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The Subsidies Keeping Nuclear Energy Afloat Across the Globe

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1. Introduction

Since first introduced, the nuclear industry has received huge amounts of financial support. It is difficult to quantify exactly how much it has received in subsidies in the past or continues to receive today. This problem is not confined to nuclear power: the entire energy sector is renowned for the lack of available data on this issue. In the European Union (EU) there is no comprehensive official record of past or present energy subsidies due to the lack of a harmonized reporting mechanism. The only exception to this is the annual report of direct state aid for the coal industry (EEA, 2004). Worldwide, information can only be gathered in bits and pieces, just enough to gain a rough impression of trends.

In recent years energy markets in many parts of the world have been opened to increasing levels of liberalization and privatization and this process of liberalization will continue in the near future. Under the terms of the most recent electricity and gas directives to be implemented by all EU countries, full liberalization of the European energy market should be completed in 2007 (Froggatt, 2004). This will lead to changes in the financial relation between governments and electricity producers.

1.1 Historical Investments in Nuclear Power

In the past, energy production and supply, as well as research and development (R&D) into new technologies, have been heavily subsidized by governments. As a result energy sources have been utilized that would not have been financially viable under free market conditions. In liberalized energy markets investment decisions reflect market conditions more closely (Varley & Paffenbarger, 1998). Private investors are not willing to invest in unprofitable projects.

Initially, much of the funding for the nuclear industry came indirectly as a result of military spending on nuclear weapons research. Direct subsidies were given in the belief that nuclear power would offer a cheap, reliable and infinite source of energy. It is difficult to estimate the full scale of these subsidies as many of them do not appear on national expenditure accounts and much nuclear research has been carried out in secret for military purposes. However, a number of indicative estimates do exist. According to one study the US federal government spent $111.5 billion on energy R&D between 1948 and 1998, of which the nuclear sector received 60% (Green Scissors, 2002). According to Scheer (2004), OECD governments had already spent about $318 billion (adjusted to 2004 dollars) on nuclear energy R&D by 1992.

However, the figures above only refer to direct government spending on R&D, which is just one of the ways in which nuclear power is subsidized. There are many other ways in which the nuclear power industry is assisted by subsidies.

1.2 Market Liberalization

In the current context of liberalization of energy markets the prospects for building new power plants are poor due to their high financial risk. At present only old nuclear plants are generally profitable because the costs of construction have already been paid off and the lifetimes of the plants extended. One of the main reasons for the uncompetitive and unattractive market position of nuclear energy is the capital intensity involved. At least $2 billion, perhaps more, would be required to build a new reactor. This is a huge risk to take in an uncertain market. Moreover costs are likely to increase due to improving reactor safety demands, radiation protection and waste disposal (Bruggink & van der Zwaan, 2001). In a liberalized market, investors are not likely to take capital intensive long-term risks. In the words of the International Atomic Agency (IEA) '…*the weak economic position of nuclear power today limits prospects for new plants.*' (IEA, 1998, p.61).

Despite renewed publicity from the nuclear power industry suggesting improved prospects for nuclear orders and new designs that will solve any safety problems, the reality is that the majority of new orders are from countries where electricity utilities have market protection (e.g. China and Korea), and even then ordering rates have been lower than projected (Thomas, 2002).

The aim of this report is to outline a number of the subsidies still enjoyed by nuclear power. In section 2 the concept of energy subsidies will be defined and an introduction given to the types of subsidies that exist. Sections 3 and 4 will investigate current and recent on-budget and off-budget subsidies to the nuclear power sector. Section 5 will examine the issue of external costs, another important form of subsidy to the nuclear industry. In section 6 a number of important ongoing debates will be outlined, and in section 7 we will briefly assess the subsidies received by the renewable energy sector.

2. What is an Energy Subsidy?

2.1. Definitions

There is no generally accepted definition of what constitutes an energy subsidy. The narrowest definitions refer only to direct payments made to energy producers or consumers (Pieprzyk, 2004). Such definitions ignore a wide range of other support mechanisms, such as tax measures, trade restrictions, purchase obligations and price controls (EEA, 2004). Hence the OECD (1998) definition describes subsidies as '*…any measure that keeps prices for consumers below market levels, or for producers above market levels or that reduces costs for consumers and producers*'. This is similar to the definition given by the IEA, which interprets energy subsidies as '*any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers*' (UNEP/IEA, 2002, p.9).

In this study we use the broader definitions of OECD and IEA, as these give a true reflection of all of the support mechanisms available to nuclear power. In order to summarize the types of subsidies available, table 1 gives a broad overview of the different types of support.

Table 1: ***Types of energy subsidy (adapted from UNEP/IEA (2002) and EEA (2004))***

Government intervention	Examples
Direct financial transfers	Grants to producers Grants to consumers Low-interest or preferential loans to producers Repayment holidays - i.e. interest free loans during construction Credit guarantees
Preferential tax treatments	Rebates or exemption on royalties, duties, producer levies and tariffs Tax credits Tax exception on fuels Accelerated depreciation allowances on energy supply equipment
Trade restrictions	Quotas, technical restrictions and trade embargoes
Energy-related services provided by government under full cost	Direct investment in energy infrastructure public R&D
Regulation of the energy sector	Demand guarantees and mandated deployment rates Price controls Market-access restrictions Preferential planning consent and controls over access to resources Waste management payments
Failure to impose external costs	External costs Energy security risks and price volatility costs

2.2. Why are Energy Subsidies Used?

The use of energy subsidies has been justified to achieve one or more of the following aims: security of supply, environmental improvements, economic benefits, or employment and social benefits (EEA, 2004). Subsidies can also be effective in promoting niche technologies which help to achieve the objectives above, and are often used to reach economies of scale in the early years of a technology's development.

According to standard economic theory, subsidies are only justified when they lead to an overall increase in social welfare. Therefore, removing subsidies that are both economically costly and harmful to the environment, would represent a so-called 'win-win' policy reform (UNEP, 2004). In this context the EU Sixth Environmental Action Programme encourages '*…reforms of subsidies with considerable negative effects on the environment and that are incompatible with sustainable development*' (EEA, 2004).

2.3. Are Nuclear Energy Subsidies Appropriate?

Nuclear power has now been around for over half a century and has been given enough time to mature and bear fruit. In fact, according to the IEA, nuclear power plant technology is now '*mature and proven*' (IEA, 1998, p.66). Therefore, nuclear subsidies can no longer be justified on the grounds of promoting a niche technology.

According to the conditions set out in section 2.2 subsidies to the nuclear energy sector would only be appropriate if they increased overall social welfare (i.e. if the benefits to society and the environment outweighed the financial costs). The socio-environmental problems associated with nuclear power are well documented; examples include radioactive waste, safety problems, health effects of radiation, nuclear weapons proliferation and the threat of terrorism. Recently the nuclear industry has claimed that it can play an important role in combating climate change. However, a report recently published report by WISE/NIRS (2005) explains why this claim is not valid. Nuclear subsidies cannot be considered appropriate on the grounds of improving social welfare or the environment.

As a contribution to security of supply, subsidies to the nuclear industry might have some limited justification. The availability of the nuclear fuel uranium from relatively stable regions of the world will only be possible as long as it is financially viable. At the present rate of uranium use, this will only be for the next 50 years and if the total global electricity demand were to be covered by nuclear energy, the supply would be exhausted in 3 to 4 years. From a viewpoint of cost efficiency, it would be much more worthwhile to invest in renewable energy production (solar, wind, small-scale hydro and biomass) that provides unlimited security of local available supply.

3. On-Budget Subsidies

The main subsidies to the nuclear energy sector have been classified as either 'on-budget' or 'off-budget'. The main difference between these two types of subsidies is that on-budget subsidies appear on national balance sheets as government expenditure, whereas off-budget subsidies do not (EEA, 2004).

On-budget subsidies refer to cash transfers paid directly to producers, consumers and other related bodies (e.g. research institutes) (EEA, 2004). For this reason the majority of on-budget subsidies are relatively easy to quantify. One of the most comprehensive studies of on-budget subsidies was carried out by Ruijgrok & Oosterhuis (1997). They found that in the period 1990 to 1995, the average amount of direct energy subsidies from EU member states, and the EU itself, to nuclear energy amounted to approximately $4,674.8 million annually. This represented over 23% of the total annual energy subsidies within the EU during that period. The majority of the subsidies went to fossil fuels (51%), while renewable energy sources received only 7% of the total sum.

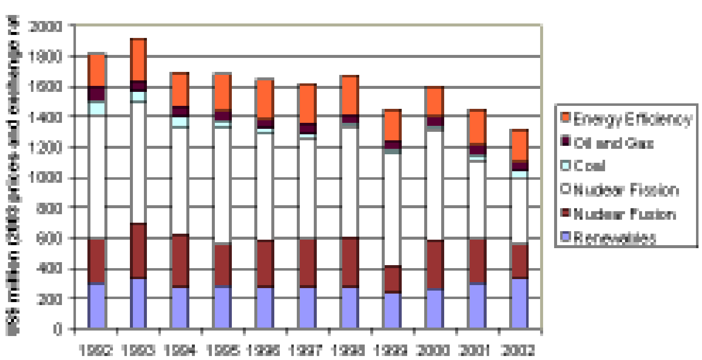
3.1. Public Funding of R&D

A large proportion of on-budget subsidies are made as direct payments for nuclear energy R&D. The governments of almost all OECD countries undertake energy R&D. Although the total level of energy R&D funding in OECD countries has been declining in recent years (13% reduction in real terms over the period 1990-2000), the share of the funding going to nuclear power has remained high.

The expenditure by the majority of Member States (those that are part of the International Energy Agency) is shown on the graph below. During the last decade the budget has decreased from •1.8 billion to around • 1.3 billion

Despite being a mature player in the energy sector nuclear power continues to drain much of the direct R&D resources and

Figure 1: ***IEA-Europe States' Energy Research and Devlopment Budgets 1992-2002 (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, UK)***



Source: IEA 2004

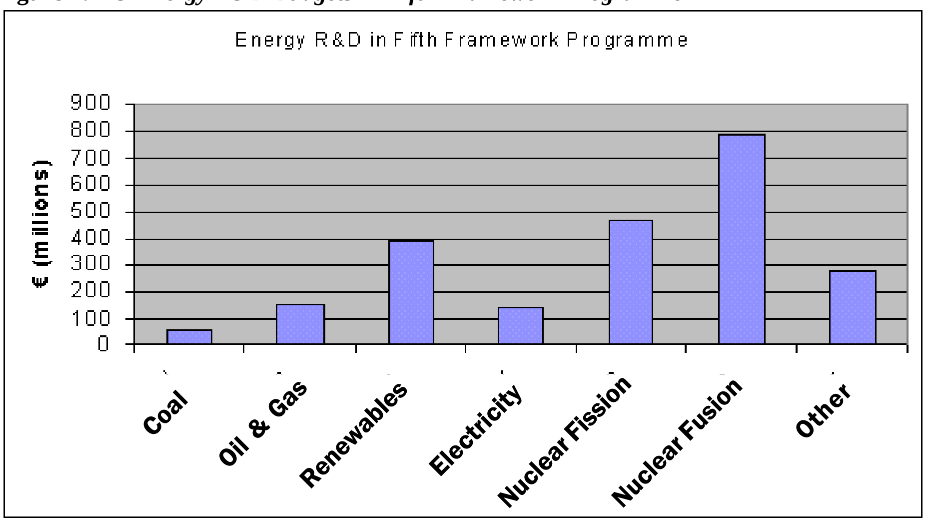
thereby has an unfair advantage over other energy types. In liberalized energy markets this situation will not be allowed to occur as nuclear power enjoys a great competitive advantage over less developed renewable energy sources.

It should be noted that these official figures do not include so-called ‘shadow R&D subsidies’. These refer to monies spent by public institutions (e.g. universities and nuclear physics institutions) on nuclear research funded by general research grants. These grants may finance nuclear research but are not officially included in the R&D subsidies totals.

3.2. EU Framework Programmes

Since the EU was formed Energy Framework Programmes have been key features of EU energy policy. In 1957 the Joint Research Centre was established to carry out research into nuclear issues under the Euratom Treaty. The first non-nuclear Community R&D Policy was not introduced until 1974. And in 1984 the Commission introduced its first five year Framework Programme to cover all non-nuclear energy R&D across the energy sector; the current program (the Sixth Framework Programme) will conclude in 2006. Nuclear technology continues to have its own Framework Programme under the Euratom Treaty. This programme has different rules to the general EU Energy Framework Programmes, including being subject to less democratic scrutiny and the European Parliament being only relegated to a consultative role (Froggatt, 2004).

Figure 2: ***EU Energy R&D Budgets in Fifth Framework Programme***

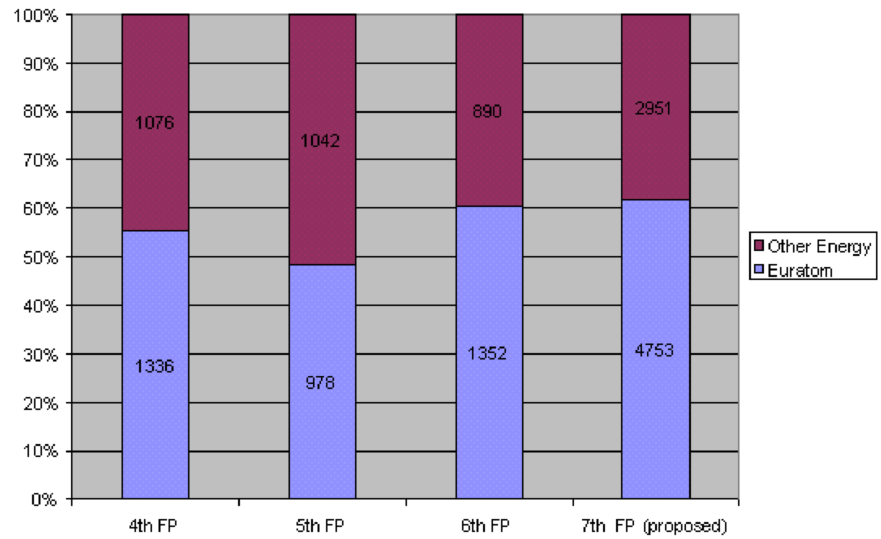


Data Source: Froggatt 2004

Figure 2 shows the funding levels for various sectors from the Fifth EU Framework Programme and corresponding Euratom Programme. This means that of the money spent from the last EU Framework Programme, almost 55% went to nuclear energy.

Figure 3 shows the historic and proposed imbalance in the EU energy R&D sector. Nuclear technology - fusion and fission-, receives 61% of energy R&D funding, despite only currently contributing 13% of the EU’s energy consumption. The proposal of the Commission for the Seventh Framework Program (2007- 2013) is to maintain these percentages. This is remarkable as it once again highlights the ‘special treatment` given to nuclear power. Firstly, the research and development budget is separate from that of other energy programs. This effectively means that nuclear is ‘ring fenced’ from the other debates about how the limited funds for energy R&D should be allocated. Secondly, there is no Parliamentary co-decision on the Euratom programme, only consultation.

Figure 3: ***EU Funding Energy Priorities***



Source: Cordis and European Commission

For the Euratom programme the allocation between the main areas is clearer. As can be seen in figure 3 fusion research is set to receive a considerable boost in its funding, an increase from roughly •200 million per year over the years 1995 to 2006 but rising to •600 million per year at the end of the Seventh Framework Program. This is in anticipation of the construction of the ITER, the experimental fusion reactor to be built in France.

Table 2: ***R&D under Euratom Framework Program (in million Euro)***

	4th	5th	6th	7th		
				2007-11 (proposed)	2011-13 (estimate)(2)	Total (estimate)
JRC (1)	441	49	319	541	241	782
Fission		142	209	395	211	607
Fusion	895	788	824	2167	1197	3364
Total	1336	978	1352	3103		4753

Source: Cordis and European Commission.
(1) European nuclear research reactors.
(2) The additional year allocations have been calculated for fission and fusion using the same ratio as adopted in the previous period.

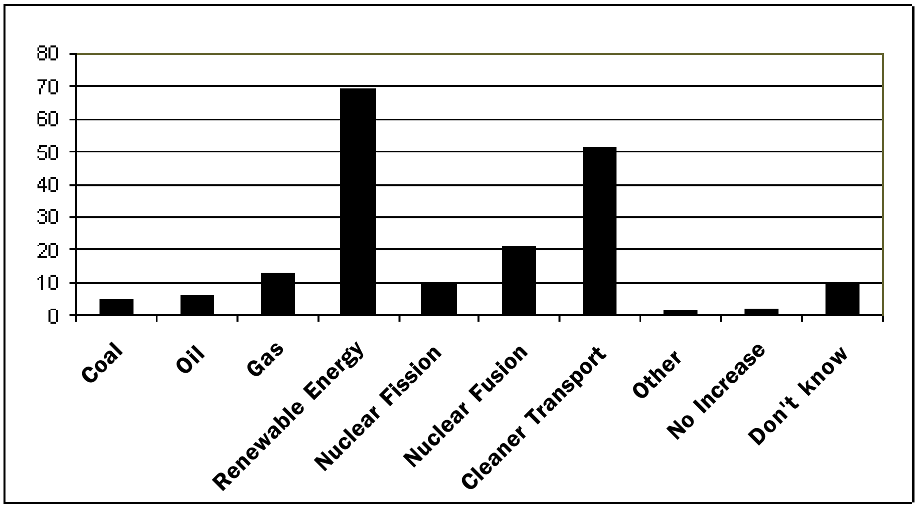
3.3. EU On-Budget Spending and Public Approval

Within the EU, energy R&D is also carried out by individual Member States; in fact the level of funding from Member States is roughly double the amount from the EU Framework Programmes. Once again over half of these investments are directed towards nuclear power (Froggatt, 2004).The high levels of funding to the nuclear energy sector are even more striking when one compares them with the EU public's preferences. The results of a public opinion poll on energy funding carried out by the European Commission were released in December 2002. Members of the public from each Member State were asked which energy related technologies should be researched more by the EU. The results of the survey are shown in Figure 4. From this we can see that the support for nuclear R&D (particularly nuclear fission) is very low compared to renewable energy sources.

3.4. Other Examples of On-Budget Spending

In the EU two special programmes exist to provide transitional aid within the energy sector: the PHARE program gives aid to new EU accession countries, and the TACIS program to countries from the former Soviet Union. In 2001 the EU set up initiatives under

Figure 4: ***Public preferences for EU energy R&D spending***



Source: Frogatt, 2004

these programs in an attempt to improve nuclear safety in these regions. However, these investments were made at the cost of other energy sectors. Approximately 80% of the total budget of these programs was spent on nuclear safety, and only 6.5% of the total was spent on promoting or developing renewable energy sources (Froggatt, 2004).

Other on-budget subsidies sometimes neglected are specific nuclear security costs such as the cost of infrastructure adaptation for transporting nuclear waste, military protection against terrorism as was seen directly after 9/11, or the naval escort of ships transporting nuclear waste. These costs are only partially covered by the nuclear energy sector, the rest by on-budget subsidies (Greenpeace France, 1998).

As the Senior Vice-President of the Italian energy compagny ENI, Leonardo Maugeri, puts it: "*Many energy industrialists think nuclear is the answer, but they rely on a misleading analysis of its costs competitiveness. Even if you ignore the political concerns surrounding nuclear waste, producers often fail to correctly calculate the real price of electricity produced from nuclear energy. It costs about as much to close a nuclear plant as it does to build a new one, which is why nuclear power companies are now lobbying worldwide to delay planned plant closings*". (Newsweek, September 20, 2004)

4. Off-Budget Subsidies

Off-budget subsidies typically refer to transfers to energy producers and consumers that do not appear on national accounts as government expenditures. The range of off-budget subsidies is very large and includes: tax exemptions, credits, deferrals, rebates, preferential tax treatment, market access restrictions, regulatory support mechanisms, preferential planning consent and access to natural resources (EEA, 2004 REF5). It is notoriously difficult to estimate the size of off-budget subsidies, especially in the nuclear power sector. In this chapter a number of the most important off-budget subsidies to the nuclear industry are described.

4.1. Preferential Tax Treatment

In 1989 the UK government withdrew nuclear power from its electricity sector privatisation program as it was perceived to be too great an investment risk. A year later, a consumer subsidy was introduced to help the ailing nuclear sector since it could only recover about half of its costs from sales of power to the new electricity market. The sums from this subsidy represented 50% of Nuclear Electric's income in 1990.

In the following years, efforts were made to reduce costs considerably and by 1996 the consumer subsidy was no longer necessary. However, by 1998, market competition had forced a reduction in the wholesale electricity price, meaning that even the more modern nuclear plants were unable to recover their operating costs (Thomas, 2002). This is only one example that shows the preferential treatments received by the sector. In many countries where utilities are still state-owned, preferential tax treatment continues. Given the poor economic performance of nuclear power stations in recent times, it seems unlikely that they would be able to continue operating if they were not to receive such subsidies.

4.2. Stranded Costs Recovery

As a result of the falling costs of electricity, and the increasing price of nuclear generated electricity, existing nuclear power plants are often unable to make the rate of return expected when the plant was built. The difference between the book value and the market value of such facilities is known as a stranded cost. Owners of such facilities argue that as the plants were built in good faith at a time when market conditions did not exist, and were approved by regulators, they should be entitled to the income they had anticipated when the plant was built. If this income cannot be recovered from the market they argue, then the plants should receive these monies as subsidies (WISE/NIRS, 2003).

The Federal Energy Regulatory Committee in the USA has accepted the general principle of stranded costs recovery in the transition to a competitive market. In the USA one estimate of stranded costs suggests that this was between $24-56 billion as early as 1996 (DOE, 1996). According to Bunyard (1999), the stranded costs in eleven states adds up to some $112 billion.

Prior to the privatization of the nuclear industry in the UK all of the nuclear generating assets were owned by the government. Upon privatization the burden of stranded costs was shared between tax payers and consumers. The taxpayer effectively subsidized the industry through the government's auctioning of its nuclear electricity assets at heavily discounted prices, and energy consumers through a nuclear surcharge attached to electricity bills (ILO-ACTRAV, 2004).

The importance of stranded cost recovery has also been recognized in the EU Electricity Directive (Varley & Paffenbarger, 1998) and the European Commission has agreed on cost compensation schemes for the energy sector as part of the liberalization package (Arnellio, 2001). The benefits to the nuclear industry in Spain alone are estimated to be around 3 billion Euro.

4.3. Liability Limitation

One of the most important forms of off-budget subsidy for the nuclear sector is the limitation of liability in the event of an accident. In most business situations, individual risks are covered by an insurance policy for which the operator pays a premium based on a quantitative assessment of the risk involved. High risk production facilities usually face high insurance premiums, and the cost of production is increased (Leurs & Wit, 2003). For nuclear energy, however, an exception is made.

In the EU the maximum economic liability of nuclear operators is set by the *Paris Convention on Third Party Liability*, and the *Brussels Convention Supplementary to the Paris Convention*. Although the maximum operator liability was revised upwards in 2004 to •700 million (NEA, 2004), this amount would be truly insignificant in the event of a nuclear disaster. In the US, the Price-Anderson Act limits the nuclear industry's liability in the case of an accident to about $9.1 billion. The rest of the costs would be paid by the taxpayer (Mechtenberg-Berrigan, 2004).

Since nuclear operators are only obliged to take insurance up to agreed liability levels established in such agreements, the price of nuclear electricity production remains artificially low. Furthermore, should an accident occur, the majority of the costs are shifted to government treasuries, and ultimately to the taxpayer. Two examples can be found in France and Germany.

France: If EdF were required to fully insure their power plants with private insurance using the agreed European limit on liabilities, this would mean an increase of EdF's nuclear production costs of around 8%. At present EdF is not yet insured to even this level. If there was no EU ceiling in place and EdF had to cover the full cost of a worst case scenario accident, it would increase the insurance premiums to 0,05 EUR/kWh, thus increasing the cost of generation by around 300% (Leurs & Wit, 2003).

Germany: Ewers and Rennings (1992) estimated the total damage of a reactor meltdown in Germany at 5.469 billion EUR. Given a probability of 1 meltdown per 33,000 reactor years and 0% discount rate, a situation of full liability would lead to external costs of 0.022 EUR/kWh.

4.4. Decommissioning Funds

So far very few nuclear installations have been decommissioned, but in the coming years many plants will reach the end of their lifetimes and will be shut down. Experience in the USA and elsewhere has shown that this is an extremely expensive process. For example the decommissioning of the Yankee Rowe nuclear reactor in Massachusetts was expected to cost $120 million but actually cost about $450 million (compared to the construction costs of US$39 million) (Mechtenberg-Berrigan, 2004).

Making accurate estimates for the costs of decommissioning projects has proven to be very difficult for many reasons. First, because of the small number of plants so far decommissioned there is little data on which to base projections. Secondly, there are many different aspects involved in the calculation of costs, e.g. security, environment, local and national economy, and financial risks. Furthermore, the timescales involved in decommissioning are very long.

In order to cover the costs of decommissioning most countries require operators to pay into some kind of decommissioning fund. However, given the uncertainties involved in the calculation of decommissioning costs it is impossible to accurately state in advance how much money operators must put aside in these funds. According to Finnish legislation nuclear companies are responsible for the decommissioning of their power plants. To date it has been estimated that Finnish operators have reserved approximately •1 billion in special funds for the purpose of decommissioning. However, when one considers the huge expenses involved in decommissioning to date this appears to represent a huge underestimation of costs (WISE/NIRS, 2003).

Electricity consumers in the UK have already effectively paid for the decommissioning of the Magnox power plants, although the amounts left in the decommissioning fund would suggest otherwise. In the 1989 pre-privatization accounts of the Central Electricity Generating Board and the South of Scotland Electricity Board, £3.8 billion of assets were set against decommissioning liability. If we account for inflation and allow for a 3% annual rate of return, this sum would have approximately doubled by now. However, upon privatization this amount was simply absorbed by the government. Furthermore, between 1990 and 1998 electricity consumers had to pay a 'Fossil Fuel Levy', which amounted to 10% of their electricity bills and raised £8 billion. According to Michael Heseltine, then Minister of Environment, in a speech to Parliament, this amount was '*to decommission old unsafe stations*'. In reality it was used to finance a new nuclear power station (Sizewell B) (Thomas, 2004).

If these amounts had been truly set aside for the purposes of decommissioning, as they were intended, the fund would now amount to well over £16 billion. The British government assumes that a Magnox plant costs £1.1 billion to decommission, therefore it is clear that the British public has already more than paid for the costs of decommissioning. However, as the money supposedly set aside for decommissioning has been used for other purposes, only £4 billion of the provisions remain in the Nuclear Liabilities Investment Portfolio (Thomas, 2004). Again, the remaining amounts will have to be raised from other sources, i.e. from future tax payers or consumers.

Similarly, in the USA all nuclear utilities are obliged to make regular contributions to a decommissioning fund. According to a report by the General Accounting Office in December 2000, the size of all owners' decommissioning fund accounts was estimated at $27 billion. This sum would cover less than half of the amount needed to ensure an adequate supply of funds for the eventual decommissioning (Mechtenberg-Berrigan, 2004).

Eventually all nuclear reactors will have to be safely decommissioned, so if the monies in these decommissioning funds are not adequate, they will have to be found elsewhere. It is likely that these costs will be borne by future tax and ratepayers. The current underinvestment in decommissioning funds does therefore represent a subsidy to the nuclear sector.

5. External Costs

External costs are those imposed on a society, or the environment, but that are not accounted for in the market price of a product or service. In the energy sector, all energy sources have external costs associated with them. These can include damage to human health, the natural and built environment and costs associated with pollution and climate change etc. (EEA, 2004). While they do not represent subsidies in the traditional sense, they do subsidize electricity production by transferring the external costs from the private to the public domain. Within the field of environmental economics, much work is being carried out to quantify external costs with a view to internalizing them in the price of products and services. In this way the market price would reflect the true cost of products and services, and not only the private costs (Kahn, 1998).

The quantitative assessment of external costs of the energy sector is notoriously difficult. One of the main reasons for this is the complexity of natural systems, which makes it difficult to find or prove cause-effect relationships. Furthermore, it is often very difficult to quantify the monetary damages associated with energy production (Pieprzyk, 2004). For damage to buildings and infrastructure it is relatively simple to assess monetary damage but the estimation of health damage is surrounded by ethical value judgements, for example what monetary valuations can be placed on nature and human life?

Nevertheless, a number of estimates of external costs have been made for various energy sources. One of the most frequently cited examples is that of the ExternE project, which estimates the external costs associated with the electricity production fuel cycle in the EU-15. For the nuclear sector an estimate of •2.7 billion of external costs per year was made. This estimate was substantially lower than that for fossil fuels, and in the same order of magnitude as renewable energy sources (EC, 2003). However, the estimates of external costs associated with nuclear energy have been strongly criticised for excluding some of the most important factors. For example, human mortality and morbidity associated with exposure to high-level nuclear waste, and the contribution of civilian nuclear programs to the risk of proliferation and terrorism were considered too difficult to value, and therefore were therefore not included (EEA, 2004).

An earlier attempt to quantify the external costs of the nuclear industry did take into account the costs associated with a potential nuclear accident (Moths, 1994). These costs were internalized by assuming that nuclear operators would have to insure their plants without liability limitation as described in section 4.3. In this case it was found that the external costs of nuclear generated electricity would be approximately 1,80 EUR/kWh. For comparison the external costs associated with electricity generation from lignite (itself a very polluting source) were estimated at 0,09.7 EUR/kWh (ExternE 1995, cited in Pieprzyk (2004)).

6. Ongoing Issues

Controversies surrounding subsidies to the nuclear sector are not a thing of the past. To highlight this we address two ongoing issues: the EC inquiry into the UK Nuclear Decommissioning Authority (NDA), and the HR6 Energy Bill in the USA.

6.1. EC Inquiry into the UK NDA

In December 2004 the EC began an investigation to determine whether the establishment of the NDA in the UK complied with EC rules which affirm that state aids should not distort or threaten to distort competition.

The role of the NDA as foreseen by the UK government is to manage most of the nuclear liabilities for the country's public sector. Assets belonging to British Nuclear Fuels Limited (BNFL) have been transferred to the NDA, as well as responsibility for its liabilities. Furthermore, the NDA has taken responsibility for the liabilities at the UK Atomic Energy Authorities (AEA) sites.

During this restructuring BNFL was split into 2 parts. One part was transferred to the NDA and the other, including BNFL's US subsidiary Westinghouse, will continue commercial operations as a smaller company. It will do so free of financial obligations from past operation, as the transfer of the first part will be done at no cost. This means that BNFL will be absolved of its liabilities, and will effectively be subsidized. The EC launched its investigation based on the claim that this advantage, provided by the UK government, is likely to represent state aid within the meaning of Article 87(1) of the EC Treaty (EUROPA, 2004). Under EU law, state aid is illegal unless it can be clearly proved that the negative impacts of the aid on trading conditions is outweighed by its positive contribution to the fulfilment of other Community objectives (Thomas, 2004).

6.2. HR6 Energy Bill

In 2003 a new comprehensive energy bill, the HR6 Energy Bill, was proposed in the USA. Instead of signalling a future where energy conservation and renewables stood paramount, the bill proposed giving billions of dollars of taxpayers' money to the fossil fuel and nuclear sectors (Mechtenberg-Berrigan, 2003). In a review of the tax breaks and subsidies included in the Bill, the League of Conservation Voters (2003) estimated that $7.372 billion would go to the nuclear sector; Friends of the Earth (FOE, 2003) estimated that total to be $9.2 billion.

The bill passed the House largely unamended in April 2003, and in July 2003 the Senate passed a different version. The House-Senate conference committee subsequently added a provision to give a $6 billion production tax credit to help invigorate the nuclear industry. The House agreed to this conference report.

In an effort to pressure the Senate into acting on the conference report, the House brought an identical bill (HR 4503) to a vote. The House approved the bill in June 2004. The Senate later approved billions of dollars in tax credits for the nuclear industry but failed to pass the overall energy bill. While the complete bill eventually failed to pass the Senate, it does show the willingness of many politicians to subsidize the nuclear industry. Similar amounts are included in the energy bill being considered in the current Congress.

7. Subsidies to Renewable Energy Sources

It is often argued that a significant limitation to the large-scale expansion in the use of renewable energy sources is the supposed high amount of financial support that would be required to introduce these technologies and make them competitive (Pieprzyk, 2004). However, the subsidies received by renewable energy sources so far are dwarfed by those given to the nuclear and fossil fuel sectors. For example, it is estimated that the USA nuclear energy sector received financial support to the tune of $15.3 per kWh in the first 15 years of its development (1947-1961), compared to wind energy which received just $0.46 per kWh in its first 15 years. Hence, in the first 15 years of their respective lives the nuclear sector received about 30 times the level of support as the wind sector (Goldberg, 2000). Furthermore, Froggatt (2004) refers to the results of research, which suggests that for the same level of investment, wind power creates 5 times as many jobs and 2.3 times as much electricity as nuclear.

This underinvestment in renewable energy sources comes despite an increased awareness of the need to adopt such sources. The EU has made clear its priority to develop and deploy renewable energy systems. In 2001, an EU Directive was adopted that established a legal framework for their future development, including a target of 12% of the EU's energy (or 22.1% of its electricity) to be generated by renewable sources by 2010 (Froggatt, 2004). Whilst the use of renewables is increasing in the EU, this is not occurring as fast as many would desire, partially because of the relative underinvestment in this sector.

Even if all subsidies to all energy sectors were halted this would not create a 'level playing field'. This is because relatively new and innovative methods would lose out to the huge historical investments that have been enjoyed by nuclear and fossil fuels.

Were appropriate subsidies re-directed to renewables to allow these to develop to maturity, it would not only be beneficial to the environment, but would also bring other advantages such as reduced external costs, the creation of new jobs, and less dependency on other countries for energy supplies.

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