with, and build on, existing linkages with a common research programme.

- Then, there are the states bordering the candidate countries, such as Ukraine and Russia. It is also vital to engage in further timely cooperation with these countries in the field of energy research – building on existing cooperation ventures¹⁹ – and to reach agreements on issues like environmental standards.
- Last, but by no means least, however, there is also the global aspect - and the global partnership for sustainable development (Johannesburg). Among other things, this involves the duty to bring European expertise and technology to bear to help resolve global problems and the difficulties faced by less developed countries. This duty not only means sharing scientific and technical know-how. It also presents an opportunity to export cutting-edge technology and thus to foster EU competitiveness and prosperity.
- The global dimension of the energy issue is an additional incentive to seek out and foster strong international cooperation in the field of energy research. International organisations such as the IEA (International Energy Agency) and the IAEA (International Atomic Energy Agency) are also appropriate catalysts and vehicles on this front.

3.9 In order to provide energy feedstocks and dispose of residues from energy consumption (or more precisely energy transformation), it is essential to press ahead with the development of all known and possible energy sources in a bid to explore, improve and harness their potential for securing a safe, cheap and sustainable energy supply. As research and development are the wellsprings of the future, the effort this requires should be measured against the backdrop of global competition, the urgency of the environment issue and the size and cost of overall energy consumption.

3.10 It must be remembered that, since it currently appears that the energy issue is set to become dangerously acute in the second half of the century, the strategy, test period and prospects for development must look beyond that timeframe. That said, given the long-term nature of the developments and solutions required, it is essential to act decisively now.

3.11 The Committee is pleased that many of its key views are shared by the RTD Strategy Working Group E-WOG (a Commission advisory group) and would refer to that group's working paper²⁰.

4. **A joint research strategy: some considerations**

4.1 Any rational research strategy starts by considering how best to conserve existing resources - or to tap into new ones - and - how to reduce CO₂ emissions and other harmful emissions or residual matter - and keep energy prices down. However, such a strategy must also work out long-term and global objectives and pursue them with resolve.

¹⁹ OJ L 299/14, 28.11.2000

²⁰ E-WOG Working paper *Sustainable and Affordable Energy for the Future; Priorities for European Union Energy RTD: January 2001* EUR 19790

4.2 Industrial R&D must focus on objectives that offer scope for quick returns and can be rapidly translated into results, products, processes and services – in other words, objectives with a relatively short payback period for the research investments involved and which thus can largely be met by companies themselves. Public research establishments on the other hand must address what basic developments are required, and, in particular, promote projects where the objectives can be reached only in the longer term. Overall, industry and science must work closely together in mutual partnerships in order, ultimately, to arrive at marketable solutions through basic research and demonstration projects.

4.3 The changes attendant upon the European single market (liberalisation)²¹ are generally deemed beneficial to security of energy supply. However, in the light of sharper global competition, these measures may, in some industrial sectors, cause shifts in incentives and responsibilities for longer-term preparedness, resulting, temporarily at any rate, in less industrial R&D.

4.4 Policymakers must, where required, make rules or give industry incentives to prevent this happening. It is also vital to work towards ensuring that industry too meets the Barcelona objectives²² i.e. that it too invests markedly more of its own resources in research and development.

4.5 Companies should become more involved in publicly funded projects undertaken jointly with research establishments, so that the energy research findings can be assimilated and turned into products more quickly. It is particularly important to involve plant builders and operators in getting demonstration projects up and running.

4.6 A joint research strategy also requires adequate funding both for public research establishments and for industrial research. It takes years – often decades – of R&D work for an idea to go through the various stages (laboratory trial, prototype and demonstration model) before finally becoming a marketable product. If such developments are to have a chance of success, national and European research funding must be constant and long-term so that the players, companies and research establishments involved have the security to plan ahead and the courage to become involved.

4.7 The tools to foster research on the EU's part must be selected and shaped in such a way that they are fine-tuned to the specific topics and the differing timeframes involved. The Committee feels that an appropriate range of options is offered by the machinery used under the fifth framework programme and the Euratom programme, and the measures proposed under the sixth framework programme and the Euratom programme.

4.8 Another aim should be to further pool the political and administrative responsibilities required for planning and decision-making so that the need for the players involved (e.g. the various

²¹ Centre for European Policy Studies CEPS: *Security of Energy Supply*, Report of a CEPS Working Party, November 2001, page 22, ISBN 92-9079-358-9

²² See footnote 2 and point 1.6

European Commission directorates-general, ministries and Member States) to coordinate and agree does not lead to disproportionate delays – or even logjams – but results in a well-coordinated, efficient, coherent approach that is consistent with the objectives of the European Research Area and makes full use of the opportunities that area offers.

5. A future European energy research programme: topics

5.1 The Committee itself has no intention of framing or proposing any agenda for an energy research programme of this kind. Nor indeed is that part of its remit. Rather, the Committee recommends that the Commission undertake this task in the established manner, in close cooperation with industry, science and Member State governments.

5.2 The resultant European energy research programme could then be incorporated into plans for the period beyond FP6, although it should, as far as possible, also be taken into account during the sixth framework programme itself. The fund to be taken over from the ECSC and the increase in the research budget agreed in Barcelona open up the additional room for manoeuvre that is required.

5.3 With no single solution to the energy problem on the horizon, the issue can only be tackled by continuing to develop and explore all kinds of promising energy sources, technologies and options.

5.4 It is vital both to (continue to) develop well-known and proven techniques and concepts consistently and inventively, and also to give new ideas and innovations a chance.

5.5 As things stand therefore, useful energy research could focus on key areas such as:

5.5.1 Overall yardsticks

- resources;
- residues/emissions;
- availability;
- security of supply;
- sustainability;
- safety/risks;
- reliability;
- other environmental factors;
- geopolitical considerations;
- costs;
- acceptance.

5.5.2 Technical categories

- energy provision;

- energy transport, conversion, storage and use;
- process engineering;
- materials research and development;
- systems development and research.

5.5.3 **User categories**

- transport;
- industry and business;
- building, housing and private households.

5.5.4 **Primary energies and the conversion processes thereof**

- coal and derivatives;
- crude oil and derivatives;
- natural gas and derivatives;
- nuclear fission;
- nuclear fusion;
- hydropower and tidal energy;
- biomass and derivatives;
- wind power;
- solar heat systems;
- photovoltaics;
- geothermal energy.

6. **Topics - some examples**

6.1 First of all, it should be stressed that R&D work to date has already been highly successful. Examples range from the significant rise in conventional power plant efficiency (including the desulphurisation and denoxing of flue gases) to the development of fuel cells, low-consumption diesel engines, high-output wind turbines (and their extensive introduction onto the market) and passive emergency cooling systems for nuclear reactors. They also include the decisive advances that have been made in the field of fusion research. These and many other examples show what can be achieved through a thirst for research, the art of engineering, a spirit of invention and both entrepreneurial and political commitment, when the right conditions are in place. They also show that a far-sighted approach and the investment outlay involved are worthwhile and can achieve the desired objective.

6.2 Building on that, the following are some examples of topics for future R&D work. The list is non-exhaustive (i.e. it does not rule out further ideas and projects that happen not to appear):

6.2.1 **Energy transfer, conversion and use**

- further development of steam - and particularly gas - turbines as a key technology to boost efficiency (materials);
- more efficient industrial technologies (e.g. steel-making, chemical production and the food industry);
- improved internal combustion engine systems, including hybrid technologies;
- leakage-free natural gas production and transport;
- production technologies for alternative fuels (methanol, ethanol, synthetic hydrocarbons, hydrogen) and the transport and storage of gaseous fuels (natural gas, biogas, hydrogen);
- improved thermodynamics and thermal insulation in building engineering;
- active and passive use of solar energy in building engineering (including the artistic/aesthetic stimuli that are important for architects);
- electricity and heat storage techniques;
- network planning and management;
- fuel cells for stationary and mobile use and to power vehicles;
- technologies that can modulate output to reflect the demand/supply fluctuations of renewables;
- hydrogen technology²³;
- superconductive energy transport and storage systems.

6.2.2 Material sciences, energy systems research

- materials and operating equipment, for instance for gas and steam turbines, fuel cells, solar cells, thermal insulation, heat stores, special cables, superconductors and fusion power plant components;
- energy systems research: correlations between economy and ecology, technology impact assessment, market analyses, model scenarios, foresight.

6.2.3 Energy supply including safety and environmental considerations

²³

On account of misleading reports often heard in the media and advertising, it should be pointed out that hydrogen is not readily available as a primary energy source, but must first be generated from water using electricity. Its advantage may lie in its storability and suitability for use as fuel (especially in fuel cells). It does not produce carbon dioxide when burnt.

- further development of (i) traditional power plant technologies in a bid to make them more efficient (ii) combined technologies and new processes such as dry lignite power plants, pressurised pulverised combustion of lignite and hard coal, pressurised fluidised bed combustion of lignite, hard coal and biomass, integrated coal gasification, co-incineration of replacement fuels or biomass, co-generation gas and steam turbine power plants, steam power plants with critical steam conditions;
- flue gas filtering and purification, CO₂ sequestration, landscape protection;
- use of biomass, the logistical considerations involved and optimum applications, emissions;
- heat and power co-generation, decentralisation versus centralisation;
- hydropower, safety (geological, internal, external);
- heating and air-conditioning within buildings;
- wind and solar power plants: development and testing of various approaches and projects, e.g. solar thermal energy for electricity generation and building heating systems, various technologies for photovoltaic use and component (cell) production, ongoing progress with regard to efficiency, cost reduction, network connections, matching supply and demand, energy storage, marketing and landscape protection;
- fission reactors: internal and external security, development of alternative reactor concepts, especially inherently safe reactors; transport, processing and storage of radioactive fission products; transmutation of particularly radiotoxic and long-lived radionuclides;
- development of fusion reactors: fundamentals, concepts, demonstration activities, technology, internal and external security; drawing up a strategy to significantly cut the timeframe for building a demonstration power plant.

6.3 **Remarks on these examples**

6.3.1 The greatest threat to energy supplies within the EU is the dominant use (combustion) of fossil fuels (79% of overall energy supply), and the 70% import-dependency forecast in the medium term. Equally, in the short and medium term, the potential for saving these fuels – and thus for cutting CO₂ emissions – is also particularly high. This could be achieved by improving processing, incineration and conversion techniques and by making more effective use of heat and secondary energy. Examples include making electricity-producing power plants more efficient (especially in terms of materials developments and metallurgy) and improving industrial processes, for instance in the chemical and steel industries. Other cases in point include the propulsion technologies of motor vehicles, thermal insulation and the passive solar use of buildings.

6.3.2 The use of some of renewables such as hydropower - and to some extent also biomass combustion (wood) - has a long tradition and is (broadly speaking) competitive. Also, hydropower is used effectively in **reservoir power stations** to meet peak load (peak demand).

6.3.3 Other renewables such as wind and solar technologies are also widely used, but make up only some 1% of EU energy supply and (still) remain uncompetitive. Yet it is far cheaper to use wind energy than to produce electricity by photovoltaics. However, there is still a lack of storage facilities. This means that supply depends on daily or annual cycles and weather conditions, and "conventional" power plants have to be kept on hand as a buffer. It also limits the potential share of the overall electricity market.

6.3.4 For that reason, incentives are being put in place in several Member States to foster the use of still-uncompetitive processes. Examples include consumer prices that are considerably higher than the market price (e.g. under laws that grant priority to renewables) and cheap loans. Such moves are based on the expectation that, in future, the costs of production technologies will fall as fossil fuels become more expensive (prices and energy taxes), thereby closing the existing gap.

6.3.4.1 Research must therefore, above all, aim to make these technologies more competitive and more readily available in their own right (storage). That said, however, a clear distinction – not always made - must be drawn between R&D on the one hand, and the promotion of market position on the other.

6.3.4.2 In particular, the increasing need for adequate research promotion (and the costs that involves) should be set against the costs to consumers and public authorities of market subsidies that have now reached sizeable levels. Another question arising in this connection is: how much of a rise in energy prices can the European economy put up with in the longer term, not least in the face of global competition?

6.3.5 In principle, nuclear energy may be generated both by the fission of very heavy atomic nuclei such as uranium or plutonium and by the fusion of very light atomic nuclei such as deuterium or tritium. These processes differ fundamentally, however, in terms of how they work, operating conditions, environmental and safety aspects, resources, etc.

6.3.6 Fission reactors have been operating widely across the world for decades. However, technical and safety standards vary from country to country. EU reactors are among the best developed. It is thus clear even at this stage that the Union is facing new tasks in raising these standards in non-Member States. The main purpose of research must therefore be to boost safety standards still further, to press for their application in non-EU countries as well and to seek ever more effective solutions for the disposal of long-lived radioactive fission products.

6.3.7 Fusion reactors are still at the development stage. However, from a safety angle and given their much lower levels of radiotoxic waste – with no long-lived components (actinides) – and the virtually unrestricted supply of resources, they are potentially a key, sustainable technology of the future. Spurred on by the successes of the fusion programme that is already fully integrated into the European Research Area (see also point 3.6 above), it has been possible, through worldwide

collaboration involving the EU, Japan, Canada and Russia, to draw up construction plans for the ITER international experimental reactor. ITER is designed to demonstrate at power-plant level the technological and scientific potential of nuclear fusion as a practical energy source. Under ITER, therefore, research must focus on demonstrating the feasibility and environmental benefits of this technology as quickly as possible so as to lay the groundwork for building the first electricity-producing fusion power plant.

6.3.8 EU industry and research lead the way in virtually all of the fields mentioned above. It is vital therefore to maintain and build on that position and expertise and to use it to the advantage of vulnerable European energy supply, and for the purposes of global networking and to meet global commitments.

6.3.9 In this context, the Committee would repeat its call to policymakers, industry and scientists to make scientific and technical professions sufficiently attractive that enough talented young people opt to train for them. This means, among other things, ensuring that training centres meet the highest standards, and bringing home to those embarking on their studies the crucial importance of scientists and engineers who, in the various energy sectors, ensure an adequate, environmentally sound energy supply. If young people are to be encouraged to embark on a long-term career in energy technologies, the sector has to offer sufficiently attractive career and promotion opportunities and remuneration.

6.3.10 The Committee would also repeat its call to bring the allied issues of energy, energy research and sustainability into consultations with civil society, including schools and the media. In society and within the democratic process, people above all need information to help ensure that, in this field, the right course of action, the right precautionary measures and the right decisions are taken.

7. Summary and Committee recommendations

7.1 Securing a low-price, environmentally sound and sustainable energy supply within the EU is an issue at the heart of the decisions taken at the Lisbon, Gothenburg and Barcelona Councils. Further efforts are needed, however, to meet this key objective. There is an energy problem that needs to be resolved. Industry, science and politics have a joint task to develop the necessary strategy and provide the requisite resources.

7.2 However, the strategy designed to resolve the energy problem must not adopt a piecemeal approach. It is vital to discuss the matter fully and in its long-term, global context, and to tackle it on a broad front. Resolving the energy issue is the key element and definitive touchstone of any global sustainability partnership.

7.3 Intensive research and development in particular may be the key to potential solutions. Energy research is the strategic element and essential mainstay of any long-term, successful energy policy. R&D investments are the current generation's way of making amends to future generations for present-day consumption of resources and for polluting the atmosphere with emissions and residues of energy consumption.

7.4 The Committee therefore recommends that the Commission draw up an integrated European energy research strategy, from which a comprehensive future European energy research programme will be derived. This programme should, if possible, be launched during the lifespan of the sixth framework programme, but at the latest during the following period. The additional resources required should be provided from the increase in overall R&D expenditure (in line with the Barcelona decisions) and from parts of the ECSC fund.

7.5 Key importance is thereby attached to the European Research Area - and the policy tools available under it. The Committee would also urge governments, industry and Member States' research establishments to become involved in any European strategy of this kind, and to play a part in any European energy research programme. The opportunities offered by the ERA should be utilised through a comprehensive, transparent and coordinated energy research strategy, supported by all the players involved.

7.6 The Committee is fully aware that many of its recommendations are already reflected in the Commission proposal for the sixth framework programme, the Euratom programme and other Commission schemes. They are, however, incomplete and disjointed. Although underpinned by different Treaties, the result should be a coherent, consistent, long-term European energy research programme that clearly has the dedicated resources it needs for implementation, is transparent to the public and enjoys strong backing vis-à-vis political decision-makers.

7.7 In order to provide energy feedstocks and dispose of - and reduce - residues from energy consumption, it is essential to press ahead with the development of all known and possible energy sources in a bid to explore and improve their potential and turn it to the best possible use. As research and development are the wellsprings of the future, the effort this requires should be measured against global competition, the critical supply position, the urgency of the environment issue and the size and cost of overall energy consumption.

7.8 Industry involvement should focus on objectives that offer scope for quick returns and can be rapidly translated into results, products, processes and services – in other words, objectives with a relatively short payback period for the research investments involved and which thus can largely be met by companies themselves. European single market rules and other incentives must be geared towards ensuring that industry meets the Barcelona objectives and becomes involved in the European energy research programme.

7.9 Public research establishments on the other hand must address what basic developments are required, and, in particular, promote projects where the objectives can be reached only in the longer term. Industry and science must work closely together in mutual partnerships in order, ultimately, to arrive at marketable solutions through basic research and joint demonstration projects.

7.10 The issues included in the resultant research programme should include all appropriate user-related aspects, including households, buildings, industry and transport, and should also take account of the various supply, conversion, distribution and application technologies, including energy saving and the development of new concepts. This also brings in security-of-supply

issues, technical risk reduction or management, environmental protection and the prevention or disposal of residues from energy use (greenhouse gases, radioactivity). Other aspects include the (further) development of the requisite materials, and systems studies for analytical or forecasting purposes in which demographic, economic and environmental scenarios are worked out and tested.

7.11 Steps should be taken to foster, continue and support cooperation and networking not only with the candidate countries, but also with their neighbouring countries and, ultimately, at global level too. In terms of supply, and of the potential economic, environmental and political impact involved, energy is, in the final analysis, a global problem.

7.12 In conclusion, the Committee would also repeat its call to bring the allied issues of energy, energy research and sustainability into consultations with civil society, including schools and the media. In society and within the democratic process, people above all need information to help ensure that, in this vital field, the right course of action, the right precautionary measures and the right decisions are taken.

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