Status and Trends of Nuclear Power in the World[1]

An Update of Myths and Realities

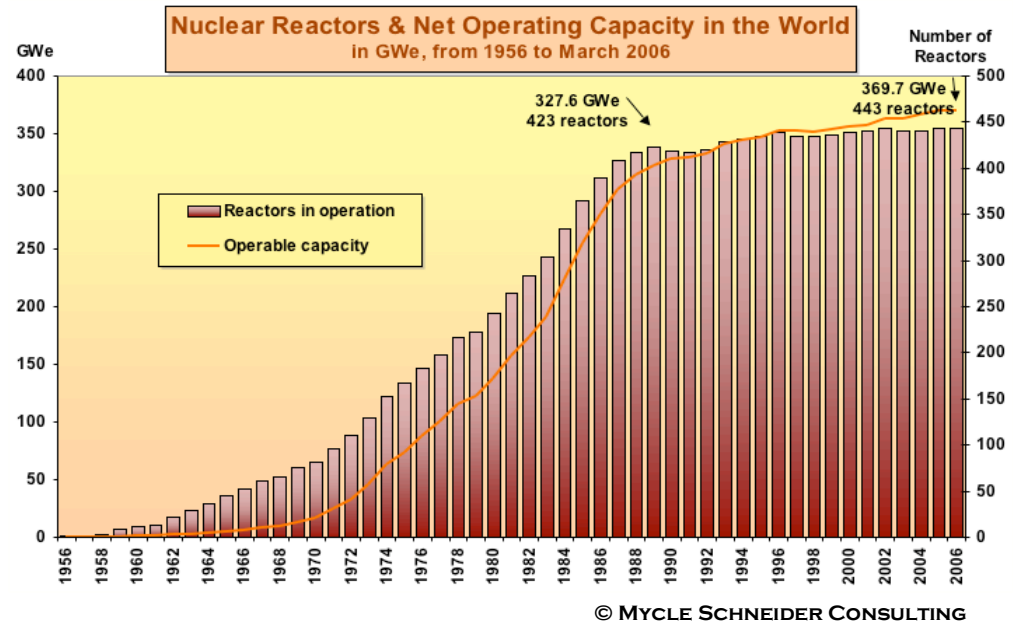
Mycle Schneider* with Lutz Mez** and Steve Thomas*** Paris, 14 March 06

Nuclear Power is back on the agenda. The media coverage of nuclear energy, in numbers of articles, in key countries like the US, the UK, France, Germany has increased several times since year 2000. Heads of State talk about it, the upcoming G8 Summit put it on the agenda. The international nuclear industry is jubilating: "Our industry is not in the defensive mindset that it was in before. On the contrary, we must now make the most of the nuclear revival and go on the offensive."[2]

So what is behind the "nuclear revival"? What is the result of the industry "offensive"? Surprisingly little, so far, as the following analysis will demonstrate.

As of 1 March 06, there are 443 nuclear reactor operating in the world, only 20 more than in 1989, representing an installed capacity of about 370,000MW. Nuclear power plants provide 16% of the world's commercial[3] electricity – the same as hydropower – 6% of the commercial primary energy and 2%-3% of final energy.

Graph 1:



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[1] Paper forthcoming in *Energy & Environment* Special Issue on *Energy Policy and Nuclear Power - 20 Years after the Chernobyl Disaster*, Multi-Science Publishing, May 2006
[2] Frank Deconinck, Chairman of the European Nuclear Society, 13 February 2006
[3] The term *commercial* designates all the energy/electricity that is being traded. Unfortunately, the statistics do not capture energy provided by non-commercial sources such as non grid connected photovoltaic panels, and in particular non commercial biomass use that plays a very significant role in countries like India, China and the entire African continent.

Table 1: Nuclear Power in the World

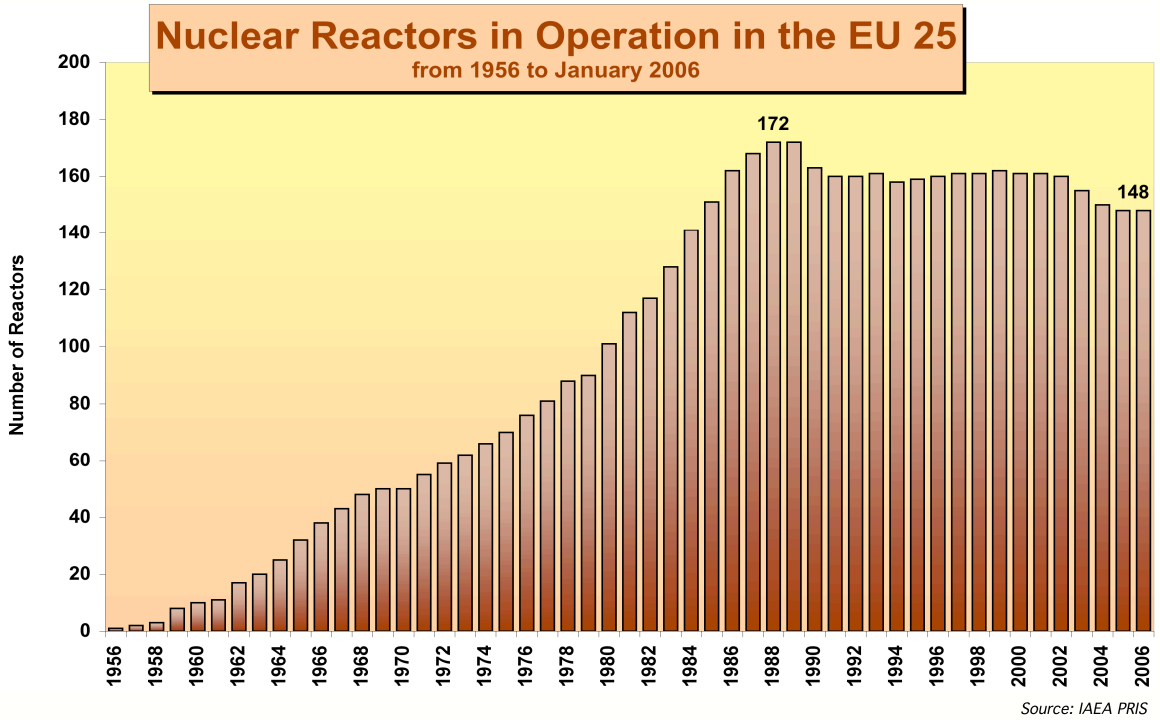
Countries	Nuclear Power Plants (as of 1March 06)			Nuclear Energy (as of 1 Jan 05)	
	Operate	Average Age	Under Construc -tion	Share of Electricity	Share of Com.Primary Energy
USA	104	25	0	20%	8%
France	59	20	0	78%	38%
Japan	56	20	1	25%	10%
Russia	31	23	4	17%	5%
United Kingdom	23	26	0	24%	9%
Korea RO (South)	20	12	0	40%	14%
Canada	18	20	0	2%	13%
Germany	17	23	0	28%	11%
Ukraine	15	17	2	46%	14%
India	15	17	8	3%	1%
Sweden	10	26	0	50%	33%
China	9	4	3	2%	1%
Spain	9	23	0	24%	10%
Belgium	7	24	0	56%	19%
Slovakia	6	17	0	57%	21%
Czech Republic	6	13	0	31%	13%
Taiwan	6	23	2	22%	9%
Switzerland	5	29	0	40%	21%
Bulgaria	4	19	1	38%	20%
Hungary	4	19	0	33%	10%
Finland	4	25	1	27%	19%
Argentina	2	26	1	9%	3%
South Africa	2	20	0	6%	2%
Mexico	2	13	0	5%	2%
Brazil	2	13	0	4%	2%
Pakistan	2	19	1	2%	1%
Lithuania	1	19	0	80%	38%
Slovenia	1	23	0	40%	21%
Armenia	1	24	0	36%	23%
Romania	1	8	1	9%	3%
Netherlands	1	31	0	5%	1%
Iran	0	0	1	0%	0%
Korea DPR (North)	0	0	0	0%	0%
EU25	148	22	1	31%	15%
Total	443	21	26	16%	6%

Sources:
IAEA-PRIS 2006, BP 2005

The total installed capacity has increased faster than the number of operating reactors because units that are being shut down are usually smaller than new ones coming on-line and because of uprating of capacity in existing plants in many countries. In the USA for example, according to the World Nuclear Association, the Nuclear Regulatory Commission has approved 96 uprates since 1977, a few of them "extended uprates" of up to 20%.[4]

In the EU25, the decline of nuclear power has been almost steady since 1989, when the number of operating units reached a historic record with 172 units. Currently there are 148 reactors operating in the EU25, which is 24 units or 14% less than 17 years ago. The same year construction started on one unit in Finland (2005), two reactors were shut down, one in Germany and one in Sweden.

Graph 2:



There are 31 countries that operate nuclear power plants, but the big six alone, USA, France, Japan, Germany, Russia and South Korea, produce three quarters of the nuclear electricity in the world. The role of nuclear power in the overall energy sector remains very limited even in these countries. In France, the "most nuclear" country in the world that generates 78% of its electricity with nuclear power plants, nuclear only provides 17.5% of its final energy. Like most of the other countries, France remains highly dependent on fossil fuels that cover over 70% of its final energy consumption of which oil holds the lion share with 45%. None of the other five largest nuclear countries cover more than 7% of their final energy by nuclear power, the US and Russia less than 4%.

[4] http://www.world-nuclear.org/info/inf17.htm

Table 2: The role of nuclear power in the energy supply of the principal producers of nuclear electricity.

Country	Primary Energy[5] *in Mtoe*	Final Energy[6] *in Mtoe*	Nuclear Final Energy[7] *in Mtoe*	Nuclear Share in Final Energy *in %*
France[8]	276	161	28	17,5
Japan	515	359	23	6.4
South Korea	217	138[9]	9	6,7
Germany	330	241[10]	15[11]	6,4
USA	2332	1557[12]	61	3,9
Russia	671	418	13	3,1

There are an additional 26 reactors listed as "under construction" by the International Atomic Energy Agency (IAEA). However, nine building sites have been listed there for between 18 to 30 years. The record holder is the Bushehr-1 plant, one of two units originally to be supplied by the German reactor builder Siemens and now to be completed by the Russian industry. 15 of the remaining 17 reactors are being built in Asia, half of them in India, one in Finland and one in Bulgaria that just entered the statistics (again). The Indian expansion program is essentially limited to small domestic type reactors under 500MW each. Only two units under construction, to be supplied by Russia, reach 1,000MW each. The operating performance of the Indian nuclear program is extremely poor by international standards. While the attempts to re-launch the international nuclear cooperation, in particular with the US and France, remain highly controversial, there is little prospect that nuclear power will provide significantly more than the current 2% of its electricity any time in the near future.

Chinese Fantasies

There have been many newspaper stories about fabulous plans by the Chinese nuclear industry. Reality looks a bit different. In 1985 China ordered its first foreign reactors, provided by a British-French General Electric Company (GEC) led consortium with participation of Electricité de France (EDF). Asked at the time during a press conference if EDF was not losing its shirt in the deal, EDF's President stated: "Not the shirt, but the cuff-links". And the Director General added: "…and golden ones." The consortium lost a never revealed large sum of money in the deal but it was considered justified because it was seen as the door opener to a vast nuclear market. The Chinese had announced "plans" for 20,000MW to be built until year 2000. At the turn of the century, one tenth of that plan had materialized.

[5] BP Statistical Review of World Energy 2004, June 2005
[6] For year 2002, except for France
[7] Calculated by the authors on the basis of IEA World Energy Statistics 2004, except for France
[8] Figures 2004, from Ministère de l'Industrie, except for primary energy, from BP Statistical Review of World Energy 2004, June 2005
[9] IEA World Energy Statistics 2004
[10] IEA World Energy Statistics 2004
[11] Calculated on the basis of IEA, Energy Policies of IEA Countries, 2004 Review, and AG Energiebilanzen, Auswertungstabellen zur Energiebilanz für die Bundesrepublik Deutschland, 1990 bis 2003
[12] IEA World Energy Statistics 2004

In the mean time, in 1996, it was announced that the 20,000MW would be achieved by 2010. Ten years later, as of March 2006, there are 7,000MW installed that provide, like in India, about 2% of the country's electricity. Together with another 3,000MW that are currently under construction, the country will have a maximum of 10,000MW installed by 2010, half of the "plan". The Chinese go for technology shopping. Besides the two British-French units they ordered two Franco-French, two Canadian and two Russian plants. The latest international call for tender is expected to favour US Westinghouse technology – subject to a political embargo, US companies were not allowed to provide nuclear equipment to China until 2004 – over the Franco-German so-called Generation III European Pressurized Water Reactor (EPR). The Toshiba owned US Company[13] is willing to sell the blueprint of its AP1000 Generation III design, while AREVA, the French lead consortium, has not agreed to transfer EPR technology and equip a potential future competitor. In the meantime the first two 600MW units developed by the Chinese industry were connected to the grid.

As to figures of up to 40,000MW to be installed in China by 2020, they are nothing more but wild speculation with little industrial credibility. Lead times for nuclear plants, the time from final investment decision to grid connection are about 10 years. This is rather a minimum, considering the extreme delays in many of the nuclear programs around the world, not only in Eastern Europe and South America. The last unit to be built in the US, Watts Bar, had been under construction for over 23 years before it was finally connected to the grid in 1996. In fact the entire currently operating US reactor fleet has been ordered between 1963 and 1973. Even in France, because of massive technical problems, it took nine years from construction start before the last two units of the programme, Civaux-1 and -2, produced any electricity and respectively 13 and 11 years before they finally entered into commercial operation.

French Fears About Competence Loss

France has decided in principle to build a 1,600MW EPR at its Flamanville site that already hosts two 1,300MW reactors. However, as of March 2006, the reactor order is not officially placed yet. The main reason for the project is the fear of a huge competence gap. It is 15 years ago that the French nuclear industry launched its last reactor construction in the country. Interest in nuclear related technical and higher education options are decreasing. The effect is not as dramatic as in a country like Germany, where in five years only two students took a full nuclear option, but it is there. Maintaining competence has become a very major issue. Only a very small number of people that have participated in the building of the first generation of units, starting in 1971, will be there when and if they were to be replaced beginning around 2020. The Flamanville EPR, even if not needed in terms of generating capacity, is seen as a tool to boost motivation. "One cannot attract young people into a technology without a project and one would have to do without a transfer of competence and experience".[14] Whether this strategy will work remains to be seen. EDF does not maintain national statistics of candidatures, but states that "like many other companies, EDF notes a relative disaffection of young people for technical professions, which is even more sensitive in the case of the appeal for candidatures in apprenticeships."[15] There are fewer students and higher education in a nuclear option is still no guarantee that young people will feel attracted by the technology.

[13] Toshiba acquired Westinghouse from the UK Company BNFL in February 2006 for US $5.4 billion but the deal needs to get approval yet by the US Committee on Foreign Investments. Many analysts consider that Toshiba has overpaid for Westinghouse. BNFL had bought the company in 1999 for US $1 billion.

[14] Joël Dogué, Director of the Flamanville-3 EPR project, EDF, EPR Public Debate, « Tête de série » Bordeaux, 5 January 06

[15] EDF, written response to a question by Mycle Schneider, transmitted by CPDP, letter dated 2 March 06

Over the last years a significant portion of the graduates that chose nuclear engineering at the Ecole des Mines in Nantes[16] either did not even start working in the area or quit the nuclear sector within the first year. Of the remaining nine students that will get their diploma in 2006 in the option Nuclear Technology, Safety and Environment, at least three wish to join the medical sector rather than the nuclear industry.

France has pushed nuclear power, a typical base load technology, far into the middle load, and has not set up any effective corrective mechanism. The overcapacity in the country has been structural for many years. An installed capacity of 116,000MW, of which 63,000MW nuclear, has to be compared with a historic peak load of 86,000MW. Even with a comfortable reserve capacity, the available additional capacity remains significant. France is the only country in the world that actually shut down reactors over the weekend because nobody would buy the power, not even at dumping prices. No wonder that France exports vast amounts of electricity, some 91TWh in 2005 (equivalent to the output of about 12 nuclear power plants). However, France also imports increasing amounts of electricity, over 32TWh in 2005, because it has managed to push peak load in disproportion, mainly through the equipment of a quarter of French housing with electrical space heating. Peak load power is, of course, a lot more expensive than nuclear powered base load. The French system is imbalanced; it needs more peak load generating capacity and has an overcapacity of base load capacity. Therefore mothballed old coal fired power stations are being reactivated and gas turbines are being built. In addition, the EU renewable energy targets put France under pressure to finally get serious about its commitments.

The Finnish Case

Finland is building the only new reactor in the EU, the first one to be ordered outside France, since the 1980s. The case is truly unique. Finland has had by far the highest electricity consumption growth rate in the EU, mainly due to pricing policy and the large-scale introduction of space heating. About 30% of the dwellings in Finland are heated by electricity. The country doubled per capita consumption over the last twenty years to reach a level of over 15,000kWh per year, which is two and a half times EU average and even 20% higher than the US. If Finland had contained consumption to the level of Germany, still slightly higher than EU average, it would save about three times the amount of electricity that the EPR under construction is expected to generate or about twice the current production of the existing four nuclear power plants. In 2005 Finland imported 18TWh of power[17], including from Russia, where four Chernobyl-type RBMK-1000 reactors (Leningrad-1 to -4) at Soznovy-Bor, close to St. Petersburg, operate in particular for export.

The EPR, future third unit of the Olkiluoto plant, should replace some of the electricity imports from Russia. The project has been put together in a quite unusual manner. Rather than one utility ordering the facility, about 60 future clients, municipalities and utilities became shareholders of the project. The AREVA-Siemens consortium granted a fixed price of

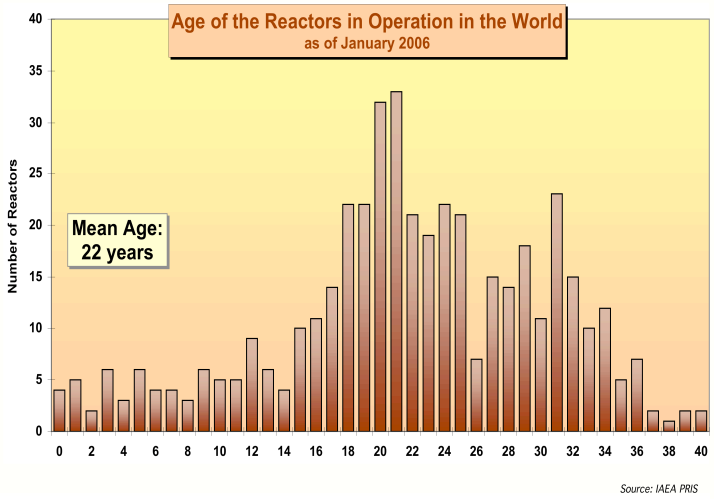
[16] Mycle Schneider is lecturing at the Ecole des Mines de Nantes.
[17] Net imports, which covered 20% of the consumption, were particularly high in 2005 because of a large seven week long labour dispute in the paper industry that led to a sharp drop of power generation in the sector.

€3 billion. The German public bank Bayerische Landesbank[18], provided a syndicated loan to the Finnish lead utility TVO of €1.95 billion, over 60% of the contract value, at a particularly preferential interest rate of 2.6%. The French public COFACE export credit agency covered an additional €720 million loan. In December 2004 the European Renewable Energy Federation filed a complaint before the EU Commission for "possible infraction of EU State aid, export credit, procurement, safety and other regulations".[19] Less than a year after the construction start, the project is already nine months behind schedule. Soaring world steel prices put an additional question mark on the profitability of the project.

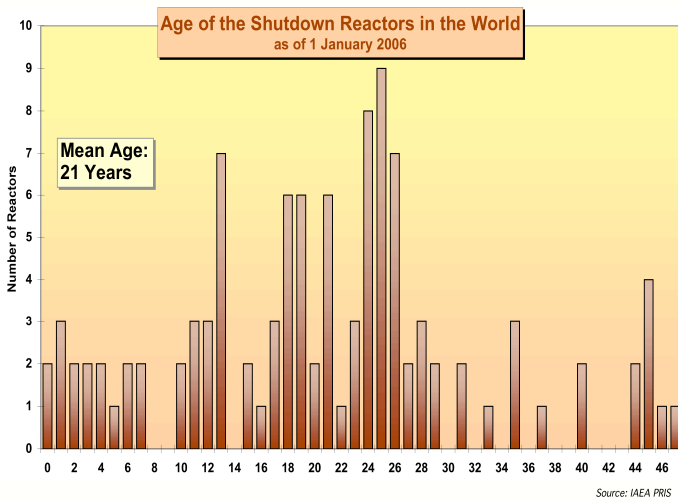
Rapid Aging

In the absence of any significant new build, the nuclear power plants are aging rapidly. The current average age of operating units is roughly 22 years (see graph 3). Currently there are only two small operating units that have operated for 41 years. In fact the seven units that have reached 38+ years have an average size of 200MW, not comparable with the bulk of the large operating units that have 900MW or more. The average age of 109 shut-down nuclear reactors[20] is about 21 years and the experience with long operating times is very limited. Only

Graph 3:



Graph 4:



17 units, half of them small military plutonium production reactors have operated beyond 30 years. However, the international nuclear industry is currently planning on reactor lifetimes of 40 years and sometimes up to 60 years. Even 40 years *on average* seems highly optimistic considering the lack of industrial experience with long lifetimes. The current age structure of the operating reactors (see graph 4) shows that about 80 units will reach age 40 or over[21] until

[18] The Bavarian State, seat of Siemens, holds 50% of the Bayerische Landesbank and the Sparkassenverband, controlled by local authorities, holds the other 50%.
[19] EREF, Press Statement, 13 December 04
[20] Not taking into account 8 small units of less than 100MW.
[21] The German plants are calculated with an average maximum age of 32 years, as stipulated by the German phase out law, which has not been put into question by the new grand coalition government. (for details see Mycle Schneider, Antony Froggatt, *The World Nuclear Industry Status Report 2004,* www.greens-efa.org/.webloc

2015 and an additional 200 reactors will operate for four decades or more by 2025. Even if it was possible to practically double current operating age of all reactors, their replacement at age 40 would mean a need to connect a unit to the grid every month and a half until 2015 and one every 18 days between 2015 and 2025. Considering the long lead times of nuclear power plants of at least ten years, such a scheme is impossible. In other words, either the average age of currently operating plants must be significantly extended beyond 40 years – this is highly unlikely given the industrial experience so far and would lead to a whole range of specific new problems related to aging materials and therefore to safety – or the number of operating units will decline. The editors expect the latter, a slow but steady decline, where new units don't make up for the ones that are shut down. This is also the result of the analysis provided by the 2005 edition of the World Energy Outlook of the OECD's International Energy Agency:

> "The share of nuclear power in global primary energy demand will decline over the projection period [2030]. Few new reactors are expected to be built and several will be retired. Nuclear power will struggle to compete with other technologies and many countries have restrictions on new construction or policies to phase out nuclear power. As a result, nuclear production is projected to peak around 2015 and then decline gradually. Its share of world primary demand will remain flat, at about 6%, through 2010 and then fall to less than 5% by 2030."

Nuclear Power's Economics and Climate Change

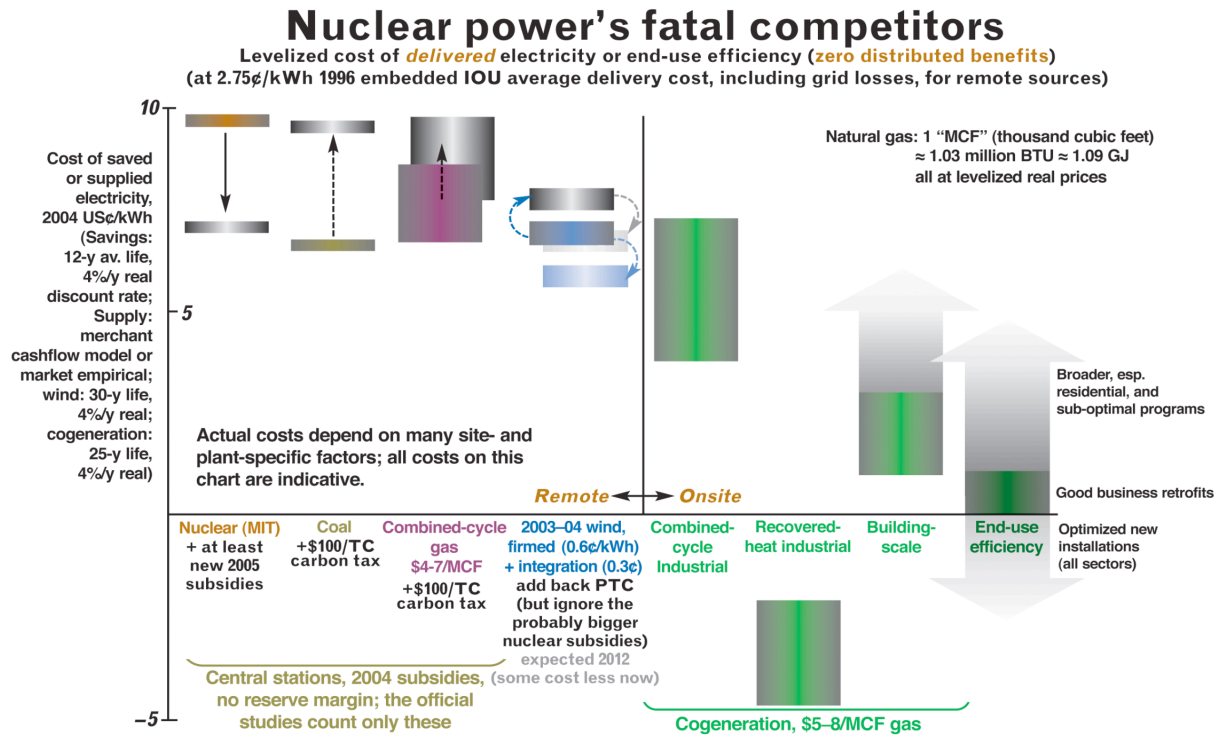
Amory B. Lovins, CEO of Rocky Mountain Institute and long time energy analyst, has looked at nuclear energy's competitors and concludes that the strongest growth patterns are with small scale non- and low carbon technologies that have already outpaced nuclear energy[22]:

> "These data show that micropower has already eclipsed nuclear power in the global marketplace. Of that micropower, ~65% of 2004 capacity and ~77% of 2004 output was fossil-fuelled CHP, which was about two-thirds gas-fired, yielding an average carbon intensity no more than half (ranging from ~30% to ~80%) as big as the separate power plants and boilers or furnaces it replaced. The rest of the micropower was diverse renewables, whose operation, like nuclear power's (neglecting enrichment), releases no fossil-fuel carbon. Worldwide, these low- and no-carbon decentralised generators surpassed nuclear power's total installed capacity in 2002 and its annual output in 2005. In 2004 they added 5.9 times as much net capacity and 2.9 times as much annual output as nuclear power."[23] [xx verify final version of quote]

According to Lovins, nuclear energy remains the most expensive option to supply or save a specific amount of energy. Even with a US$100/t carbon tax it needs subsidies to make nuclear power competitive with coal, combined cycle gas plants or even wind turbines. In any case, energy savings and small-scale non- and low carbon options as well as conservation measures turn out much less costly than nuclear power (see graph 5).

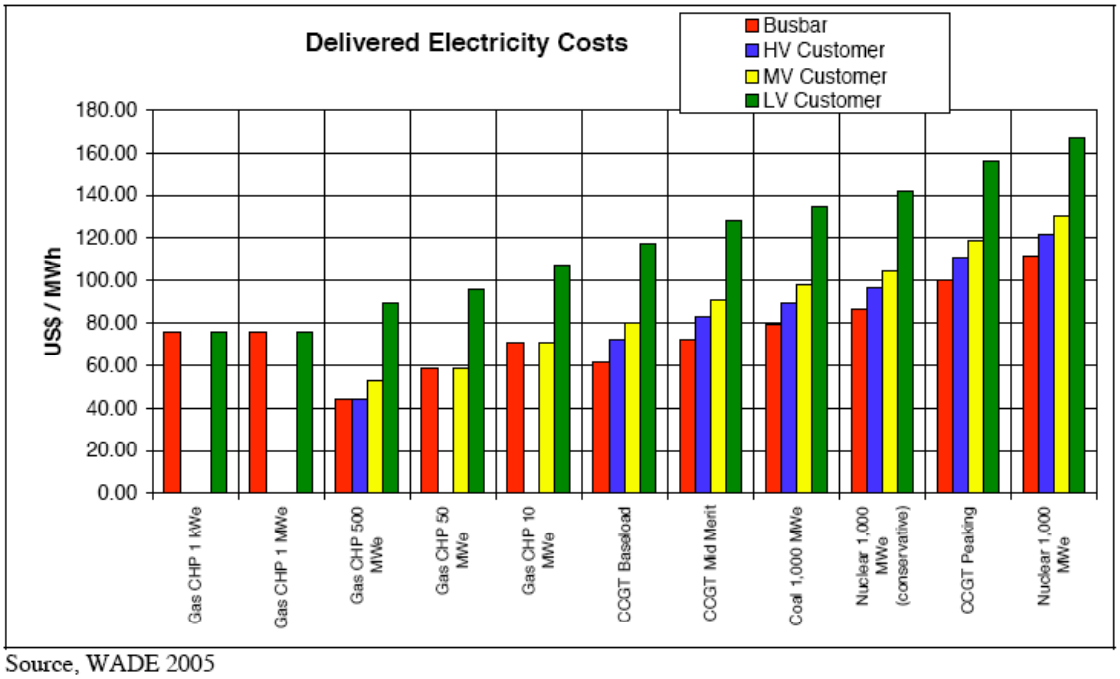
[22] Lovins takes hydro into account only up to 10MW.
[23] Amory B. Lovins, *Mighty Mice,* Nuclear Engineering International, December 05

Graph 5: Comparative Cost Estimates Coal, Gas, Nuclear, CHP, Conservation



Another recent comparative delivered electricity cost estimate carried out by the World Alliance for Decentralized Energy (WADE) clearly identifies nuclear power as the most expensive option (see graph 6).[24]

Graph 6: Comparative Cost Estimates Gas, Coal, Nuclear



Source, WADE 2005

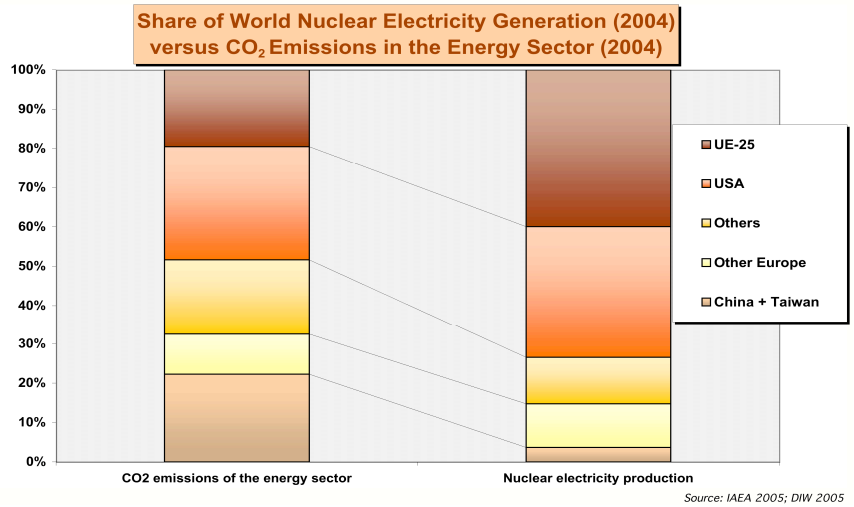
[24] WADE, *Projected Costs of Generating Electricity,* August 2005

The Lovins and WADE assessments are in line with the literature study carried out by one of the authors[25]:

> « Amongst the forecasts examined in this report, the typical construction cost projected is about £1100/kW. The one forecast that appears to be based on an actual contract cost, the Lappeenranta study, uses a significantly higher construction cost forecast. It should be noted that the Olkiluoto bid, which is the basis for the Lappeenranta study, is often seen as being below the economic price. Another area where large improvements in performance are expected is in the non-fuel O&M costs, where forecasts are often only about 40 per cent of current UK costs and about 70 per cent of current US costs. Operating performance forecasts typically suggest load factors of 90 per cent, far above the level achieved in Britain so far and in line with the performance achieved by only the most reliable plants worldwide.
> However, the most difficult and important assumption, is arguably on the cost of capital. In some cases, such as the RAE and the IEA/NEA forecasts, the assumptions chosen would only be credible if the owners of the plant were allowed full cost recovery. The US forecasts use more sophisticate methods of determining the cost of capital, but given the lack of progress in most of the USA with introducing competition into electricity, it is not clear that these studies fully reflect the impact of opening electricity generation to competition. Unless there was a return to a monopoly electricity industry structure, a measure that in current circumstances seems almost inconceivable, this would mean the owners would effectively being subsidised by taxpayers (if there was government underwriting) or electricity consumers (if a consumer subsidy was reintroduced).
> It is questionable whether such arrangements would be politically viable or whether they would be acceptable under European Union law which proscribes (except in a specific cases) state aids. If the owner of the plant is going to be required to bear significant economic risk, a real discount of at least 15 per cent, as used by the PIU, is likely to be imposed and even with very optimistic assumptions of construction and O&M costs (e.g., the PIU or Chicago University forecasts) this would result in generation costs probably in excess of about 4p/kWh. »

The question of economic performance per delivered energy service is fundamental in the debate about options to greenhouse gas abatement. However, other systemic parameters are also of major concern. It is striking that the economies that are the largest greenhouse gas emitters are at the same time the largest producers of nuclear electricity (see graph 7).

Graph 7: CO2 Emitters and Nuclear Power Producers



[25] Steve Thomas, *The economics of nuclear power: analysis of recent studies*, PSIRU, July 2005

Even France that has been the exception to the rule is now back on track: CO2 emissions have continued to rise over the last years. The main reason lies within the systemic dynamic. Nuclear power is provided by large production units. The larger the unit, the larger the capital investment and the financial risks. At the same time the investing utility looses flexibility compared to smaller scale decentralised units that can be built in two years and less. Investment into a large power generation source means a long term bet on electricity demand development. Investments into large units tend to lead to overcapacity. A situation that currently prevails in the EU and in most industrialised countries. Current "forecasting" by utilities and their lobby organisation that "predict" imminent lack of generating capacity are reminiscent of the 1970s when high forecasts led to the current huge structural overcapacities. As if there was no option to influence future demand… In that sense, one can argue that nuclear power actually hinders effective greenhouse gas abatement through large-scale investment into energy conservation and efficiency programs.
The UK Government's Sustainable Development Commission recently issued its report on nuclear energy and came up with the following conclusion[26]:

> "The majority of members of the Commission believe that, given sufficient drive and support, a nonnuclear strategy could and should be sufficient to deliver all the carbon savings we shall need up to 2050 and beyond, and to ensure secure access to reliable sources of energy.
> The relatively small contribution that a new nuclear power programme would make to addressing these challenges (even if we were to double our existing nuclear capacity, this would give an 8% cut on total emissions from 1990 levels by 2035, and would contribute next to nothing before 2020) simple doesn't justify the substantial disbenefits and costs that would be entailed in such a programme."

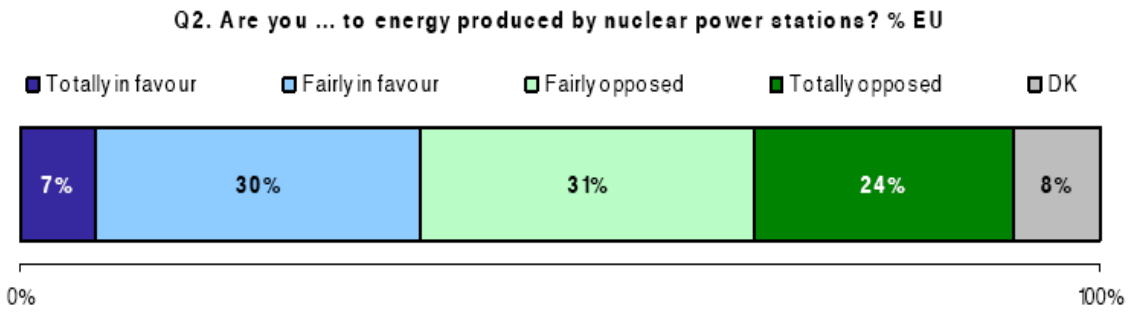
Nuclear power's contribution to greenhouse gas abatement is modest for existing plants and would remain less efficient, non-sustainable, more expensive and less accepted than alternative options.

Public Opinion

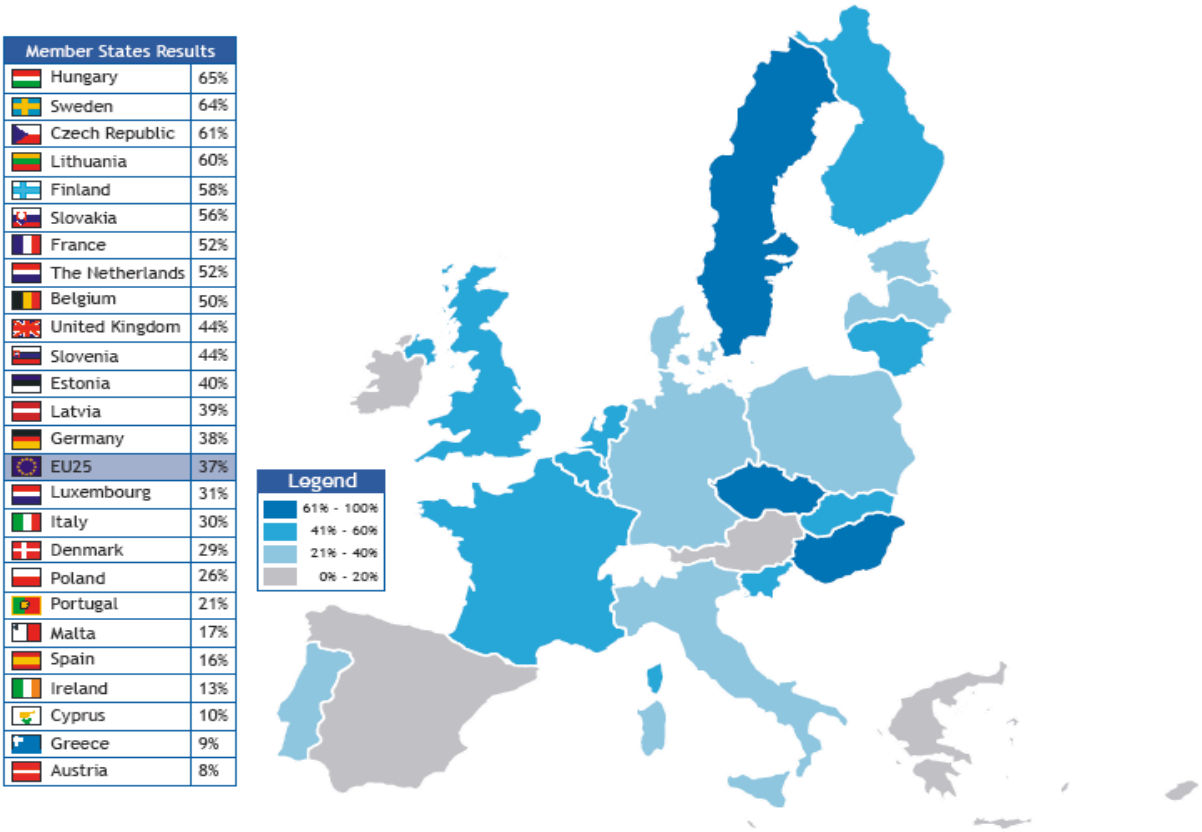
The public attitude to nuclear energy has had a major influence on nuclear power programs in most of the nuclear countries and, in some cases, has prevented utilities to go nuclear or to phase out nuclear power. Public opposition banned nuclear power in Denmark and Ireland, prevented an already built unit from starting up in Austria, led to a short-term phase out in Italy and to long-term phase out in Belgium, Germany and Sweden. According to opinion polls acceptance has grown in some countries like Finland, Sweden and US. However, the vast majority rejects nuclear power. More so, there is only a very small minority – 7% in the EU25, according to the latest poll carried out on behalf of the European Commission[27] – that is "totally in favour" of nuclear power. Opinions vary widely amongst countries. It is remarkable that the highest acceptance seems to be in the Nordic and Eastern European nuclear countries, while the lowest is in the non-nuclear and Southern countries. Spain is a noteworthy exception in that it has an operating nuclear power program with a very low acceptance. The current government's programme to embark on a phase out strategy seems to based on broad public support.

[26] Sustainable Development Commission, *Is Nuclear the Answer?*, London, March 2006
[27] Special Eurobarometer, *Radioactive Waste,* commissioned by DG TREN, European Commission, September 2006

Graph 8: Public Opinion on Nuclear Power in the EU25



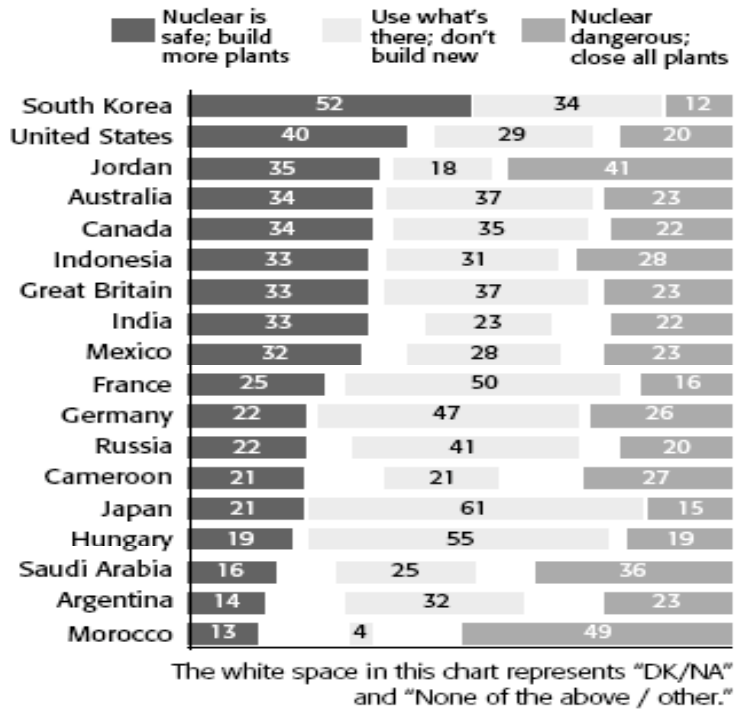
Graph 9: Public Opinion on Nuclear Power in EU25 Member States



Member States Results	
Hungary	65%
Sweden	64%
Czech Republic	61%
Lithuania	60%
Finland	58%
Slovakia	56%
France	52%
The Netherlands	52%
Belgium	50%
United Kingdom	44%
Slovenia	44%
Estonia	40%
Latvia	39%
Germany	38%
EU25	37%
Luxembourg	31%
Italy	30%
Denmark	29%
Poland	26%
Portugal	21%
Malta	17%
Spain	16%
Ireland	13%
Cyprus	10%
Greece	9%
Austria	8%

The results of the European Commission poll support the idea that people reject nuclear power once they get the impression that there is actually a choice. Whenever asked what would be the preferred technological option, people tend to answer "renewable energy". The International Atomic Energy Agency (IAEA) recently published the results of an 18-country opinion survey that made an appropriate distinction between existing nuclear power plants and units to be built.[28] While 62% favour the use of existing units, 59% were against the building of new plants and 25% say that nuclear power is dangerous and all existing plants should be shut down. It is remarkable how similar the results of the survey are for countries like France and Germany despite them pursuing radically different nuclear policies: 25% and 22% respectively support new build, while 50% and 47% support existing but oppose new build. Only the opposition to all operating units is more pronounced, while 16% of the French are in favour of shutting down operating plants, the figure reaches 26% in the German case.

Graph 9: Public Support for Existing and to-be-built Nuclear Power Plants



Conclusion

Nuclear power plays a modest role in the international energy situation and does not provide more than 2%-3% of final energy on the planet. Even in France, the most nuclear country, this technology does not cover more than 17.5% of the final energy consumption. The present survey of nuclear power programs in the world indicates that, in sharp contradiction to numerous reports, the number of nuclear power plants in the world is very likely to decline rather than to increase unless the average lifetime of the facilities would be extended *on average* far beyond 40 years, the double of the current average age. It is obvious that such a major increase in operating lifetimes, far beyond past industrial experience, would entail a

[28] *Global Public Opinion on Nuclear Issues and the IAEA - Final Report from 18 Countries*, prepared for the International Atomic Energy Agency (IAEA), GlobeScan Incorporated, October 2005

number of specific, in particular safety related problems. The decline of nuclear power will not be prevented even if some major plans, like up to highly unlikely 30,000MW of additional capacity in China, became reality. Nuclear power remains expensive and has to face increasing competition from decentralised small-scale electricity generating sources including combined heat and power and renewables. If high capital expenditure, supported by State subsidies, into nuclear energy lead to a remake of large structural overcapacities with its inherent energy wasting and prevent societies from investing into energy conservation and efficiency, the nuclear path might actually constitute a significant barrier to the implementation of necessary and urgent greenhouse gas abatement strategies.