

Nuclear power: The beginning of the end

The global significance of nuclear energy is greatly overestimated – accounting for a share of barely two per cent of worldwide energy consumption, it is a rather phoney giant: The closer one looks at the facts, the less potential this controversial energy source seems to hold for the future.



Originally planned as a prestige project of the European nuclear industry, the reactor in Olkiluoto, Finland, turns out to be a financial disaster due to construction problems and a series of delays.

Photos (2): dpa

Nuclear power has never played a leading role in the global energy mix, and can also abandon any hopes of acquiring such a role in the future. At the same time, the costs have to date been enormous, even if we discount the unforeseeable risks of its radiation legacy. It is thus no surprise that the global nuclear phase-out has de facto long since begun – without waiting for political resolutions.

The boom period for the nuclear power industry was more than three decades ago. The capacity of the new plants coming onto the national grids every year already crossed its zenith in the mid-1970s, and has since dropped to on average one-tenth of the figures recorded back in those days. In the meantime that is not even enough to maintain the current generating base – since 2008, the overall output of the nuclear power plants worldwide has also been decreasing. There was not a single new plant taken into operation last year, but three old reactors were finally shut down at the end of the year alone. Strangely, such news earns little notice in the media, quite unlike the widely cited but seldom analysed declarations of intent with regard to new projects which are supposedly planned. On the bottom line, however, the total number of plants in operation has not actually increased at all for the past 20 years, because new construction has been accompanied by an equivalent decommissioning of older plants.



Declining number of reactors

Since 2002, the peak to date, the number of active power plants has in fact decreased, from 444 to currently 436 reactors. The effective nuclear phase-out has been proceeding even faster in the European Union, with one in five reactors having been shut down over the past 20 years. In his comprehensive “World Nuclear Industry Status Report 2007”, the independent political advisor and nuclear industry expert Mycle Schneider describes the foreseeable demise of the nuclear power industry. Even if we base predictions on the optimistic assumption that today’s power plants achieve an average operating life of 40 years – by contrast, the average for the reactors decommissioned to date has been just 22 years – half of the present plants will reach their retirement age in the coming 17 years. And there is presently no sign of activity which could reverse this worldwide phase-out. Only a handful of countries are pursuing the construction of new nuclear power plants seriously and to any significant extent: China and Russia, for example.

The fairy tale of cheap nuclear electricity

One perfect example of how easily nuclear electricity can fall into the cost trap is the prestige project of the European nuclear industry in Olkiluoto, Finland. The first new reactor to be built in Europe for more than 20 years was intended to polish up the ailing image of nuclear power. For the contractors Areva and Siemens, however, the project has already evolved into a financial disaster. Having planned the plant as a reference for the renaissance of nuclear power, they offered the Finnish power utility TVO a fixed turnkey price of around € 3 billion, allegedly without calculating a profit margin for themselves. The project was financed for the most part by the state-regulated German bank BayernLB – at an interest rate of just 2.6 %. The German taxpayer is thus also subsidising the Finnish project. In the meantime, construction problems and a never-ending series of delays have already pushed costs way over the original sum. Furthermore, the plant will not be handed over before 2012, three years after the scheduled date – the ensuing contract penalty to be paid by the project consortium is estimated to be around € 1 billion. They will thus have spent more than twice as much to build the plant as they will receive from their client.

Specified costs too low

A Greenpeace study has analysed economic efficiency on the basis of 75 reactors in the USA and the latest reactor construction experience gained in India. The results show that the official price per kWh for nuclear electricity represents only a good half of the real costs, because the planned outlay for new plants is frequently exceeded by up to 300 % or more, while at the same time, the costs specified for nuclear waste transport, dismantling and waste disposal are kept artificially low.



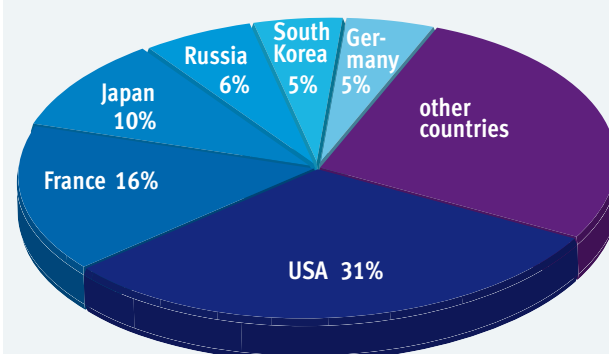
“Cigar Lake” project, one of the largest ore mines in the world and the only one with an ore grade of 1 %, had to overcome a time-consuming ecological appraisal and approval process. Photo: Cameco

It is above all the highly complex technology which makes nuclear power generation so expensive, not to mention the difficult – critics would say “impossible” – separation of civilian and military use. That is probably also why nuclear power has always remained a niche technology for luxury consumers. Just six countries account for three-quarters of the annual nuclear electricity generation and consumption: USA, France, Russia, Japan, Germany and South Korea. The attempts undertaken by the Bush administration to preserve the leading role of the USA by building new nuclear plants foundered on the lack of interest shown by the energy sector.

Nuclear reactors running on reserves

The fact of a worldwide decline in nuclear power is also associated with a circumstance of which large sections of the general public are unaware. The fuel uranium has long since been in short supply, and nuclear power plants have been consuming more uranium than is mined worldwide since 1991. The difference – currently around 40 % of the demand – is drawn from reserves dating from the time before 1990. The heyday for uranium mining was back in the early 1980s, when large quantities of uranium were required for the production of nuclear weapons in the

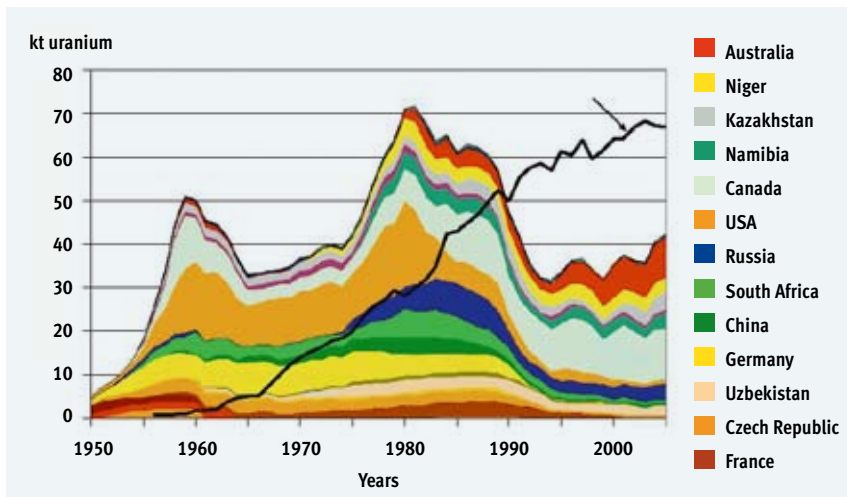
Who produces nuclear power?



Just six countries produce three-quarters of the world’s nuclear power – with the USA and France alone accounting for almost 50 %.

Data: International Atomic Energy Agency IAEA, 2007

Uranium demand and production worldwide



The black line shows the annual uranium consumption in nuclear power plants worldwide. The coloured areas represent the uranium production of the individual mining countries. Consumption has been higher than production since the early 1990s.

Graphic: LBST / EWG

USA and the Soviet Union. For many years now, a part of those weapons has been systematically dismantled, with the result that, statistically, every tenth kWh of nuclear electricity is generated using uranium from former Soviet warheads. Russia has been selling a certain amount of its weapons-grade uranium to the USA, where it is converted into fuel for nuclear power plants: the nuclear industry's own interpretation of the disarmament slogan "Swords to ploughs". These contracts expire in a few years and it is still uncertain whether Russia will be renewing them. After all, it is itself short on uranium, and is having to negotiate for additional deliveries from Australia. Even in Russia, by far the largest country in the world, there are not even sufficient resources to cover domestic demand.

The imminent shortage of uranium has already led to similar price developments to those we have seen for oil and coal. The spot market price for uranium oxide soared from US\$ 7 per pound (1 lb = 453.6 g) in 2000 to over US\$ 130 per pound in mid-2007. And analysts agree that the recent easing of the spot market price is only a temporary dip in the long-term trend. Uranium is thus just as much a cost factor for the plant operators as other fuels. The experts from Energy Watch Group have calculated that an increase of US\$ 100 per pound for uranium adds €-ct 0.5 to the costs of each kWh of electricity. A uranium price of US\$ 700 per pound, for example, would already double the cost of electricity generation in a nuclear reactor. And that is not even the "worst case". If the industry is unable to increase uranium production significantly in the coming years, the remaining reserves will be exhausted in around 10 years. The operators will then face a situation which is already today reality in India, where a lack of uranium frequently forces reactors to be shut down or operated with reduced output. The domestic uranium production is insufficient there, and supplies from abroad are hampered by political hurdles, because India has not signed the Nuclear Non-Proliferation Treaty.

The uranium shortage is a topic of open discussion in the branch. At uranium conferences in New York and Toronto in February 2007, the top managers

of the second-largest supplier of nuclear fuel rods, James C. Cornell and Jeffrey R. Faul from Nukem Inc., commented on the situation with the words: "Forget the nuclear renaissance. (...) Uranium prices will continue to rise for the foreseeable future."

Mining costs money and energy

Alongside the dependence on reserves, one of the main reasons identified to explain the increasing uranium prices is the exhaustion of once prolific deposits. Only Canada still possesses deposits with an ore grade of 1 %. The difficulties to be overcome to exploit even the last rich deposits are well illustrated by the Canadian "Cigar Lake" project, one of the largest mines in the world and the only one with such high-grade ore. Production was scheduled to commence in 2007 – 26 years after its discovery and at the end of a time-consuming ecological appraisal and approval process.

The deposits in other countries offer ore grades of just 0.1 %, and more than two-thirds of all deposits lie below 0.06 %. At such minimal concentrations, uranium mining is only economical if the uranium can be exploited as a by-product of copper or gold mining. But only around 10 % of the uranium is to be found in such lucrative company. As the most favourable deposits are gradually exhausted, the proportion of mines with low-grade ores is on the rise. Their development, however, is increasingly complicated and expensive. Furthermore, and a particularly important aspect of the nuclear energy debate: the energy consumption for uranium mining is also increasing and places great burdens on the carbon balance of nuclear energy, which is after all one of the favourite arguments of its supporters. If the ore grade falls below 0.02 %, the balance even becomes negative – and uranium mining thus pointless.

Even if all the planned measures to increase uranium production are realised, the gap can only be partially closed. To cover the demand of just the existing nuclear plants, the worldwide mining capacity would have to be raised by more than half. In reality, however, uranium mining even declined by 5 % in 2006. The prices for uranium are thus set to rocket, even if no new reactors are built.

Given the economic framework, it is unreasonable to expect an expansion of nuclear energy. Even so, its significance is still widely overestimated. It has gone almost unnoticed, for example, that nuclear power has long since been overtaken by renewable sources: nuclear power contributed 6.2 % to final energy consumption in Germany in 2007, whereas renewables together are fast approaching the 10 % mark already.

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Further information:

All the studies, supplementary material and press information are available for free download at www.energywatchgroup.org.
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S&WE is presenting the results of the Energy Watch Group study on worldwide energy sources in a five-part series. Following on from oil, coal and nuclear power, **S&WE 12/2009 will report on natural gas.**