Stimulating A Democratic Debate About The EU's Research Priorities:

A Criteria Based Approach to the 7th EU Research Framework Programme for Energy and Nuclear

November 2005

This report is published by the

Greens-EFA Group in the European Parliament

based on analysis provided by a group of consultants including Ada Amon, Antony Froggatt, Mycle Schneider

The Greens | European Free Alliance
in the European Parliament

Political statement by

Rebecca Harms: MEP
Satu Hassi : MEP
Claude Turmes : MEP
David Hammerstein : MEP

The 7th Framework Programme (FP) proposal is the largest ever research and development scheme put forward by the European Commission, in regard to its scope, number of countries, length of time and expected overall budget.

The proposed research programme split into two pieces of legislation, one for nuclear technology, the Euratom FP, and the second for everything else. To further the separation the Euratom budget does not require the approval of the Euratom Parliament, unlike the general FP. This creates an artificial split between the energy research and development budgets and stops the Parliament from influencing the strategic development of the overall energy sector.

The need for a unified energy budget is highlighted by the fact that the Euratom budget is more than the proposed funding for all other energy technologies. Energy technologies are expected to receive approximately €3 billion for seven years, while the Euratom budget is likely to be €4.8 billion for the same period. Within the nine areas under the energy programme it is unclear how the budget will be allocated to the different technologies. However, early indications are that all renewable and energy efficiency technologies will receive between €118 -134 million per year. This is remarkably low especially when compared to the fact that the fusion budget is expected to rise to €600 million per year in 2011.

Defining Criteria for Research and Development.

The allocation of funding in the energy sector must be based on traceable and transparent criteria that enables technologies to be judged on their ability to assist the EU to meet its energy objectives which are "competitive, environmental sustainable and secure". Furthermore, the relatively limited EU research and development funds must be prioritised towards technologies that rank highly against scientific objective criteria such as:
- Can the technologies lead to the rapid reductions in C02 emissions?
- Will the technologies reduce the EU's oil dependency and lower the levels of imported energy?
- How will they contribute to the EU's overall competitively and job creation in short time horizon (2015 to 2025)?
- Have the technologies received funding in the past and what impact did this make?

Finally, scarce public funding should not unnecessarily duplicate funding from private companies. Given the large profits and turnovers of in certain sectors of the energy industry these industries should have the responsibility to fund research in their areas.

Allocate Funds Along a Merit Order

If research priorities were ranked using these criteria, the result would be along the following line:

The 7th FP should give absolute priority to energy efficiency measures whose further introduction will assist with all areas of energy policy, environmental protection and economic activity in Member States. Areas like enhanced efficiency for appliances, office equipment, consumption electronics and building deserve greater funding. Speeding up the progress in the so called horizontal technologies, those used in production processes like electric motors, fans and pressured air would become a major contribution to cost savings in the EU industry and SMEs. As behavioural changes are also important when it comes to consumption patterns, social sciences like social marketing must also receive greater funding.

The second top priority areas must be renewable energies. Unlike other energies (oil, gas, nuclear) the problem of renewable energies there are no reserve limitations nor import concerns. Wind, water, biomass, marine, solar, geothermal have no or few physical limits and do not pose any additional significant risks to the planet and people. The most urgent issue for renewables is to accelerate the learning curves and reduce costs. The EU has set itself ambitious targets for the further introduction of renewable energies, to enable these to be met further investment in research and development must be made. This will bring benefits to both the EU energy market and export markets on the near term.

Technologies relating to waste disposal in already established and apparently profitable sectors, such as oil, coal or nuclear, should be de-prioritised, as it is part of these industries responsibility to store or dispose of waste that they create. Billions of euro of public funding to solve the waste problems of nuclear and coal industry would be in clear contradiction of the polluter-pays principle enshrined in the EC Treaties.

The Commission has suggested that Carbon Capture and Storage (CCS) will be a priority for the 7th FP. However, it is currently not clear if and how fast CCS could be commercial available. Research for CCS should go ahead, the question is how much private industry can provide and what would be the role of public funding. As coal and oil industries are mature industries with large turnovers and huge profits, research must come from these sectors. Public research, if any, should only be focused in helping defining the environmental and other criteria under which CCS would be truly sustainable. Furthermore, even if CCS were to function and become economically viable the available storage capacities would be relatively rapidly exhausted (possibly in one generation of power plants). Therefore, greater attention must be placed on finding final solutions (like efficiency and renewables) than to intermediate solutions.

Clean coal technologies have been supported with billions of EU research money for decades. Research money in FP7 is scarce. Should research be financed, it should be exclusively through the EU's existing "steel and coal research fund". This fund has been created exactly for this purpose. Using further FP7 money would be an unjustifiable duplication

Nuclear technology has in recent years received more than half of all R and D in the OECD. Much of this is going to nuclear fusion, but still nuclear fission receives considerable funding for waste disposal and the development of new reactors designs. These types of activities should not be funded by the public purse, but undertaken by the industry. Publicly funded fission research should be restricted to radiological protection measures.

The nuclear fusion budget expected to rise to €600 million per year by 2011. This level of funding, for a technology which is, even under the most optimistic scenarios, at least forty years from commercialisation, cannot be justified.

Stimulate A Democratic Debate Based On Transparent Criteria

Until now all decisions in the EU Commission and EU Council have been made completely outside any democratic debate. For example the provisional decision by EU Heads of States to proceed with more than €10 billion for the construction of an experimental fusion reactor in Cadarache (France) without prior democratic and public discussion is a political scandal. Citizens in Europe are right not to accept anymore of these "closed circle decisions" taken at the EU level.

In order to regain credibility with the citizens, all three EU Institutions - Commission, Council and European Parliament should introduce open and transparent decision making for the 7^{th} Framework Programme. This should require co-decision for both the R and D programmes, and therefore require full and equal scrutiny by the European Parliament of the Euratom FP. In December 2005 or in early 2006 the EU Council and Government are expected to agree the EU's overall budget –the Financial Perspectives-. It is likely that this will lower the total amount available for research and development and therefore, the Commission will revised its draft proposal for the different research areas. We propose that these changes are not based on vested national interests (such as France wanting additional funding for the fusion project at Cadarache), or on current technology bias, but on scientific criteria. With the set of criteria set out in this paper, the Greens in the European Parliament have attempted to create some objectivity for the difficult decisions ahead. Our wish is to help stimulate a debate not only in Brussels but also in the different Members States with society at large about what Research and Development is really about. National Parliaments would be the right place to further crystallize this democratic debate.

Introduction

The European Union plays an increasingly important role in determining the choice of energy sources made by Member States. Through legislation on security of supply, environmental protection and energy market rules the EU can assist Member States to ensure that the energy sector becomes sustainable, economic and secure.

Energy production and use is a fundamental part of the EU, with two of the three founding EU Treaties, The European Coal and Steel Community and The European Atomic Energy Community, charged with promoting particular energy technologies. Consequently, the early research and development (R&D) budgets of the EU, through the Framework Programmes (FP), prioritised energy technologies, with the 1st FP allocating 66% of it budget for energy. The table below demonstrates the declining allocation for energy, which have fallen to just 10.5% in the proposed 7th FP budget.

Table 1: Comparison of Energy Funding in Framework Programmes

Framework Programme	Total R&D (billion €)	Energy and Euratom as % of total
1 : 1983-86	3.8	66
2: 1987-90	5.4	50
3: 1991-94	6.6	23
4: 1995-98	13.2	22
5: 1999-2002	14.9	18
6: 2003-06	17.5	11.6
7: 2007-13*	73.2	10.5

Source: EGE[1] and European Commission[2]
**- Proposed*

The Commission's Advisory Group on Energy claims that *"in face value terms, expenditure is now less than it was 25 years ago, in real-value terms it is very much less and, as a percentage of the total Community R&D it is roughly six times smaller[3]".*

Criteria for Energy Technologies:

The European Commission has defined the objective for the EU's energy research and development as[4]:
Transforming the current fossil-fuel based energy system into a more sustainable one based on a diverse portfolio of energy sources and carriers combined with enhanced energy efficiency, to address the pressing challenges of security of supply and climate change, whilst increasing the competitiveness of Europe's energy industries.

---

[1] Key Tasks for Future European Energy R&D: A first set of recommendations for research and development by the advisory Group on Energy; Directorate-General for Research, Sustainable Energy Systems, EUR 21352, 2005
[2] Proposal for a Decision Of The European Parliament And Of The Council Concerning the seventh framework programme of the European Community for research, technological development and demonstration activities (2007 to 2013) Proposal for a Council Decision Concerning the seventh framework programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities (2007 to 2011) Building The Europe Of Knowledge (presented by the Commission), April 2005 COM (2005) 119 final
[3] Key Tasks for Future European Energy R&D: A first set of recommendations for research and development by the advisory Group on Energy: Directorate-General for Research Sustainable Energy Systems: EUR 21352, 2005
[4]Proposal for a COUNCIL DECISION Concerning the Specific Programme "Cooperation" implementing the Seventh Framework Programme (2007-13) of the European Community for research, technological development and demonstration activities (presented by the Commission), September 2005. page 47.

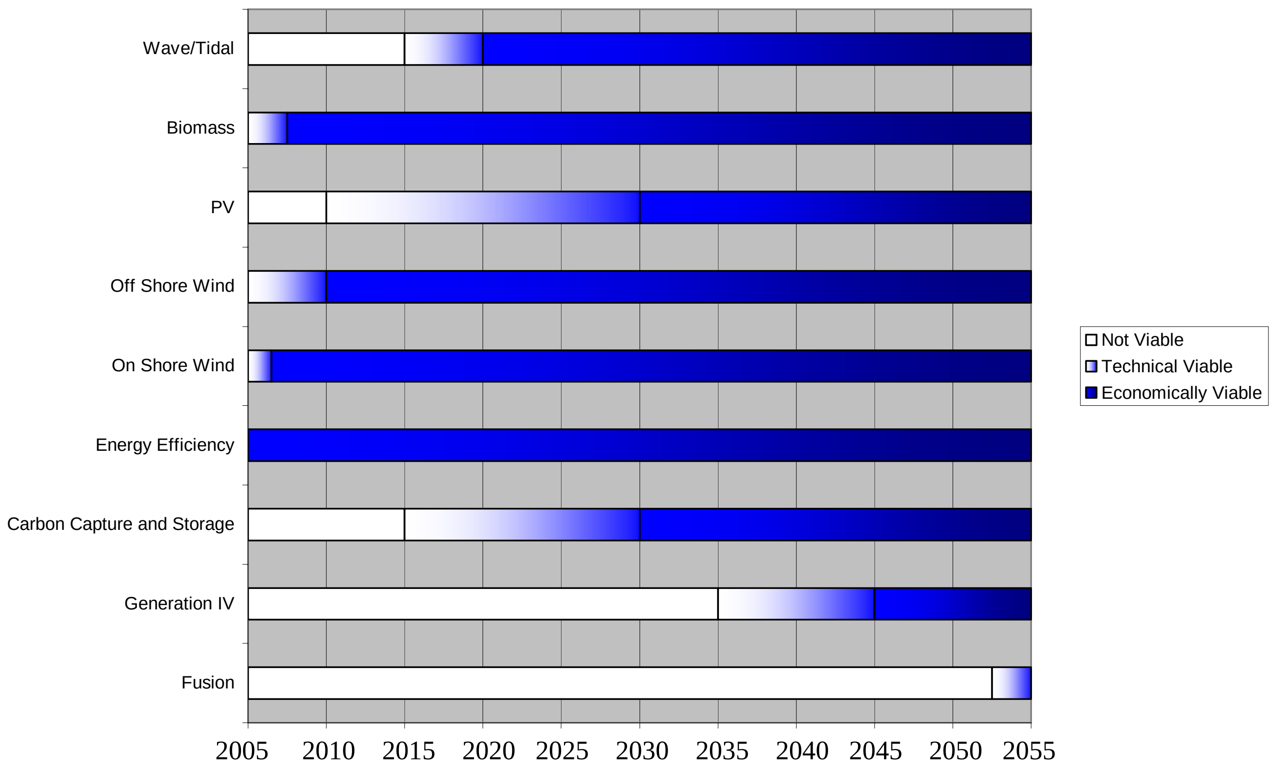
Given the enormity of this objective and the decline in prioritisation for energy research and development it is essential that the relatively limited funds are allocated correctly. To enable this to happen different energy technologies that meet appropriate criteria must be identified, developed and deployed.

In April 2005 the Commission published its broad proposals for the FP7. The final funding of FP7 is still to be determined which will depend on the approval of the whole Financial Perspectives budget which is expected by spring 2006. The April 2005 proposal gave details of the expected budgets for particular research areas, but did not suggest more detailed allocations. This will be determined later in 2005 or 2006. In order to determine the correct prioritisation of the energy and nuclear programmes a number of key criteria to evaluate the different energy options must be introduced.

Timing of new Technologies:

New energy production, transmission and use technologies are continually being developed. These are at varying stages of readiness to enter the market, some can be introduced within years, others are decades away from commercial exploitation. The EU's energy sector is currently under increasing pressures from a variety of factors in particular for security of supply and environmental reasons. Therefore, technologies should be prioritised that can meet these short to medium term concerns. The graphic below highlights the expected commercialisation dates of the different energy technologies proposed within FP7.

Figure 1: Expected Viability of Carbon Abatement Technologies in the 7th Framework Programme



Source: Matthes[5]

[5] Felix Matthes, Oko Institute, Berlin, based on information given to the Enquette Commission for the Germany Parliament "Sustainable Energy Supply in the Background of Globalisation and Liberalisation", 2000.

Security of Supply:

Energy demand in a business a usual scenario is forecast by the European Commission to increase in the coming decades at a rate of 0.6% per year (2000-2030). During this period output from the EU's domestic reserves of oil and gas will decline significantly; and as a consequence of inaction the import dependency on oil would increase from 75% in 2005 to 90% in 2030, with natural gas showing an increase from 50% to 70% over the same period.

The increasing reliance of imported energy makes the EU more vulnerable to changes in the global price of energy as well as the security of supply. In the past the price of oil has fluctuated as international events have impacted upon the actual or perception of oil supply. However, it has widely been noted that the age of cheap oil is coming to an end. Even Chevron, the US's second-largest energy group has stated in recent advertising '*One thing is clear: The era of easy oil is over*[6]'. Chevron, further points out in a TV commercial that '*The world consumes two barrels of oil for every barrel discovered*[7]'. This rising demand, in particularly fuelled by existing consumption in the North and growing consumption in China and India, is expected to result in a new era of high oil prices.

Among geologists an intense debate on the so-called 'oil peak' has begun. The peak theory is based on the presumption that at a certain date in the future the demand for oil will outstrip production. When this happens the price of oil will rocket with dramatic consequences on the world economy. While so called pessimists like Colin Campbell of the Association for the Study of Peak Oil, claim that this could happen as early as 2008, the more optimistic geologists from the big oil companies maintain that it will not happen before 2025. Even if the truth lies somewhere in the middle, an oil peak around 2015 is such a threatening possibility that politicians must act now[8].

A key criteria to assess the importance of new technologies must be their ability to reduce oil dependency significantly before 2020.

Meeting the Lisbon Agenda

During 2005 the price of oil has increased substantially from around $25 dollars a barrel in 2002 to over $60 in early October 2005. As the prices of gas and oil are linked a similar increase in the price of natural gas has been experienced. Given that these two energy sources provide over 60% of the EU's primary energy these price increases have a significant impact on the EU's economy. Reducing dependency on these fuels aids the development of an economically secure and competitive EU.

Negative Impact of High Oil Prices:

The International Energy Agency (IEA) estimates that every 10% increase in the price of oil causes a loss of 0.5% of global GDP (approximately €255bn). The price of oil has risen more than 50% in the last year alone – with alarming new rises in the last month. A study from the University of Sussex in the UK states in its abstract[9]:

"*The empirical evidence from a growing body of academic literature clearly suggests that oil price increases and volatility dampen macroeconomic growth by raising inflation and unemployment and by depressing the value of financial and other assets."*

---

[6] Big Oil Warns of coming energy crunch, Financial Times, 4th August 2005 by Carola Hoyos

[7] http://www.chevron.com/about/advertising/docs/2_barrels_transcript_en.pdf

[8] Reducing Europe's dependency on oil: A contribution to the jobs, innovation and sustainability challenge Claude Turmes, Rebecca Harms and Michael Cramer Greens/EFA MEP for Luxembourg and Germany, July 2005

[9] ibid

Impact on job creation:

The 7th Framework programme is expected to create jobs in initial research with 220 000 new research posts expected to be created, (up from 70 000 in FP6)[10]. However, the technologies developed are also expected to create further significant employment opportunities within the EU, both in the production of energy and through the export of technology. Further technologies must be assessed as to whether they can be rapidly replicated and to contribute to the creation of job in Europe, both for domestic production and export before 2020.

Relevance for Small and Medium Enterprises (SMEs):

The importance of SMEs to Europe's economy is stressed by Commission President Barroso, *"Europe's small and medium-sized businesses are the life blood of the European economy. I believe they must be allowed to play their role as a powerhouse for growth, innovation and new jobs as we shape the Europe's reform agenda[11]."* This is recognised within the Commission's FP7 proposal as it states, *"the participation of SMEs will be optimised across the specific programmes[12]"* and "*Small and medium-sized enterprises are a tremendous source of innovation and growth potential for the future. The Seventh Framework Programme seeks to make the most of this potential by proposing measures to increase the participation of SMEs in research projects, and to develop systems for their increased access to research results[13]".*

<u>Sustainability</u>

There are two over-riding environmental issues relating to the energy sector, firstly climate change and how to reduce greenhouse gas emissions and secondly how to reduce current and future environmental damage resulting from the use of nuclear technology.

Climate Change:

The EU has defined and confirmed on a number of occasions, an indicative long-term global temperature target of not more than 2 °C above pre-industrial levels.[14] In order to achieve this, the world will have to reduce emissions far more substantially than the 8% by 2008-2012 mandated (for the EU) by the Kyoto Protocol.

This is an extremely ambitious but absolutely necessary objective. To achieve this target the concentrations of CO_2 in the atmosphere must stabilise at about 400 parts per million in the atmosphere in the longer term. The graphic below highlights the implications of delaying reducing CO_2 cuts, as a delay of ten years will require a 31% cut in CO_2 emissions in 2025, while if action is taken now only a 14% cut will be needed.

---

[10] What the Seventh Framework Programme means for Europe, European Commission Press Release 21st September 2005.Http://europa.eu.int/rapid/pressReleasesAction.do?reference=MEMO/05/336&format=HTML&aged=0&language=en&guiLanguage=en

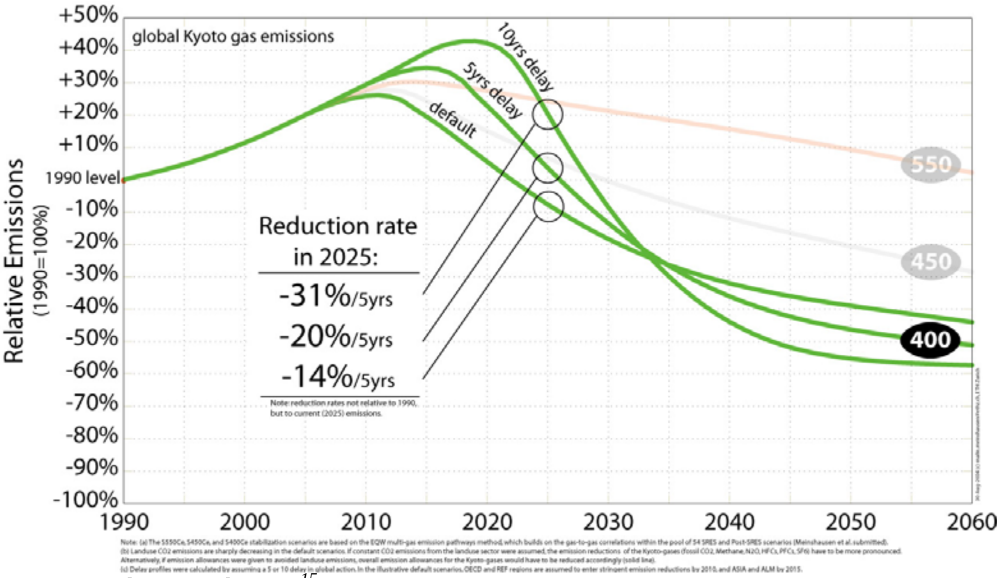
[11] The Future of the Lisbon Strategy – Committing Europe for Growth Conference on Nov 25th 2004, European Parliament, http://www.sme-union.org/

[12] Proposal for a COUNCIL DECISION Concerning the Specific Programme "Cooperation" implementing the Seventh Framework Programme (2007-13) of the European Community for research, technological development and demonstration activities (presented by the Commission), September 2005. page 5.

[13] What the Seventh Framework Programme means for Europe, European Commission Press Release 21st September 2005.Http://europa.eu.int/rapid/pressReleasesAction.do?reference=MEMO/05/336&format=HTML&aged=0&language=en&guiLanguage=en

[14] Spring European Council 2004, 25-26 March 2004) (Doc 7631/04 (ANNEX), page 29

Figure 2: Implications of Delays in Reductions of CO2



Source: Malte Meinshausen[15]

As a consequence priority must be given to technologies that can deliver CO2 reductions on the short term, 2015-2025.

Creating New Risks:

It is essential that new technologies that are developed are not expected or likely to lead to further environmental risks One clear example is that of nuclear power, proponents of which suggest that its role in the energy sector must be expanded in a carbon constrained world, as nuclear power does not emit CO2 during electricity production. However, this fails to adequately consider the environmental cost associated with nuclear exploitation, in particular through uranium mining, nuclear waste disposal and decommissioning, and the ongoing dangers of nuclear proliferation. The increasing concerns on terrorist attacks on nuclear facilities or using nuclear materials has created further problems for the nuclear sector. Finally, the environmental, societal and economic cost of a nuclear accident can be disastrous across a whole region, as occurred as a result of the Chernobyl accident in 1986.

<u>Added Value of Public Research</u>

As noted it is proposed that energy technologies will receive relatively less funds (compared to other sectors) in FP7 than ever before.   A report released by Merrill Lynch in July 2005 (before oil prices reached $60 per barrel) suggested that the profits for the 70 largest companies in the oil sector was expected to rise 26% this year to $230 billion, with sales of $2.57 trillion, up nearly 10%. The 70 companies are expected to return about $110 billion to shareholders this year through dividends and share buybacks[16]. In comparison, the European renewable energy sector as a whole has annual sales of €15 billion.

[15] On the Risk of Overshoot – 2 degrees; Malte Meinshausen, Swiss Technical University, Presented at, Avoiding Dangerous Climate Change, 1-3rd February 2005, Exeter, Met Office, UK. http://www.stabilisation2005.com/programme2.html

[16] High Energy Prices Drive Earnings, But Some See Turn in 2006 By Bhushan Bahree Staff Reporter, The Wall Street Journal July 26, 2005

The traditional energy industries, coal, gas, nuclear and oil, in particular at the current time, are enjoying unprecedented high prices and can and should pay for their own research and development. An objective of the public sector research and development must be to allocate funding to new technologies that are not already supported by large and profitable companies.

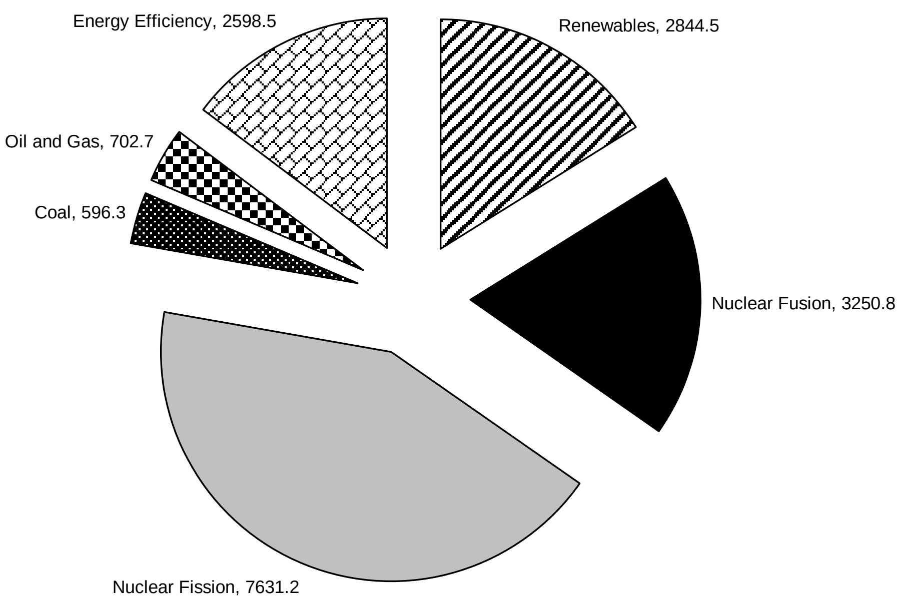
Historical Performance

Similarly, technologies that have already received vast research and development grants should not continue to receive funding at the expense of other emerging technologies. Nuclear technology has historically received the majority of all energy related research and development, both on the Member State level and with the EU's funding programme.

The European Commission has estimated that between 1974 and 1998 Member States granted approximately $55 billion in research and development assistance for nuclear technology alone from their national budgets[17]. Furthermore, *The Economist* estimates that "more than half" the energy subsidies every granted by the OECD have gone to nuclear technology[18].

The research expenditure by Member States is shown in the graph below. Nuclear fission and fusion continue to receive the largest share of funding, with the two options receiving three times more than all renewable research and development funds together over the last decade.

Figure 3: IEA-Europe States' Energy Research and Development Budgets 1992-2002[19]

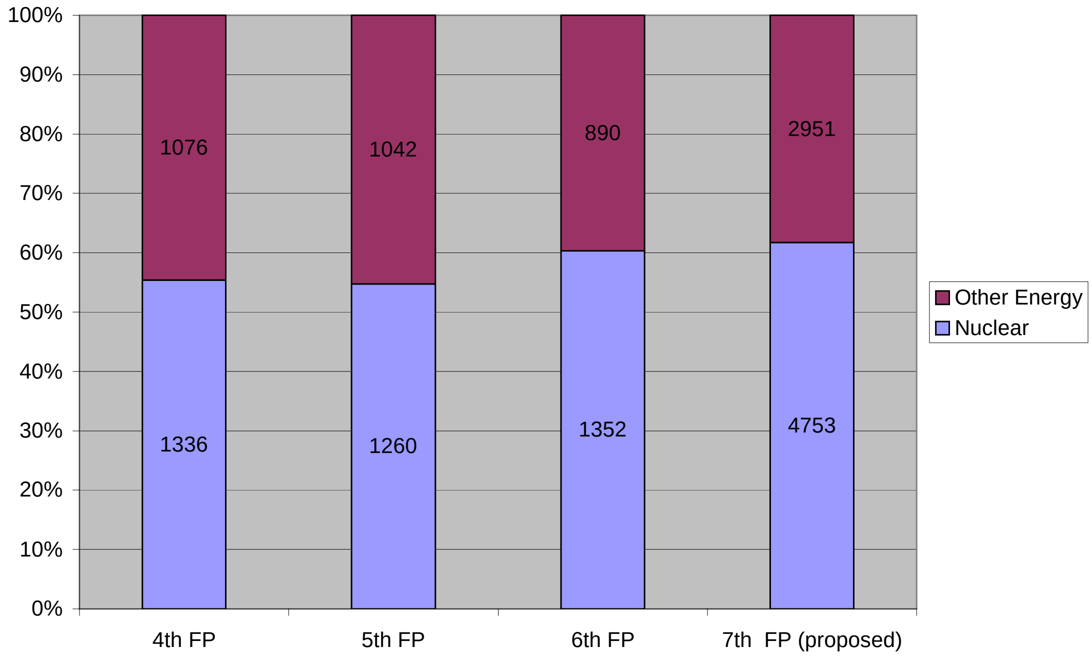


[17] European Commission Staff Working Paper, December 2002, *Inventory Of Public Aid Granted To Different Energy Sources*. http://europa.eu.int/comm/dgs/energy_transport/state_aid/energy_en.htm, page 94
[18] Nuclear Power, Out of Chernobyl's Shadow, The Economist, May 6th 2004
[19] This includes: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, UK

Source: *IEA 2004*[20]

This bias towards nuclear power is reflected in the historic and proposed FP budgets. The graphic below shows the historic and proposed imbalance of energy sector R&D. Nuclear technology - fusion and fission-, despite only currently covering 13% of the EU's commercial primary energy consumption receives 61% of energy R&D funding.

Figure 4: Comparison of Energy and Nuclear Research and Development Budgets



Source: Cordis[21] *and European Commission*[22] *NOTE*[23]

Future research and development funding must take into consideration historical expenditure and its impact on the development of technologies. This must ensure that additional funds are not allocated to established programme purely for institutional reasons, but rather scare resources are made available to technologies that meet the relevant scientific criteria.

[20] International Energy Agency: December 2004: Energy Policies of IEA Countries, Special 30th Anniversary Edition, Annex B10:
[21] *http://www.cordis.lu/en/home.html*
[22] *COM (2005)119 final*
[23] *The Euratom Programme budget is officially for the years 2007-11, this is €3101 million, however, the proposal also contains a provisional budget for 2007-13, of €4753*

Proposed Areas of Funding and Budget

The Commission is proposing the following **nine** research priorities in the energy field under the general FP and **three** in the nuclear field under the Euratom FP. For historical reasons all nuclear research is undertaken through a separate framework programme. This separates nuclear from all other energy sources and is one of the reasons why nuclear power continues to receive such relatively high resource allocations.

Energy

Hydrogen and fuel cells

A number of analysts from State, industry, energy companies and NGOs believe that hydrogen will or shall play a major role in the energy systems of many countries in coming decades. However, the concepts involved are subject to broad disagreement. A key question involved is the method to produce hydrogen. Hydrogen is not an energy *source* it is an energy *carrier*.

In order to evaluate the potential for hydrogen in the energy sector in an intelligent way, just as in the case of electricity, one has to pay attention to generation and distribution schemes and technologies. Just as electricity, it is not good or bad, it has numerous possible useful applications and its level of benefit to society depends on how it is generated, stored and shipped.

Positive visions are fundamental for the development of society. However, technological dreams have always their price, which should be submitted to careful review by the society.

Hydrogen can be generated in two ways by gas reforming or by electrolysis. Gas reforming, which generates hydrogen from biomass, ethanol, methane – which in turn can come from natural gas or from biomass (steam reforming) has an energy efficiency ratio of 30%. While electrolysis, the splitting off the oxygen molecule (O) from water (H2O), is much less efficient, with a conversion ratio of only 12-15%[24].

Future energy systems must be driven by the intelligent exploitation of energy efficiency and conservation potentials to cover the society's energy service needs. Energy generation, with high priority, shall be based on decentralised renewable energy sources that, in most cases, provide a win-win scenario for societal cost and benefit. The selection of the appropriate renewable energy technology is as much depending on local and regional conditions as on the availability and performance of a given system.

In the context of the potentials of a future hydrogen economy, this means that the evaluation of global system performance is fundamental. One of the most promising uses of hydrogen is in the transport sector that remains the most dependent on oil and generates an ever increasing share of greenhouse gas emissions. However there is a great deal of difference between various systems when it comes to fuel chain and vehicle efficiency that make up the largest share of the overall system. Efficiency ratios can vary by a factor of three, which has, of course a significant impact on overall system performance.

Research and development in the hydrogen sector is important but should be concentrated on comparative system analysis, renewable energy based technology development and a clear prioritising of steam reforming systems that promise the highest overall efficiency. Interdisciplinary

[24] Making the EU the Most Energy Efficient Economy in the World, Claude Turmes MEP, Presented at the Sustainable Energy Forum, Amsterdam, October 2005. http://www.senternovem.nl/AmsterdamForum/

research approaches that take into account the better integration of new technology into global change – for example, solutions to the transport problems are inseparable from the challenges of radical urbanism reform – shall be developed and receive significant support under EU funding.

There is a great danger that research funds labelled "hydrogen" will be in fact used for nuclear and fossil fuel research. The Greens/EFA group is in favour of a clear distinction of funding that goes to non-renewable energy sources. The Greens/EFA is in favour of a clear distinction of funding that goes to non-renewable energy sources.

Renewable Energy.

"*Several renewable energy technologies that could make a big contribution by 2020 need more research and development*"[25].

There are three separate renewable energy sections within the European Commission's proposal for FP7, these are for electricity generation, fuel production and heating and cooling. Each of the final end uses requires different, although often compatible, renewable energy sources and/or systems.

The 21st century will be the renewable energy century. 21 different renewable energies will play an ever-increasing role in the next decades. Their advantages for reducing environmental and health impacts for society, their contribution to reduce the dependency on and conflicts for highly volatile oil, job creation and local economic added value potential are recognised, however, what is often forgotten is the diversity of their use.
- Heating and cooling like passive solar architecture, biomass or geothermal based biogas co- or trigeneration, solar thermal collectors for heat.
- Electricity from solar PV, solar thermal electricity, hydro, geothermal, on and off-shore wind, marine energies like sea current, wave, tidal and osmosis energy to
- Transport fuels like bio-ethanol, bio-methanol, rapeseed, biomass based synthetic fuels and green hydrogen.

In an energy intelligent world, renewable energies will cover 80% or more of all energy needs before the end of this century.

Despite the potentials that renewable energies have they not all are being introduced as quickly as they can and should be. Since 1997 the EU has had an indicative target that by 2010 12% of energy should come from renewable energy sources, up from 5.2% in 1995. To help achieve this goal two sectorial targets have been introduced for the same deadline:

- Electricity: That 22% of the electricity should be generated from renewable energy sources, up from 14% in 2000.
- Biofuels: That there should be an increase from 0.6% of biofuels from renewables in 2000 to 5.75%.

In 2004 the Commission published a Communication on renewable energy which documented the progress made by Member States in meeting their renewable energy targets[26]. Overall, the Commission concluded that on the basis of current trends only 18-19% of electricity would come

[25] EU Communication on Renewable Energy, section 4.3.5

[26] Communication From The Commission To The Council And The European Parliament The share of renewable energy in the EU Commission Report in accordance with Article 3 of Directive 2001/77/EC, evaluation of the effect of legislative instruments and other Community policies on the development of the contribution of renewable energy sources in the EU and proposals for concrete actions, April 2004.

from renewable sources by 2010. The report highlighted the fact that some technologies, in particular wind energy, was forecast to more than meet the targets envisaged in 2000, of 40 GW of installed capacity by 2010 and was on track to have 75GW. However, other areas, in particular energy from biomass had so far failed to meet expectations.

Whether or not the existing targets will be met will depend on the right mix of policy instruments efficiently applied at the relevant levels, EU, national, regional and local. However, it is clear that research and development funds play a vital role in enabling new technologies to be introduced. There has been recognition that the traditional energy sources, oil, gas, coal and nuclear have all historically benefited from substantial research grants. As the Bonn International Renewables Conference's political declaration notes *"Ministers and Government Representatives emphasize the need for additional targeted research and development"*.

Renewable energy technologies match the criteria for energy lending. As they do not result in the emission of CO2 and do not create significant additional environmental risks. Equally important, is that they do not rely on imported energy and thus increase the EU's security of supply. However, as important is the timescale in which they can be introduced. Some technologies, are already technically viable and in some conditions economically viable, such as wind power. Other technologies require additional technical research to increase their efficiency and reliability, which with the correct level of funding can bring them to commercial realisation within a decade or so.

Renewable energies meet many of the criteria for assessing the prioritisation of limited public research and development funds. They can contribute to both security of supply and environmental objectives. Furthermore, they create local and regional employment in particular for small and medium enterprises. Despite this however, historically renewable energies have not received significant research and development funding. It is estimated that on average in FP 4-6 renewable energy received approximately €100 million per year[27], less than one fifth of the total energy and nuclear research and development budget.

It is therefore essential that additional funds be made available to renewable energy within the 7th FP. At minimum energy efficiency and renewables must receive the majority of all energy and nuclear research and development funds.

<u>CO2 capture and storage technologies for zero emission power generation</u>

Since the FP5, the EU has been supporting the development of technologies that are designed to enable the CO2 emissions from power stations to be captured and stored, to enable the continuation of the fossil fuel economy, in particular the coal sector.

The Commission believes that carbon capture and storage (CCS) should be a priority within the energy programme of the FP7. If CCS is undertaken it will apply to large stationary sources such as power stations, where CO2 can be separated from the flue gases and then stored, in redundant coal mines or oil wells. This storage must last at least a few hundred years –beyond the fossil fuel era – to delay the release of CO2 and thus reduce the immediate impact of climate change.

If this new prioritisation is reflected in the budgets, then it might be expected a significant increase over previous programmes, where in the FP5 the technology received €16 million and €37 million in the FP6.

[27] FP7 Priorities for the Renewable Energy Sector 1 March 2005 Prof. Arthouros Zervos President EREC; EUREC Agency & EREC (European Renewable Energy Research and Industry)

There are a number of major concerns and barriers to the widespread introduction of CCS that will need to be overcome prior to its widespread introduction, these include:

Environmental Risks: The storage of CO2 must be guaranteed for at minimum hundreds of years. There must be a zero risk of release of the vast quantities of CO2 that would need to be stored, if this is to be a viable mechanism for alleviating Climate Change. The danger of accidental or deliberate breaching of CO2 storage facilities and the irreversible consequences of the release of CO2 will make the engineering and security barriers hugely and potentially prohibitively expensive.

Timetable: There is an urgent need to address the problem of climate change. Therefore significant investment into technologies that may or may not be viable and economic some decades from now, at the expense of technologies that are closer to viability cannot be justified. Furthermore, if there is a belief that carbon storage is a viable option some decades from now, it will give justification to the continued operation and expansion of the coal and other fossil electricity generators, even before carbon storage is viable. This will therefore, at least in the next decades when action must be taken, result in an increase of C02 emissions.

Creating a Sustainable Energy Sector: There is an urgent need to create a global sustainable energy sector. It has been shown that this can be achieved using only energy efficiency and renewable energy technologies. Carbon storage may be a technology that is viable, but it is impossible that it will be practical in all geographical, geological, political and economic conditions. The public funding of the development of carbon storage technologies will take away valuable resources from technologies that do create a global sustainable energy sectors, i.e. energy efficiency and renewables.

Carbon Capture and Storage (CCS) are technologies, which support the continuation of large scale and centralised energy systems. Similar to nuclear fusion, it is untried, has significant negative potential environmental consequences and is unlikely to be economic compared to other already available carbon free technologies. Due to this, significant public funding, and in particular through the Framework Programme should not be made available.

Clean coal technologies

The coal sector has and continues to receive huge energy subsidies. Over the last decade four 'old' Member States (France, Germany, Spain and UK) granted approximately €70 billion in aid to their industry for both production subsidies and to help phase out the industry[28]. It cost EU tax-payers an average of €40 000 per worker per year between 1998-2000.[29] In Germany alone around €120 billion was given to the coal sector between 1970 and 2003[30]. The enlargement of the European Union has lead to additional State Aid claims for the coal sector with four new Members granting aid to the coal sector, and in particular Poland that granted €3.8 billion in 2003[31].

In addition to state aid from Member States, the EU awards grants through a programme that remains from the now abandoned European Coal and Steel Community (ECSC) Treaty. The fund took over the remaining financial resources of the ECSC – an estimated €1.3 billion – and will use the interest

[28] European Commission. 2002. Report from the Commission on the application of the Community Rules from State Aid to the Coal industry in 2001: Recent State Aid Decisions and Press Releases: http://europa.eu.int/comm/energy/en/state-aid1.html
[29] http://europa.eu.int/comm/competition/state_aid/scoreboard/statistics/s13.html
[30] Material provided by the Oko-Institute in Germany. (Personal communication between Martin Cames and BMWA (Bundesministerium für Wirtschaft und Arbeit (Ministry for Economic Affairs and Employment)), March 2004.
[31] http://europa.eu.int/comm/competition/state_aid/scoreboard/statistics/s1_poland.html

gathered for further developing the coal and steel industries. €60 million was allocated in both 2003 and 2004 for these activities, of which €17 million was allocated to coal each year[32].

Clean Coal Technologies (CCTs) are being developed to reduce emissions, in particular NOx and other flue gases, both through thermal efficiency improvements and thus less coal being utilized, and by cleaning the flue gases after combustion. A number of mechanisms are already established and current deployed, this includes:

- pulverised coal combustion (PCC) with subcritical steam driving a steam turbine, with various levels of flue gas cleaning to meet local requirements;
- cyclone fired wet bottom boilers with subcritical steam driving a steam turbine, again with various levels of flue gas cleaning to meet local requirements;
- stoker boilers for small applications, with subcritical steam, possibly using a low sulphur content coal.

While other technologies are currently under development, this includes:

- Pressurized fluidized bed combustion (PFBC) currently uses bubbling bed boilers, in combined cycle with both a gas and steam turbine. Sorbent injection is used for SO_2 reduction and particulates removal from flue gases;
- Integrated gasification combined cycle (IGCC), using different types of gasifier, and in combined cycle with both a gas and steam turbine. The syngas stream is cleaned of hydrogen sulfide and particulates, before combustion and expansion of the combustion products through the turbine. Various levels of integration are used;
- Combined heat and power (CHP) applications where the (subcritical) steam turbine is designed to produce both power and useful heat for process or district heating/cooling.

The coal sector has received and continues to receive vast government support, in particular on the EU level through the European Coal and Steel funds. Furthermore, the industry is established with a large turnover and profits. Consequently, the use of EU research and development funds is not appropriate, in particular as, despite some environmental improvements, coal stations, continue to be a major source of CO_2 emissions.

<u>Smart energy networks</u>

The development of smart energy networks is essential. The current energy sector is based on large centralised energy sources, rather than a mix of appropriate sources, where generation and consumption are matched geographically as close as possible to reduce transmission losses and improve security of supply.

The International Energy Agency has developed global investment scenarios. These include a scenario which results in significantly lower CO_2 emissions and improved security of supply. The main driving force of the scenario is an increase in energy efficiency and renewable energy. The resultant energy system has much lower energy demand and an increase in distributed generation – electricity production that is connected directly to the distribution grid. In this scenario the level of investment in the transmission grid is reduced by 40%, within the EU the IEA forecast would result in an investment savings of $40 billion, between 2001-2030[33].

---

[32] European Commission: 19th June 2003. *Expiry of the European Coal and Steel Community (ECSC) Treaty: an Overview: Memo:*
[33] World Energy Investment Outlook 2003, International Energy Agency, table 7.4, page 353.

Re-orientating the energy sector to facilitate the introduction of a sustainable energy sector is fundamental. The use of research and development funds into smart energy networks should therefore be given priority.

Energy efficiency and savings

Across the European Union there is an urgent need to increase energy efficiency and energy saving. This can be done across all sectors with existing technology. The energy efficiency potential is even greater in new Member States where energy has and is used far less efficiently. In relation to unit of GDP, despite significant improvements in the last decade, new Members use around three times as much energy as old Members[34]. As new Member States are increasing their energy prices to match that of the EU, the economic benefits of efficiency gains will increase. Despite even by 2030, based on current policies, the difference in energy intensity is still expected to be around double. Therefore as a priority, investments in energy efficiency and energy saving measures must be made in new Member States.

Further funding into implementation mechanisms and the development of new technologies will both increase the economic and technical potential for energy efficiency and speed up its introduction. The European Commission has already noted in its draft Directive on End Use Efficiency and Energy Services that 20% of consumption is higher than economically justified and thus can be saved at little cost or even with cost savings[35].

Energy efficiency improvements have been recognised by the European Commission as the 'priority of priorities'. Despite this the EU has proposed an unambitious target of only a 1% increase in energy efficiency per year between 2006-12 in the aforementioned Directive. This will clearly fail to counter the increase in demand predicted by the IEA and fail to seriously address climate and security of supply concerns.

Projects under this sub-topic are expected to be new concepts and technologies to improve energy efficiency and savings for buildings, services and industry. This includes the integration of strategies and technologies for energy efficiency, the use of new and renewable energy technologies and energy demand management.

One key example is the forgotten social sciences. As a recent analysis indicates, *"research questions focus on how information can be supplied in complex policy contexts that allow persons to assess the social significance of their individual actions, effectively consider their policy and market options, alter their choices in concert with the actions of other individuals and organizational actors, and participate effectively in both markets and public-sector decision-making processes. This applied research often involves the development and evaluation of policy innovations; policies are typically designed by focusing on a single tool, such as regulation or financial incentives, whereas these policies involve the coordination of tools."*[36]

[34] The Impact Of Structural Changes In The Energy Sector Of CEE Countries On The Creation Of A Sustainable Energy Path - Special focus on investment in environmentally friendly energy and the impact of such a sustainable energy path on employment and access conditions for low income consumers (Project No IV/2002/07/03) Report for European Parliament's DG Research Project coordinator: Diana Ürge-Vorsatz Further authors: Lutz Mez, Gergana Miladinova, Alexios Antypas, Martin Bursik, Andrzej Baniak, Judit Jánossy, Jan Beranek, Diana Nezamoutinova, György Drucker December 2003

[35] Proposal For A Directive Of The European Parliament And Of The Council On Energy End-Use Efficiency And Energy Services (Presented By The Commission) Brussels, 10.12.2003 COM(2003) 739 Final

[36] Decision Making for the Environment: Social and Behavioral Science Research Priorities, Committee on the Human Dimensions of Global Change (HDGC), Center for Economic, Governance, and International Studies (CEGIS), 2005

Energy efficiency is essential for the EU to meet its climate and environmental commitments, to improve economic competitiveness and to reduce dependency on imported energy. While many energy efficiency improvements can be made using existing technologies further improvements can only come about through additional research and development projects. Energy efficiency has been described by the European Commission as "the priority of priorities", this must be reflected appropriately in the 7th Framework Programme.

Knowledge for energy policy making

The budget item will be used to develop tools, methods and models to assess the main economic and social issues related to energy technologies and to provide quantifiable targets and scenarios for medium and long term horizons.

It is essential that scenarios are developed that look at all aspects of energy production, transmission and use. Fundamental to this will be the environmental impact and this must be included in future scenario work.

Nuclear

The proposed budget for nuclear research and development is contained in separate legislation to which the European Parliament does not have co-decision with the final decision resting with the European Council of Ministers. The budgets for the past FP and that proposed for FP7 is outlined in the table below.

Table 2: Breakdown of Euratom Framework Programme (in million €)

	4th	**5th**	**6th**	**7th**		
				2007-11 (proposed)	2011-13 (estimate)[37]	Total (estimate)
JRC	441	331	319	541	241	782
Fission		142	209	395	211	607
Fusion	895	788	824	2167	1197	3364
Total	1336	1260	1352	3103		4753

Source: Cordis[38] and European Commission[39]

As can be seen fusion research is set to receive a considerable boost in its funding, an increase from roughly €200 million per year over the years 1995-2006 but rising to €600 million per year at the end of the 7th FP. This is to pay for the EU's contribution to the ITER which is to be located in France.

Fusion Energy Research

Nuclear fusion is perhaps the most astonishing example of politicians' faith in technology. Over a period of nearly 50 years billions of dollars have been spent on research into a supposedly miraculous energy source without a single kWh yet being produced. It might all be just another farce in a long list of technology disasters were it not for the quite extraordinary sums of money that have been spent: in the ten years from 1991 to 2001 alone, OECD countries spent US$ 9.2 billion on research into nuclear fusion, over US$ 2 billion more than on all renewable energy sources together.

---

[37] The additional year allocations have been calculated for fission and fusion using the same ratio as adopted in the previous period.
[38] http://www.cordis.lu/en/home.html
[39] COM (2005)119 final

As has been noted, the overall percentage of funding for energy within the FP have decreased over time, but despite this by the end of 7th FP fusion R&D it is forecast to receive around €600 million per year. This represents more than 50% of the total of the combined energy and nuclear R&D budgets. This is showing remarkable faith in one particular technology, which has yet to be shown technically viable never mind environmentally or economically acceptable. The current expected cost of constructing and operating the demonstration fusion reactor is around €10 billion, however, this figure can be little more than an estimate as past experience suggests that costs of highly technical and first of a kind projects are likely to significantly increase. Furthermore, it must be emphasised that if the 7th FP does invest in the ITER, this is expected to be a long term commitment as the programme is projected to operate for around 40 years.

The Commission proposal states on fusion, *'fusion has the potential to make a major contribution to the realisation of a sustainable and secure supply for the EU <u>in a few decades from now</u>[40].'* The Commissioner for Research, Janez Potocnik, said in May 2005, that he thought fusion would be technologically viable in 30 years[41]. However, this is an optimistic view of commercialisation of fusion and even other Commission publications call fusion a '*long term energy option'*, which will not be commercial until the 2nd half of the 21st Century[42]. Furthermore, the EURATOM Scientific and Technical Committee recently stated it would take twenty years before it could be determined whether fusion is a viable option for electricity supply in the 21st century at all[43]. Fusion energy is often referred to as the energy source that is perpetually 50 years from commercialisation.

Given the technological status of fusion development, it is impossible to estimate the economics of any future fusion programme. It has been noted that the direct cost of fusion electricity may be at the high end of the estimated range for other technologies such as fission, fossil fuels, largely due to the high capital investment costs for fusion plants[44].

Although fusion power is said to be more proliferation and accident resistant than the current generation of fission reactors, these problems have not been removed. In addition, nuclear waste will remain an issue, with fusion reactors likely to create a greater amount of waste as a comparably sized fission reactor. Compared to a fission reactor, the fusion inventory is generally less toxic and shorter-lived because it consists of tritium and activation products, and contains no fission products and actinides. However, there are activation products with half-lives in the order of millions of years[45].

The ITER Consortium puts the direct construction costs at US$ 2.755 billion, which is 49% of the direct capital cost.[46] That would bring the total investment to around US$ 5.6 billion. The construction time is reported to be around 10 years.

As far as operating costs are concerned, the ITER Consortium has this to say:[47]

'The annual costs of operating ITER are estimated to be, on average, on the order of $188 M (54% of the 1998 ITER design operating costs), to be shared among the participating Parties, and totalling

---

[40] COM (20005) 119, Annex 1.
[41] Janez Potocnik, Commissioner for Research, Key Note Speech, at the What Science, What Europe, Conference, Green/EFA conference, 2/3 May 2005.
[42] Energy from Fusion, European Commission, Community Research, 19315
[43] Scientific and Technical Committee EURATOM: The Energy Challenge of the 21st Century: The role of nuclear energy; European Commission, Community Research, EUR 20634 EN, Brussels, 2003
[44] Information by the EFDA leader, "Socio-economic aspects of fusion power" , EFDA Report, 2001, cited in Post Note: Nuclear Fusion, UK Parliamentary Office of Science and Technology, January 2003, No 192.
[45] Nuclear Reactor Hazards. Ongoing Dangers of Operating Nuclear Technology in the 21st Century, Greenpeace International April 2005.
[46] http://www.iter.org/cost.htm
[47] ibid.

$3760 M over 20 years. These estimated costs include personnel costs (~32%), energy and tritium fuel costs (~20%), and capital improvements, spare parts and materials, and waste management operations (48%).'

A report on nuclear fusion by the Bundestag Committee on Education, Research and Technology Assessment[48] states: *'According to current estimates a total of € 60 to 80 billion would still have to be spent over a period of 50 years on research and development – of which € 20 to 30 billion in the EU – before it will possible to produce power from nuclear fusion.'*

Funding for the Fusion programme should be cut. In the next ten to twenty years it is essential that a variety of CO2 neutral technologies are introduced. Fusion, at best, may be technically viable in 30 years and cannot therefore contribute to meeting these short-term targets. The huge budgetary allocation to fusion research cannot be justified.

<u>Nuclear Fission and Radiation Protection</u>

The nuclear sector has been in commercial operation of over fifty years and thus it cannot be described as an infant technology. All through its existence nuclear power has had priority status over other energy sources for Government support. Half of the EU Member States do not operate nuclear power plants, two have nuclear phase-out legislation in place and one alone, France, generates 45% of all nuclear electricity in the EU.

The nuclear utilities in Europe generate tens of billions of Euro in revenue each year. Under the laws within each Member State a percentage of which is supposed to be put aside for the disposal of radioactive waste. These funds should eventually contain hundreds of billions of Euro. The framework programme at most will contribute tens of million of Euro and thus the contribution that the EU funds make to this process can only be minimal. Therefore it is not an appropriate use of limited funds.

Regarding the development of a new generation of reactors – the so-called Generation IV reactors - at best these will be commercially available twenty years from now and thus cannot play a role in reducing greenhouse gases when most needed - in the next few years.

No EU research and development funds should be allocated for the disposal of radioactive waste or for the research into the next generation of reactors.

<u>Nuclear Activities of the Joint Research Centre</u>

The current explanation of the nuclear activities of the JRC are to 'provide customer driven scientific and technical support to the EU policy making process in the nuclear field, ensuring support to the implementation and monitoring of existing policies while flexibly responding to new policy demands'. For the next seven years this has a provisional budget allocation of €782 million. Once again nuclear waste and the development of the new reactor systems are given prominence within the JRC funding priorities. However, these areas should already by funded by the nuclear utilities, part of whose revenue's are earmarked for such activities.

[48] Deutscher Bundestag Drucksache 14/8959, Report by the Committee on Education, Research and Technology Assessment, 'Monitoring Nuclear Fusion' 2.5.2002, http://www.bundestag.de/parlament/gremien15/a17/ber_tech/1408959.pdf

Prioritising Energy Research

The European Commission have to date not published a breakdown of the approximately €3 billion FP budget for energy. If this was divided equally then each sector identified would receive approximately €330 over the seven year period. However, this may not be the case as indicated in a speech given by Energy Commissioner Piebalgs in April 2005, he changed the order of this listing and stated '*It is not by chance that I place clean coal technologies and CO2 capture storage at the top of the list*[49]'.

Priority must be given to technologies that result in the rapid transformation to a sustainable and secure energy sector in Europe. Further consideration must be given to the past funding and the ability of the commercial sector to fund the developments. In the light of these concerns the following prioritisation for funding with the energy sector is recommended.

1. Energy Efficiency and Saving
2. Renewable Energy – Fuel Production
3. Renewable Energy – Electricity
4. Renewable Energy – Heat and Cool
5. Smart Energy Networks
6. Knowledge for Energy Policy Making
7. Hydrogen and Fuel Cells
8. Carbon Capture and Storage
9. Clean Coal Technologies

[49] Towards Zero Emission Power Plants, European Co2 Capture and Storage Conference, Andris Piebalgs, 13rd April 2005.

FP7 Criteria Table

	Historical Performance		Short Term Economic Viability of Technology (2020)	Rely on Imported Fuel	Help Meet Lisbon Agenda			Sustainability		Added Value	Historical Support
	Share of OECD R and D	Actual Share of Energy			Increase Energy Price Security	Job Creation	Support SME's	CO2 Reduction	Additional Environmental Risks		
Hydrogen and Fuel Cells											
RES – Electricity											
RES-Fuel Production											
RES- heating and Cooling											
CCS											
Clean Coal											
Smart Energy											
Energy Saving											
Energy Policy											
Nuclear Fission – Generation IV											
Nuclear Fusion											