International Physicians for the Prevention of Nuclear War (IPPNW) – German Section

EUROSOLAR
The European Association for Renewable Energy

Facts on Nuclear Energy

Background Information

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1. Nuclear power is a dead end
Uranium is only available for the next few decades – what then?

Nuclear power stations are being run on a limited supply of raw material uranium. Natural uranium is extracted from underground mines, surface mines or from the so-called in-situ solution procedure and comes mainly from Canada, Australia, Nigeria and Namibia. Smaller amounts are furthermore provided by Uzbekistan, Russia, Kazakhstan, the USA and the EU.

In 2004, approximately 440 commercial nuclear power stations were operated worldwide. This year, the demand for natural uranium amounted to 62,000 tons. The EU had an annual demand of approximately 20,000 tons of uranium. Part of the demand for uranium is covered by stocks available from the military.

The economically profiting uranium reserves were disclosed in the so-called „Red Book“ from the International Atomic Energy Agency (IAEA) and the OECD Nuclear Energy Agency (NEA) in 1999. Dependent upon the amount of the manufacturing costs, a total of between 1.25 and 4 million tons of uranium is therefore “economically” degradable. This is partially to do with secured uranium and the estimated deposits from uranium.

According to the demand of 62,000 tons of uranium in 2004, the reserves will last for the next 20 to 65 years.

Should the nuclear power station capacities be expanded, then the reserves would accordingly be used-up faster. According to the perceptions of the IAEA, the demand of uranium can be estimated to be approximately 7.6 million tons up to the year 2050. Given an estimation of economically profiting uranium of approximately 4 million tons, in the event of an expansion of nuclear energy then the reserves would be well exhausted before 2050.

If necessary, fast breeder reactors could stretch the uranium supplies temporarily. However, the “fast breeders” have failed worldwide due to technical, safety and economical reasons.

The development of this type of reactor was stopped in the USA in 1977 due to potential hazard reasons. The British breeder program failed due to high costs and little chances of success. In Germany, the fast breeder in Kalkar costing over 5 million Euros could not be put into operation because of unsolved safety and technical problems. The Japanese breeder Monju is to be repaired due to serious technical problems.

This shows that fast breeders provide no solution for the extremely tight uranium reserves.

Nuclear energy is soon to come to an end. In a few decades, perhaps in 20 or 30 years, uranium will become so rare and expensive that nuclear energy, despite massive subvention, will end up uneconomical for good.

In opposition to this is renewable energy (sun, wind, water and biomass), which is inexhaustible. As long as the sun shines and people live on our planet, then these energy sources are at our disposal.

2. Nuclear power is a con trick
Nuclear energy is dispensable for the energy supply

In order to increase the importance of nuclear energy, the nuclear industry restricts itself to the manufacturing of part of the nuclear energy to the generation of power. The energy demand of mankind, however, is not only limited to the demand of electrical power. Far more amounts of energy are needed for transport and for heating purposes (cooking, heating and industrial purposes).

Nuclear energy is, in fact, relatively unimportant. According to the energy statistics from the International Energy Agency („Key World Energy Statistics 2003“), 2,653 terawatt hours were produced worldwide in 2001.

This amount was equivalent to only 6.9 per cent of the global demand for primary energy.

Even this small portion demonstrates an overestimation of nuclear energy.

This is because electricity from hydroelectric power stations, wind turbines and solar stations is measured as a primary energy by statistic practice (degree of efficiency) of the energy of the water, the wind or sun; which is how one measures uranium. Primary energy, in contrast to nuclear energy, only counts as the actual amount of energy extracted from the electricity current.

This is of course problematic, because one is comparing apples to pears. On one hand the primary energy with which the power station is being powered is being shown (uranium, not atomic electricity) and on the other, energy is being indicated which comes from the plant itself (electricity, not water or wind or sun).

According to the substitutions method, this problem can be solved. Here, not only the loss of the atomic electricity from the conversion process in the power station is being considered, but also the primary energy consumption from the electricity of renewable energies; this corresponds to the amount of energy which would be necessary in order to provide a large amount of generation of electricity in average fossil power stations!

Should one assume the comparable nuclear energy conversion efficiency rate of 33 per cent, then a result for the generation of electricity from water power, which achieves an amount of 2.2 per cent when compared to the efficiency rate, arrives at a primary energy amount of 6.6 per cent.

One can also view this the other way round and can assess the nuclear energy in the same way as hydraulic power. As a result, one sees that nuclear energy supplied only 2.3 per cent of the worldwide energy consumption in 2001!

This shows that even hydraulic power, with its 2.2 per cent, contributed almost just as much to the world energy demand as nuclear energy with its 2.3 per cent.

As this is no trick calculation, the statistics were then used by the International Energy Agency in their calculations in 2001. Thereafter, 2,646 terawatt hours of nuclear energy and 2,569 terawatt hours of electricity in hydroelectric power stations was generated. The hydroelectric power stations delivered almost as much electricity as the nuclear power stations.

From the official primary energy statistics, however, a drastic inclination resulted: despite almost the same amount of electricity generation, the International Energy Agency showed that for hydroelectric power stations there was a primary energy amount of only 2.2 per cent, whilst the amount of the nuclear energy was artificially inflated from 2.3 per cent to 6.9 per cent.

Should the primary energy demand double up to the year 2050, as the global energy scenarios would assume, then the nuclear energy would become completely insignificant and could cover 1 to 2 per cent of the global energy demand in 2050, even by moderate development. This is assuming that there would be affordable amounts of uranium reserves at our disposal.

The renewable energies in total account for a far higher proportion of the world energy demand as nuclear energy.

Even today, the total renewable energies constitute for a much higher amount of the global energy demand than nuclear energy.

In this respect, should one regard not only hydraulic power stations, but also wind turbines, solar panels and, in particular, the profitable energy which can be obtained from the various types of biomass, then the amount of energy in 2001 would amount to 13 per cent (primary energy).

Due to the expansion of, in particular, wind turbines and solar panels in 2004, there was a considerable increase in the amount of the renewable energies (official figures were not present at the time of the editorial).

Mankind can make do without the small amount of nuclear energy. The risks of nuclear accidents and the production of highly-radioactive nuclear waste stand in no reasonable relation to the marginal benefits of energy for a short period of time. Nuclear electricity is dangerous and dispensable.

3. Nuclear power gambles with our lives
Super-GAU risk in Europe: 16 per cent!

Numerous safety reports have shown that all nuclear power stations can account for serious accidents („Super-GAU“) due to the fact that a large amount of the life threatening radioactive substances are released into the environment. The technical equipment can fail and the people that work in the power stations can also make serious mistakes, which can lead to a Super-GAU. In addition to this, there is also the danger of terrorist attack on the nuclear power stations.

A particular source of danger is due to the increasing liberalisation of the electricity markets. Because of this, the costs increase for the nuclear power station operators. In Germany, this example can be shown, in that a number of the tests of safety-relevant components were reduced and necessary repairs were postponed temporarily.

It is remarkable what has already happened in nuclear power stations, hidden behind grey walls. Pipelines rust and get dangerous cracks over and over again. Even single pipelines have burst. A severe hydrogen explosion damaged a pipeline in a power station. The fuel elements from the loading cranes in the nuclear power stations fell time and time again. The power station personnel repeatedly and deliberately stopped the central security systems. After repairing security systems it is not uncommon to forget to reactivate them. It has happened in the past that a hardhat fell into a safety-important pump during maintenance work, which later led to the failure of that particular pump. Thunder and storms lead repeatedly to the feared case of emergency power. In one nuclear power station, it led to the total failure of the power supply. There were often dangerous fires in power stations. Due to ageing processes, the power station controls are readjusted so that the safety systems do not activate accordingly. A new digital control engineering, which is also to be used with the European pressurised-water reactor (EPR), led in one nuclear power station to the point where the most important safety device was overridden by the high-speed shutdown system. The list could be continued.

The biggest danger is the cooling of the reactor core, where the uranium bearing fuel rods are located, fails and as a result the reactor core melts due to high temperatures. Should it come to so-called "core melting", then the probability of the radioactive substances being released into the environment is very high and with the help of air mass, could be spread to hundreds or even thousands of kilometres.

In 1979 in the American nuclear power station Harrisburg (Three Mile Island/TMI), a third of the reactor core melted. In 1986 in Ukrainian Chernobyl, total core-melting took place, which led to the release of radioactive substances. The radiating clouds of smoke from Chernobyl travelled over the whole of Europe and contaminated air, soil, water and food.

The odds that severe nuclear accident (Super-GAU) occurs, are by no means slim.

According to the official report „German Risk Study of nuclear power stations – Phase B", the chances of a core-melting accident taking place in a German nuclear power station is 2.9 x 10^{-5} per year (2.9E-05/a). Should one take an operation period of a nuclear power station of 40 years into account, then the probability of a Super-GAU occurring is 0.1 per cent.

With the number of operated nuclear power stations, the probability of a Super-GAU occurring naturally increases. At the beginning of 2004, more than 150 nuclear power stations were in operation in the EU. The odds that a Super-GAU should happen in Europe in the next 40 years lie therefore by 16 per cent, or 1:6.

These are the same odds of getting a 6 when you throw a dice.

Accordingly one can also measure what the probability of a Super-GAU taking place in one of the worldwide nuclear power stations is. In 2004, approximately 440 nuclear power stations were in operation. Globally, the chances of a Super-GAU happening in the next 40 years is 40 per cent.

The given timeframe of 40 years does not, however, necessarily mean that an accident could occur in 40 years time. The Super-GAU could become a reality tomorrow or even the day after tomorrow. One can also not exclude the fact that a Super-GAU could occur two or three times in the next 40 years.

The International Atomic Energy Agency (IAEA) and companies dealing with nuclear energy, such as Siemens and AREVA, fight for the further development of nuclear energy. It is blatantly clear that the risk of an atomic accident can continue to rise.

In 1986 the nuclear power station Chernobyl reported the worst case of Super-GAU in the history of nuclear energy. The accident led to many tens of thousands of deaths. The Otto Hug Strahleninstitut in Munich, active for Chernobyl-Aid, estimated, based on official figures, that up to 70,000 people died as a result of Chernobyl.

One gets an insight to the extent of the illnesses which resulted from the Chernobyl accident if one takes into account the patients with thyroid illnesses and thyroid cancer in the Thyroid Centre Gomel of the Endocrinically Dispensary Ward of Oblast Gomel.

In this clinic, since the start-up of the Otto Hug Strahleninstitut, over 11 years approximately 120,000 patients with various thyroid illnesses and thyroid cancer were treated. Approximately 20,000 of these patients were children. In Republic of Belarus, over 12,000 patients with thyroid cancer are being treated, of this sum more than 1,000 cases are children and teenagers. Alone in the administrative territory Gomel approximately 400,000 people, who, at the time of the accident were children or teenagers, had a high risk of thyroid cancer and needed regular examinations.

In addition to the thyroid illnesses, other illnesses occurred in the Chernobyl area:

- In the area of Gomel, cases of diabetes in children has risen three times in comparison to the time before the catastrophe
- In the area of Gomel there is a notable rise in tumours of the lung, stomach, skin and prostate in men
- By women, cases reported were tumours of the breast, womb, stomach and skin
- Cases of breast cancer in women has doubled since 1988
- There is a clear increase of the illnesses connected with the reproduction of humans

After the Chernobyl catastrophe, an area of approximately 10,000 sq km in the Republic of Belarus (70 per cent), Ukraine (15 per cent) and Russia (15 per cent) acted as a prohibited zone and area of strict control. More than 500,000 people had to be relocated, i.e. they had to leave their apartments, houses and work places for a long period of time, and more than 200,000 people had to be evacuated out of the prohibited zone.

In many countries where nuclear power stations are operated, the rate population is considerably higher than that in the Chernobyl area. In Central Europe, for example, the population is ten times higher. Should a Super-GAU occur in the West, due to the fact that the population of people settled close to one another is ten times higher, more people would have to be relocated and the loss of health, work and trade would also occur.

Last but not least, there are also financial losses of a Super-GAU which are associated with the victims. The possible financial damages of a Super-GAU was estimated to be up to 5,400 billion Euros, as shown in a study from the company Prognos AG in Basel for the German Department of Trade and Industry. The damages of a nuclear power station worldwide accumulates to a maximum of only 2,5 billion Euros. That is less than 0.1 per cent of the expected losses. For more than 99 per cent of the damages of a Super-GAU, there is no cover for precaution for the atomic industry. That means that the victims leave with practically nothing.

4. Nuclear power is a waste
Where should the radioactive waste go?

Each nuclear power station transforms uranium fuel rods into highly radioactive waste during the process of nuclear fission. Everything that comes into contact with the „heated“ nuclear fuels has a deadly dose of radioactive radiation.

A nuclear power station that has an electrical capacity of 1300 megawatts produces approximately 30 tons annually, and in 40 years approximately 1,200 tons of radioactive waste. Worldwide approximately 440 nuclear power stations create an estimated 8,300 tons of radioactive waste per year. With an assumed average operation period of 35 years, this generation of nuclear power stations leaves behind an estimated 290,000 tons of highly radioactive waste, together with an amount of weak and middle-active waste.

This radioactive waste radiates and endangers people for hundreds and thousands of years.

Plutonium-239 has a half-life span of around 24,000 years. This means that, for example, 100 tons of plutonium has half the amount – or 50 tons - after 24,000 years. After another 24,000 years, 25 tons is left. After another 24,000 years, 12.5 tons is left. And after another 24,000 years 6.25 tons is still left over.

After an inconceivable timeframe of approximately 100,000 years, from 100 tons of Plutonium-239, around 6 tons is still left over. Due to the fact that approximately 5 kg is enough to build an atomic bomb (plutonium bomb), after 100,000 years there would still be enough materials to build around 1,200 atomic bombs.

Given that less than one milligram of Plutonium-239 is enough to cause lung cancer, 6 tons of this substance would theoretically be sufficient to cause lung cancer in more than 6 billion people.

As analyses of highly radioactive waste from nuclear power stations show, isotopes such as Technetium-99, Zirconium-93, Niobium-93, Uranium-233 (and others stemming from Uranium), Caesium-135, and, in particular, Neptunium-237 even after more than one million years still account for the radiation load of atomic waste!

After only a few decades of the use of nuclear energy, highly-dangerous atomic waste is therefore left for generations to come, an amount which is almost not conceivable. The use of nuclear energy ensures generations to come 3 per cent of its demand for energy and leaves not only our children and grandchildren, but also an unimaginable amount of generations of deadly radiating waste for hundreds and thousands of years.

This waste must therefore be protected from the biosphere (i.e. people, animals and plants) for many hundreds and thousands of years, or even for over a million years.

To shield the radioactive waste for such a length of time in a safe disposal area, where no contact with humans could occur, is an unsolvable task. Under each rock of this earth where one could bury the atomic waste, there is the risk that the radioactive substances could find a way to the earth's surface, for example via waterways, thus providing contamination.

The board of experts for environment questions from the German Federal Government determined in its „Expert opinion on the environment 2000“ report that the construction of a secure long-term disposal site for nuclear waste is, from a scientific point of view, practically impossible: „an estimation of the potential exposure over a long period of time is almost impossible. Investigations, which should provide a basis for a suitable waste disposal, have not shown scientific proof of an absolutely secure waste disposal site in the long term. The environment advice is therefore convinced that there is no ideal location for the final waste disposal of (highly) radioactive waste. “

In 1983 the US National Academy of Sciences determined that „practically the entire Iodine-129 [with a half-life span of 15.7 million years] of not reprocessed radiating fuels will, at some point, makes its way into the biosphere from its disposal sites.“

Nuclear power stations have only been operating for more than 50 years and still no-one knows of a location where the waste can stay put for once and for all.

5. Nuclear power is a bomb factory
Nuclear power boosts the distribution of atomic weapons

History shows that many countries that entered into atomic technology primarily had a military interest connected with it. This means that they did not only want to produce power, but to acquire the capability to build atomic bombs.

In the USA and the Soviet Union, the interest in the building of the atomic bomb was from the very beginning the decisive motive for going into atomic technology.

With the impression of the US-doctrine „Atoms for Peace“ in 1953, many countries officially started a purely civilian atomic program, although the only concern for them was the access to bomb technology.

In this way the military motive is demonstrated in Europe with the first purely civilian defined atomic programs of Great Britain, France, Sweden, Switzerland and Spain. All these programs aimed to create an industrial capacity for the production of weapon-plutonium at least in the first two decades.

Outside Europe, Argentina, Brazil, South Africa, Israel und Iraq operated a civilian-disguised atomic program for military purposes. For other countries such as Iran, much is assumed in this way. Even North Korea is accused of having at least one atomic bomb. Finally India and Pakistan developed an atomic bomb based upon a civilian defined atomic programme and publicly demonstrated its atomic bomb test.

In April 2002, the President of the Liberal Party threatened that his country could build thousands of atomic bombs. The required plutonium is available due to the fact that Japan has more than 50 commercial nuclear power stations.

All countries that have, or have been trying for years to acquire, the technology to build atomic bombs, are being supported by the countries with the available atomic programs. The export of alleged civilian atomic technology, know-how and fissionable materials is the way to the distribution of the techniques and the building of nuclear weapons.

All companies, research facilities and countries that export atomic technology are helping towards the further distribution of a highly dangerous weapon technology.

6. Nuclear power loses climate race
Upgrading nuclear energy cannot save the climate

For years nuclear economy argues its importance together with the facts of the catastrophe of the climate.

But even the nuclear economy has admitted that the greenhouse gas producers coal, oil and natural gas cannot be replaced by nuclear power stations. This was explained by the long-standing boss of Siemens (holding company Framatome ANP) Heinrich von Pierer, in 1991 at the Annual Convention for Nuclear Technology, who was engaged in the nuclear business.

„For many reasons it would unrealistic to try to replace all fossil sources of energy with nuclear energy. That cannot be done with the engineering of today regionally or globally. “

Even if one only wanted to replace a small amount of fossil energy with atomic energy in the year 2050, we would be stretching our limits. Up to 1,000 new nuclear power stations, each with an electrical capacity of 1,300 megawatts, would have to be built in order to replace the expected rise of the world energy consumption up to the year 2050 which is 10 per cent of the fossil primary energy with nuclear energy.

The construction of these large-scale installations would take many decades due to the fact that even in its best year (1985) with a mere 34 gigawatts, the atomic economy succeeded in putting 26 new large nuclear power stations in operation. Since then the production capacities for new nuclear power stations have clearly decreased. The addition of 1,000 new large power stations could take up to 40 years. In addition, the current approximate 440 nuclear power stations would have to be replaced due to ageing factors.

It is definitely questionable if it would be possible to create 1,000 new nuclear power stations. There are many reasons: the problem of finding suitable locations for so many stations. The limited construction capacities of the nuclear power station manufactures, together with the lack of qualified specialists. The non-acceptance for nuclear power in many countries. The lack of demand of many banks and companies to invest in the expensive and high-risk nuclear energy. This applies due to the high initial investments in many countries where there are liberalisation markets. The shortage of the uranium reserves.

Even if it was possible to erect 1,000 new nuclear power stations, this would provide a substitution for around 10 per cent of the fossil energy. 90 per cent of the problem would therefore be unsolved, despite a huge effort.

If these 1,000 new nuclear power stations were to only become available in the next few decades, then these marginal steps towards the protection of the climate would come far too late in order to fight off or at least limit the change in climate, as expected by climatic researchers.

Even the International Atomic Energy Agency IAEA admitted in a report in June 2004 that the nuclear energy, even in the best case scenario, could not be expanded quick enough in order to limit the change in climate.

All this shows that the nuclear energy can not solve the climate problem.

In order to recognise which energy-political development can deal with the climate problem, in which the carbon dioxide exchange is reduced, it is wise to compare various world energy scenarios.

Energy scenarios of the oil company Shell and a majority of the scenarios from the World Energy Conference (WEC) assume a drastic growth of the demand for global primary energy up to the year 2050, whereby the renewable energies will be completely expanded, the nuclear energy use enlarged and also fossil sources of energy will be burnt in much larger degrees than today. Due to the increase of the combustion of fossil fuels, the resulting consequences of all these scenarios is that the global carbon dioxide emissions would dramatically increase.

In this way the climate problem cannot be solved.

Should one compare these scenarios with a further global scenario of the World Energy Conference (WEC); together with the „Renewable intensive Global Energy Scenario“ from Johansson et. al.; together with the „Solar Energy Economy“ scenario from Nitsch et. al; with the scenario of the scientific adviser of the German Federal Government for global environmental change (WBGU); together with the „Factor-4 scenario” from Lovins, Hennicke et al, then we are shown that that a climate problem can be reached as following:

1. Limitation of the growth of the global primary energy demand via the implementation of efficient energy use techniques on the manufacturing and execution side (decrease of the primary energy demand in the industry countries, limitation of the increase of the primary energy demand in the developed and developing countries).

2. Reduction of the combustion of fossil sources of energy.

3. Abandonment of the use of nuclear energy.

4. Drastic expansion of the renewable energies.

7. Nuclear power makes less jobs
Jobs? The wind industry strikes the atomic industry!

Using Germany as an example, we note that the renewable energies provide much more jobs than atomic energy.

In 2002, only a maximum of 30,000 people were employed in the atomic industry. In the same year, the German wind energy industry alone engaged the services of more than 53,000 people, although the contribution of wind energy to the generation of electricity was much less than that off atomic energy.

The whole industry of renewable energies secured, according to the German Federal Environmental Agency, approximately 120,000 jobs in 2002. In only four years the jobs had increased by 80 per cent.

In the next 10 to 20 years, it is expected that in Germany alone 500,000 or more jobs will become available.

This shows that through the expansion of renewable energies, in just a short period of time many millions of new jobs could be generated worldwide.

8. Alternatives to nuclear power
100% energy from the sun, wind, water and biomass

The theoretically available energy supply of the natural energy sources of the sun, wind, water, biomass, sea energy and terrestrial heat is more than 3,000 times than that of the current global energy demand. Even the available sunrays amount to 2,850 times more than the global energy demand. The wind energy supply is equivalent to 200 times more than the global energy demand. Even the biomass supply is 20 times more than the current global energy demand.

The amount which could be technically used is, of course, only part of this energy supply from the renewable energies. With reference to data from the Research Network of Sun Energy, the renewable energies could nevertheless cover 6 times the global energy demand with today's engineering.

This shows that the global energy demand, using renewable energies, could be completely covered with ease.

Even Shell admits that in the year 2050 the amount of energy that mankind uses today could be gained from renewable energies. The sun, wind, water, biomass and other renewable energies could thus provide a primary energy supply of 580 exajoules in the year 2050. That would be much more than the global primary energy production from 1997 – back then 390 exajoules was used-up.

In addition, with his global energy scenario „Solar Energy Economy" (SEE), Joachim Nitsch shows that up to the year 2050 renewable energies could deliver approximately 490 exajoules, which is more than is globally used today. Nitsch's scenario is planned in the industrial nations together with engaged energy efficiency politics, in order to limit the growth of the global primary energy consumption. Sources of fossil fuels would be able to deliver only 24 per cent in 2050. Nuclear energy would not be needed. The scenario of Nitsch plans in the industrial nations besides engaged energy efficiency politics, in order to limit the growth of the global primary energy consumption. In this manner, the carbon dioxide emissions could be reduced globally by 23 million tons in 1997 to 11 million tons in 2050.

Already at the end of the 70s and the beginning of the 80s several studies for the USA, Western Europe and France showed the possibility of a full supply from renewable energies.

The 2002 Parliament (Enquete Commission of the German Parliament) presented Germany with an energy scenario whereby the whole German power supply is realistically provided for by renewable energies, up to the year 2050. If this is possible in Germany, a country with a small area, large population, power density and a high standard of living, then it is possible anywhere else. In the meantime even the energy industry has admitted that up to the year 2050 more energy from renewable energies could be provided for than mankind needs today.

In addition to the development of the renewable energies, it is imperative that the growth of the global primary energy supply is limited. The „Factor 4-scenario" from Lovins, Hennicke et al shows that with energy efficient politics in the industrial nations, the growth of the global energy demand could be controlled from 390 exajoules in 1997 to 430 exajoules in 2050.

This primary energy demand of the year 2050 of 430 exajoules could be fully provided for via renewable energies.

The advantages of such a strategy are obvious:

1. Nuclear energy could be abandoned immediately.

2. Through the replacement of fossil fuels the aims to protect the climate could be fully achieved up to the year 2050.

3. With the efficiency politics the developing and developed countries could be entitled to catch up on the development, without having to repeat the mistakes of the industrial nations (lack of energy efficiency, extensive emissions from air pollutants and greenhouse gases).

4. Whilst the ever limiting fossil raw materials lead again and again to raw material wars, the transferral to renewable energies provide a strategy, which would clearly reduce the lead-up to war.