



Goodbye, nuclear power

Unsustainable, uneconomical and high-risk

Arguments for the future



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In Fukushima, there was core meltdown after an earthquake a good 10 years ago. In Zaporizhzhia, Russia's war of aggression puts a nuclear power plant at risk. Meanwhile, France was forced to shut down its reactors in summer. The reasons? Sudden hairline fractures and a lack of cooling water due to the heatwaves. Is nuclear power really safe and reliable?

There are good reasons why a (second) decision to phase out nuclear power was taken in Germany. Safety is one of the most important considerations: we need only glance at Chernobyl or Fukushima to see the potentially catastrophic impacts of this technology.

The unwavering fixation on this technology seen in some quarters is hard to comprehend. Quite obviously, it is not sufficiently safe and reliable. It is also far more expensive than renewable energy technologies. At a time when budgets are tight as a result of several concurrent or successive crises, we can no longer afford the luxury of high-cost forms of energy generation. And a further aspect: nuclear power is not a good fit for our future energy system. A nuclear power plant is far too inflexible – it cannot be powered up or down rapidly as necessary to supplement a wind- and solar-based energy supply. Contrary to appearances, nuclear power is not a clean source of energy – nor is it sustainable, despite its inclusion in the EU taxonomy. Besides the safety issues, its drawbacks include the environmental damage caused by uranium mining and the risks associated with the use of civilian nuclear technology for the proliferation of nuclear weapons.

From my perspective, the debate in recent months has been frustrating. This has to do with the history of the Oeko-Institut, whose founding 45 years ago can be traced back to the anti-nuclear campaign. What annoys me most, however, is the style of the media debate, which rarely relies on facts. It also wastes energy on a topic whose relevance has passed. Many young people recognised this long ago. A Fridays for Future activist told me during our conversation that she would much rather focus on future-oriented topics than revisit issues that have already been resolved or be compelled to fight old battles again. All our energies are needed to support more rapid expansion of future-fit technologies. Nuclear power is not among them, as you will see from this issue of *eco@work*.

Yours,
Jan Peter Schemmel

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“The land of nuclear lunacy”

ident Emmanuel Macron conceded in 2020 that one cannot function without the other.

Pretending that everything is fine – how does that work in the current crisis?

Many stakeholders are refusing to face up to reality because they are essentially part of the problem. In France, there is a strong link between the government and the nuclear lobby. And this lobby is still able to strongly influence public debate. But of course, there are also discussions and reactions to the present situation. This is evident, for example, from the shift in attitude towards sufficiency – in other words, limiting energy consumption. For instance, only a year ago, Macron compared this to the lifestyle of the Amish, who reject modern technologies. A year on, the government is publishing a sufficiency plan.

How is the French nuclear industry reacting to the current situation?

I often say that there are two things the nuclear industry does best: make promises – and break them. An example is the European Pressurised Water Reactor (EPR) in Flamanville. This was meant to be ready 10 years ago, and the costs are soaring. And yet an opinion often voiced in the nuclear industry is that there needs to be even more reliance on nuclear power in order to end the crisis. In early 2022, Macron announced plans to build at least six more EPRs, the first of which could not be on line before 15 years. We are the land of nuclear lunacy.

What can be done to give a boost to renewables in France? At present, their share is only around 25%.

I have faith in the economic power of renewable energies themselves. I believe they are attractive to investors. They will accelerate development and thus increase the pressure on nuclear policies. Unfortunately, France has created a great many regulatory barriers to re-

newable energies. No wonder we were the only European country to miss the renewable energy expansion targets for 2020.

What are your thoughts on the search for a repository site in France?

In my view, the government and the nuclear industry are not giving themselves enough time; they are not proceeding with sufficient care. They want to build a repository as quickly as possible so that the nuclear programme can continue. The EU Taxonomy also requires a repository plan to be in place. This creates a great deal of pressure, especially at the local level.

However, my biggest worry at the moment is interim storage of waste and piling up “reusable” nuclear materials. The main storage facilities are not robust enough and some will soon be at maximum capacity – and that could create pressure to lower safety standards. That is what we should be focusing on at present.

Thank you for talking to eco@work.

The interviewer was Christiane Weihe.

France relies on nuclear energy for around 67% of its electricity — more than any other European country. However, nuclear energy use in France is by no means trouble-free: in summer of 2022, nuclear power plants discharged hot water from their cooling systems into already overheated rivers, and in September, 32 reactors were offline for maintenance and other reasons, putting energy supply security at risk. Yves Marignac is an expert on the French energy market and Head of Department at Association négaWatt. In this interview with eco@work, he explains why France remains committed to nuclear energy despite all the problems, and discusses the prospects of a change of course in French nuclear policy.

Monsieur Marignac, why does nuclear power play such a major role in France?

In my view, there are three main reasons for this. Firstly, it stems from our country's history. In the 1970s, nuclear power – in France, at least – was associated with the narrative of cheap energy for everyone. This was to be guaranteed by a monopoly for Électricité de France, now known as EDF. The strong reactor fleet somehow became part of French identity. Secondly, the government and the nuclear industry have always relied on a kind of perennial growth, leading to a string of poor strategic decisions. As they are not ready to acknowledge failures and face the industrial and financial consequences, they constantly create new perspectives to pretend that everything is just fine. And thirdly, in France, the civilian and military uses of nuclear energy are closely linked. Pres-



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A twilight technology

Nuclear power in Germany: a retrospective



When West Germany opened its first research reactor in Garching near Munich in 1957, nuclear energy still enjoyed broad cross-party support. However, the first protests which followed just a few years later – against the Würgassen reactor in 1968, for example – attested to the already controversial nature of this form of power generation. Major accidents such as the Chernobyl disaster in 1986 also highlighted the potential dangers of nuclear power for humankind. There are many good reasons for phasing out nuclear power. Scientists at the Oeko-Institut have been raising awareness of them for more than 40 years.

The birth of the anti-nuclear movement in the Federal Republic of Germany can be traced back to the successful protests against the planned Wyhl nuclear power plant in the mid-1970s. “It was this conflict which led to the founding of the Oeko-Institut in 1977,” says Michael Sailer, a nuclear energy expert and the Oeko-Institut’s CEO until 2019. “The aim was to support the anti-nuclear movement by providing rigorous analyses and scientific advice.” The opposition was sparked partly by concerns over the substantial risks posed by nuclear energy. “There were major incidents at nuclear facilities all over the world even

in the early days, and hazardous situations have continued to occur since then – examples are Biblis in 1987 and Brunsbüttel in 2002,” says Michael Sailer. “Our objective was always to ensure that these incidents were not swept under the carpet.” For the Oeko-Institut, a further aim was to identify alternatives. “Milestones in the Institute’s history include the publication of The Energy Turnaround in 1980 and the follow-up study five years later,” says Julia Neles, Deputy Head of the Nuclear Engineering and Facility Safety Division at the Oeko-Institut. “With these studies, our researchers mapped a pathway towards a nuclear- and fossil-free future.”

SAFETY NOT GUARANTEED

The risks associated with nuclear energy were demonstrated with full force when core meltdown occurred at the Chernobyl nuclear power plant in Ukraine – with catastrophic consequences. Vast areas of land were contaminated, more than 300,000 people had to be evacuated, and there was a high incidence of radiation-induced injuries, particularly among emergency workers. Making matters worse, a cloud of radiation then spread across much of Europe. Estimates of the subsequent costs range between 100 billion and 1000 billion euros.

The Chernobyl disaster changed many people’s views on nuclear energy, but it also changed the role of the Oeko-Institut. “Throughout that period, we offered our independent expertise and provided factual information,” says Michael Sailer. “And afterwards, we were recognised and, above all, taken seriously in official circles as well.” In 1990, for example, the Oeko-Institut was involved in the safety assessment at the Greifswald nuclear power plant. “This led to the closure of all the East German reactors due to their poor safety

standards,” says Michael Sailer, who was appointed to Germany’s Reactor Safety Commission in 1999. And after the Fukushima disaster in 2011, the nuclear energy expert made numerous media appearances to raise awareness of the issues around nuclear power. “The Japanese officials initially attempted to play down the true scale of the disaster,” he recalls. Yet again, the disaster demonstrated what can happen when nuclear technology runs out of control: as a result of core meltdown, large amounts of radioactive materials were released, causing contamination of land and seawater. Around 120,000 people had to be evacuated; 25,000 of them are still unable to return home.

The disaster led to another change of direction in Germany’s nuclear energy policy. An exit from nuclear had previously been agreed by Germany’s SPD-Green government back in 2000. In 2010, however, the new CDU/CSU-FDP coalition government extended the nuclear power plant lifetimes by an average of 12 years. After Fukushima, it revisited this decision and voted to phase out nuclear power by 2022. “Before Fukushima, many supporters of nuclear power were claiming that a disaster like Chernobyl could never happen in Western-built reactors. They didn’t believe that a high-tech country like Japan could be affected,” says Michael Sailer.





FOR ETERNITY: NUCLEAR WASTE

A final phase-out of nuclear power was also a prerequisite for a resolution to the decades-long conflicts over a repository for high-level radioactive waste. "These conflicts began in the late 1970s with the plans to open a repository at Gorleben in Germany," Julia Neles explains. A comprehensive process is now under way to identify a repository site. "Here too, the Oeko-Institut's expertise is in demand. For example, we have provided advice on the process to various local authorities in areas which could be in contention as potential repository sites."

The waste from nuclear energy use has to be stored safely for time spans beyond human comprehension – in some cases, for up to a million years. "And as well as high-level radioactive waste such as spent fuel elements, there is low- and intermediate-level waste to deal with," says Julia Neles. "A repository for these waste fractions is due to be completed at Konrad pit near Salzgitter in 2027."

Nuclear power plant decommissioning also produces quantities of material that can be disposed of as conventional waste – usually because it has never been exposed to radioactive contamination. "These waste fractions have to undergo a process known as clearance," says Julia Neles, who is a member of the German Environment Ministry's Nuclear Waste Management Commission (ESK). The Oeko-Institut has already investigated issues relating to decommissioning and radiation protection in many of its projects. "For example, we have advised the German Environment Ministry on regulatory provisions and assisted state-level authorities with practical implementation."

ENVIRONMENTALLY HARMFUL RESOURCES

A nuclear power plant cannot operate without resources – and a key input for nuclear power generation is uranium, whose extraction often causes environmental damage on a massive scale. The preventive measures taken tend to be inadequate, particularly in areas populated by indigenous communities. "The groundwater, soil and ambient air become contaminated with radioactive substances," Julia Neles explains. "And very often, the proportion of uranium found in the ore is very low, so extraction generates very large amounts of mining residues."

Until the early 1990s, uranium was also mined in Germany – by Wismut GmbH in the Erzgebirge mountains. "Uranium extraction posed serious risks to miners' health and the decommissioning costs run into billions," says Julia Neles. The Oeko-Institut has been involved in various projects which investigate the risks of uranium mining. "We have produced numerous expert reports on topics such as strategies for subsequent use of rehabilitated sites, including the issue of safe permanent disposal of mining residues," Julia Neles explains.

A GLOBAL THREAT

A further hazard inextricably linked to nuclear energy use is proliferation, i.e. the risk that technology, know-how and fissionable material might be used to

develop nuclear weapons programmes. "There are synergies here. Indeed, representatives of the military in countries such as the UK and the US are now claiming that these countries can only afford nuclear weapons programmes if civilian nuclear energy use continues," says Julia Neles. And as she explains, even if a country has no aspirations to develop a nuclear weapons programme at present, this does not mean that the situation will remain unchanged in future. "Once a civilian programme is in place, it can be utilised for military purposes later on."

LOOKING AHEAD

The Oeko-Institut has kept a watchful and critical eye on nuclear energy use from the outset. "Due to the number of disasters and worrying incidents that have occurred worldwide, critical expertise is urgently required," says Julia Neles. "Unfortunately, a serious accident could happen again at any time." Whether we look back at the past or forward to the future, the message is clear: there are many good reasons for phasing out nuclear power.

Christiane Weihe



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No renaissance

The future of nuclear energy

The conversation went quiet for some time. However, the increasingly palpable effects of climate change and, not least, the impacts of the war in Ukraine on energy markets have rekindled the debate about nuclear power. There are calls in many quarters – expected and unexpected – for the use

of this technology to continue, for lifetimes to be extended and even for new reactors to be built. But is renewing our reliance on nuclear power really worthwhile? What can we learn by looking at other countries and at new reactor designs? In short: does nuclear power have a future?

Anyone looking at the EU in 2022 might think that nuclear power was set to make a comeback. After all, nuclear energy is included in the EU taxonomy, which is intended to direct investment towards environmentally sustainable economic activities. Does this mean that nuclear power is a sustainable, future-fit technology? This has many people shaking their heads in disbelief. One of them is Dr Christoph Pistner, Head of the Nuclear Engineering and Facility Safety Division at the Oeko-Institut. "There are many sound reasons for phasing out nuclear power – and very few reasons for investing in this technology in the long term," he says (*for a more detailed discussion of the reasons for the phase-out, see "A twilight technology" on p. 4*).

THE EU TAXONOMY

So what prompted the European Commission to take this step? "The decision was based in part on a report by the Joint Research Centre (JRC), produced on behalf of the European Commission to assess whether nuclear energy can cause significant harm to human health and the environment. It concluded that nuclear energy does not cause significant harm and may therefore be promoted as a sustainable technology," Dr Pistner explains. In its "Sustainability at risk" study, commissioned by the Heinrich-Böll-Stiftung, the Oeko-Institut reviewed the key arguments presented by the JRC. "The report fails to consider in sufficient depth key risks such as the proliferation of nuclear weapons. And judging solely by the risk of major accidents, nuclear energy cannot be classed as sustainable." The Oeko-Institut also found that the JRC's assessment of the potential impacts of major accidents was based on inadequate data and analyses, and very few indicators were used to assess these accidents. "For example, it did not consider the number of persons evacuated or relocated, land contamination, which can persist for very long periods of time, or the economic impacts. But unless these aspects are considered, the assessment is incomplete." The nuclear energy ex-

pert also criticises the JRC's failure to address the risks posed by the military use of civilian nuclear technology – in other words, the issue of proliferation. "Any deployment of nuclear weapons would have catastrophic impacts. An assessment of this kind must therefore also consider the risk that civilian nuclear technology will feed into countries' nuclear weapons programmes."

Granted, the German government also rejects the EU taxonomy's classification of nuclear energy as sustainable. For Dr Christoph Pistner, however, this is not enough. He wants to see Germany making a significantly enhanced contribution to the debate about nuclear energy at the international level and asserting its position on the nuclear phase-out more vigorously. "If Germany – with all its expertise – were to champion the phase-out of nuclear power with conviction, other countries might then conclude that this is not a future-fit technology."

DECOMMISSIONING AND FINAL STORAGE

Even after its last remaining nuclear power plant is shut down, this will not mark the end of the debate about nuclear energy in Germany. Although decommissioning has already begun, it will take years to remove all traces of the reactors from the landscape. "There are also older installations such as heavily contaminated experimental reactors, which are currently in safe enclosure and whose decommissioning is not even at the planning stage yet," Dr Pistner explains.

Germany will have to deal with the legacies of the nuclear age for some time – and one of the issues to be addressed is the establishment of a repository for high-level radioactive waste. Final storage of this waste in a geological repository is not scheduled to start in Germany for several decades. And the situation is not much better in other countries. "Very few countries have set out along this path so far. Sweden has approved the construction of a reposi-

tory. France and Switzerland have identified a site. Finland is the only country with a firm timeline: it aims to open its repository in 2023." Final storage is a multi-generational issue – not only due to the slow pace of the process. The nuclear waste will, after all, have to be stored safely and securely for at least one million years. "It is extremely important to ensure that there is a continued awareness of this issue and that the necessary know-how is not lost. We will continue to need experts with a knowledge of the technical aspects or of radiation protection, for example, for some time to come – not only for radioactive waste disposal but also for decommissioning."

NUCLEAR ENERGY WORLDWIDE

Germany needs this expertise also because other countries continue to rely on nuclear power. Reactors are still running; indeed, in some cases, new ones are being built. The EU has 104 nuclear power reactors, more than half of which are located in France – including several close to the German border. Finland, Sweden, the Czech Republic and Slovakia also rely on nuclear energy. "Continuous reviews of the safety of the installations and their upgrading requirements are essential – not least in Switzerland, which, along with India and the US, has the world's oldest nuclear plants," says Christoph Pistner. "France, for example, has not even implemented yet all the upgrading measures discussed after Fukushima." On average, the world's reactors are around 31 years old, rising to a staggering 37 years in Europe – which means that the risks associated with their operation are increasing. "The technology becomes more susceptible to breakdown due to wear and tear and material fatigue, so ongoing maintenance programmes are required to deal with these issues. This leads to prolonged and unscheduled stoppages. Added to that, safety standards are far more stringent today, and many older nuclear installations are not as well-protected as the newer plants."

In addition, there are newcomers to nuclear energy, such as Egypt, Bangladesh and Turkey, which rely on cooperation with Russia. "This raises the question of whether these countries are entering into new dependencies – and whether they can genuinely depend on their contractual partners. After all, we are seeing how Russia, for example – a major player in the nuclear industry, incidentally – is using the energy supply as a tactical weapon in its war against Ukraine."

The war raises another issue in relation to nuclear energy: in a situation such as this, are today's nuclear power plants sufficiently safe and secure? "In the past, there was a tendency to rely on the idea that a military attack on a nuclear power plant was taboo – and that full protection against such an attack was neither possible nor necessary," says Christoph Pistner. "But when you have a country like Russia – which develops and builds its own reactors – having no qualms about targeting these installations in a military conflict, the taboo has been broken. In the war against Ukraine, Russia seems to have accepted with equanimity that a major accident could occur at one of the reactors." For that reason, international regulations and standards must now be reviewed to determine where improvements can and must be made in order to provide better protection for these facilities during combat operations.

NEW TECHNOLOGIES

But what about the new Generation IV reactors, with their claims of lower costs and increased safety? Surely they are a reason to revisit the option of exiting the phase-out? The reactors currently on the market are Generation III reactors, which include the European Pressurised Reactor (EPR). "The Generation IV reactor designs claim to deliver a higher level of safety, improved economic performance and better fuel efficiency while addressing the problems of disposal and proliferation." In Dr Pistner's expert opinion, however, these claims are "completely spurious".

Current information on blog.oeko.de

In Germany, the debate about nuclear energy is lively and wide-ranging. The Oeko-Institut contributes continuously to this debate by sharing its expertise, e.g. via studies on topics such as the current energy crisis, the much-discussed contributions of nuclear power and the risks of stretchout operation. Visit the Oeko-Institut blog for up-to-date information about the current debates, forthcoming policy decisions and the latest developments.

<https://blog.oeko.de/goodbye-nuclear-power>

"The problem is that none of the existing designs provides solutions to all the relevant issues. What's more, the developers themselves acknowledge that the Generation IV reactors will not be market-ready until at least 2045 – far too late to achieve the climate neutrality that the world is striving for."

Small modular reactors (SMRs) are among the other technologies currently under discussion. They have an electrical power output of 1.5 to 300 MW instead of the 1000-1600 MW capacity typical of today's power plants. According to their proponents, they pose less of a risk, partly because they have a smaller radioactive inventory.

In an expert report commissioned by the German Federal Office for the Safety of Nuclear Waste Management (BASE), entitled *Sicherheitstechnische Analyse und Risikobewertung einer Anwendung von SMR-Konzepten* (Safety analysis and risk assessment of the application of SMR concepts), the Oeko-Institut investigated SMRs in detail. "At present, they are often described as the future of nuclear energy, but their development actually dates back to the 1950s." In cooperation with TU Berlin and Physikerbüro Bremen, the Oeko-Institut carried out a scientific assessment of SMR concepts, including the associated safety issues and risks. "Overall, SMRs pose the same problems in relation to nuclear power as larger reactors; at best, they simply offer improvements in specific problem areas," says Christoph Pistner. "At the same time, it is unclear whether they genuinely work and, above all, whether they really do have the potential to generate power more cheaply than today's nuclear power plants." And

for SMRs to be economically viable, they would have to be produced in their thousands. "Who is meant to invest here, given that it is not clear whether a market for SMRs actually exists? And if large numbers of SMRs are constructed, this would of course increase the overall risk."

Dr Pistner has yet to come across any design or concept which convinces him that nuclear energy has a future; this includes partitioning and transmutation – a process of separating radioactive waste and reprocessing some fractions in reactors. "Even if these processes do work when scaled up – and that's highly debatable – they will be extremely complex and costly. And a repository will still be required." As he sees it, nuclear energy therefore has an expiry date, not only in Germany. "I expect this to be a drawn-out departure," he says. "The lifetimes of the existing reactors can no longer be extended at will – and new plants are simply too expensive."

Christiane Weihe



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