100 Good Reasons Against Nuclear Power

An initiative of Elektrizitätswerke Schönau
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Nuclear Fuel & Uranium Mining

#1 Dependency

All of the uranium needs to be imported.

In the whole of Europe, only mines in the Czech Republic and Romania still extract small amounts of uranium. In Germany, virtually all uranium mining sites had discontinued operations by 1991. In France, the last uranium was extracted in 2001.

Nuclear power is no "domestic" source of energy. Rather, it makes us heavily dependent on raw material imports and multinational groups of companies: four large mining companies control two thirds of world uranium production.

#2 Evictions

Uranium mining destroys the livelihoods of tens of thousands of people.

About 70 per cent of the world's uranium reserves are located on lands owned by indigenous peoples. Uranium extraction destroys their villages, deprives them of their farmland and pastures and contaminates their water.

In 2008, the government of Niger alone granted 122 permits to foreign investors for the mining of uranium ore in a huge area in the northern part of the country - in total disregard of the rights of the Tuareg people living in this region. Like in many other uranium fields, they are threatened with expropriation and eviction. This is also exactly what happened on 26 January 1996 in the Indian village of Chatijkocha: supported by the local police force, the mining company's bulldozers flattened huts, barns and fields without any warning to create additional space for the uranium mine.

#3 Water wastage

Uranium mining depletes precious potable water resources.

Large amounts of water are necessary to separate the uranium from the ore; yet many uranium mining areas suffer water shortage.

NamWater, the Namibian water utility, recently demonstrated that the country would be faced with an annual shortage of 54 million cubic metres of water if the proposed uranium mines in Namibia were commissioned - eleven times the resources available from the entire Omaruru river delta. The enormous water consumption of mining operations and uranium ore processing plants competes with the water needs of people, livestock and agriculture.

#4 Radioactive tailings ponds

Contaminated sludge created by uranium mining is hazardous to people and the environment.

At a uranium proportion of 0.2 per cent, each tonne of uranium ore generates 998 kilograms of contaminated sludge, which is deposited in hollows and artificial lakes. These tailings still contain 85 per cent of the initial radioactivity of the ore - and many toxic substances such as arsenic.

Radioactive substances contained in the tailings contaminate both air and groundwater for thousands of years. Any dam failure or landslide has disastrous consequences.

For several decades, toxic and radioactive substances have been leaking into the groundwater from the tailings pond of the Atlas Mine in Moab, Utah, United States. This polluted groundwater then migrates into the nearby Colorado River, which provides drinking water to 18 million people. In Kazakhstan, the radioactive dust of a dried-up tailing reservoir poses a threat to Aktau, a city with 150,000 inhabitants. And there are countless uranium sludge disposal sites located in narrow valleys in Kyrgyzstan that can "potentially cause an international disaster" according to the United Nations.

#5 Cancer from the mine

Uranium mining causes cancer.

Radioactive and toxic substances released from uranium mines and their tailings make workers and the local population sick - the cancer rate increases.

About 10,000 former Wismut uranium miners in East Germany developed lung cancer as a result of radiation exposure. The inhabitants of the Kyrgyz uranium mining town of Mailuu-Suu suffer from cancer twice as frequently as their compatriots. Also, a study revealed increased cancer and mortality rates among the employees who worked at the uranium mine in Grants, New Mexico, United States, from 1955 to 1990. There is also evidence of severe health problems caused by uranium mining among the Navajo people in New Mexico and inhabitants in Portugal, Niger and many other uranium mining areas.

#6 Dead lands

Uranium mining leaves dead lands behind.

Most uranium ores contain only 0.1 to 1 per cent of uranium, some of them even a proportion as low as 0.01 per cent. Thus, between 100 and 10,000 tonnes of ore are required to produce one tonne of natural uranium. These volumes need to be extracted and processed, and the resulting contaminated sludge is to be safely stored for hundreds of thousands of years.

Add to this millions of tonnes of rock that contains too little uranium. This overburden exceeds the amount of extracted uranium ore many times over, and is usually radioactive, too. Due to their extensive long-term contamination, US President Nixon declared former uranium mining areas "national sacrifice areas" in 1972.

#7 Expensive dirt

Rehabilitating uranium mining areas costs billions - and may not even be possible.

Uranium mining creates a huge burden on the environment: entire lakes full of toxic radioactive sludge and whole mountains of radiating debris. They pose threats to groundwater and potable water resources for thousands of years, pollute the air and are hazardous to health. Big mining companies earn a lot of money from uranium extraction but the major share of the costs incurred by protection and rehabilitation is borne by all of us.

The relocation of a single sludge disposal site of just one uranium mine in the United States requires over a billion dollars of taxpayers' money. In Germany, the Federal government has to pay 6.5 billion euros for rehabilitating the former East German uranium mining sites although this work is being carried out in accordance with the less stringent radiation protection

standards applicable in former East Germany - for the sake of saving costs. Many countries in which uranium is being mined just cannot afford such remediation expenditure.

#8 Uranium gap

For the last twenty years, uranium mines have been unable to supply the volumes required for nuclear power plant operation.

Since 1985, nuclear power plants have been consuming much more uranium each year than was extracted from the ground at mining sites. In 2006, for example, all uranium mines worldwide produced less than two thirds of the required quantities. To date, the operators of nuclear power plants have closed the existing fuel gap from both civilian and military stocks, which are, however, nearing exhaustion.

In order to secure the nuclear fuel supplies required for operating the currently existing nuclear power plants alone, the amount of extracted uranium would have to increase by over 50 per cent within the next few years. For this purpose, countless new uranium mines would have to be commissioned - with all the associated damage to human health and the environment.

#9 Limited resources

Uranium resources will be exhausted within only a few decades.

On a worldwide scale, readily accessible, high-grade uranium deposits will soon be exhausted. More and more rock needs to be excavated in order to extract the same amount of uranium, which results in cost increases whilst aggravating environmental pollution.

If all known uranium resources were exploited nonetheless, the currently operated 440 nuclear power plants could be supplied for just 45 to 80 years. Provided the number of nuclear power plants increases even further, the existing uranium resources would be depleted within an extremely short period.

#10 Uranium transport

An accident involving uranium hexafluoride may have a disastrous impact.

Uranium enrichment facilities such as in Gronau, Westphalia, Germany, process uranium in the form of uranium hexafluoride (UF6). Each week, this extremely toxic, radioactive substance is transported across Europe by rail, truck or barge, with routes going right through big cities and conurbations.

In the event of an accident or fire, the containers may break, and their radioactive content would contaminate the environment. Once in contact with humidity, uranium hexafluoride reacts to form highly toxic, extremely caustic hydrofluoric acid: a lethal risk for both humans and the environment within a radius of several kilometres.

#11 Truck loads of plutonium

For fuel rod production, many tonnes of pure, military-grade plutonium are transported on European roads every year.

Many nuclear power plants use so-called MOX fuel elements, which contain a mixture of uranium oxide and plutonium oxide. The latter is obtained mainly from reprocessing spent fuel elements. A quantity as low as about seven kilograms of plutonium is sufficient to build a nuclear bomb. When inhaled, some micrograms are enough to definitely cause cancer.

Each year, several tonnes of pure plutonium oxide are shipped to the MOX fuel assembly facilities in France and Belgium – transported by trucks on the motorway.

 # 12–19 & 102

Exposure Limits & Damage to Health

#12 Risk of cancer

Nuclear power plants make children and other people sick.

The closer children live to a nuclear power plant, the higher their risk of developing cancer. Within a five-kilometre radius around nuclear power plants in Germany, children under five years of age develop cancer at a 60% higher incidence than the national average. The leukaemia (blood cancer) rate is even twice as high (i.e. +120 per cent). Leukaemia is triggered particularly easily by radioactive radiation.

Data gathered in the United States suggest that the cancer rate is also higher in adults living close to nuclear facilities.

#13 Emissions

Nuclear power plants emit radioactive substances through their stacks and into the water.

Each nuclear power plant has a vent stack and a water drain pipe for radioactive substances such as tritium, carbon, strontium, iodine, caesium, plutonium, krypton, argon and xenon, which are dispersed in the air and contaminate both water and soil. They are deposited, enriched, taken up by organisms and, in some cases, even incorporated in the cells of the body, where the conditions are particularly favourable for them to be cancerogenic and mutagenic.

The relevant authorities have approved the release of radioactive substances through exhaust air and wastewater. The following maximum levels are usually permitted: about 1 quadrillion becquerels of radioactive inert gases and carbon, 50 trillion becquerels of tritium, 30 billion becquerels of airborne radioactive particles and approx. 10 billion becquerels of radioactive iodine-131. Note that these are annual limits applying to each individual nuclear power plant.

To check compliance, measurements are carried out at regular intervals - by the power plant operators themselves.

#14 Insufficient exposure limits

Radiation exposure limits do not exclude radiation injuries.

Even today, permissible emissions of nuclear facilities are calculated using a fictitious "reference man", who is always a young and healthy male. The fact that elderly people, women, children, toddlers and embryos often respond much more sensitively to radioactive radiation is disregarded completely.

Right from the outset, both international and national radiation exposure limits have deliberately taken into account radiation injuries among the population because it was all about ensuring "a reasonable room to manoeuvre in order to expand the nuclear energy programmes".

#15 Low-dose radiation

Low radiation doses are more dangerous than assumed officially.

Even very low radiation doses cause damage to health, which is demonstrated by the findings of a number of studies conducted in several countries that also included staff working at nuclear facilities.

These studies refute the often-heard assumption that low-dose radiation causes disproportionately minor damage or no damage at all, or that it even has positive effects. Even the National Academy of Science in the United States, which is considered a conservative institution, has recently confirmed that low-dose radiation is harmful. This finding also explains the increased cancer rate in children living close to nuclear power plants.

#16 Tritium

Radioactive waste from nuclear power plants is even incorporated in the DNA.

Nuclear facilities release large amounts of radioactive hydrogen (tritium) into both air and water. Humans, animals and plants absorb this substance through the air they breathe and the nutrients they take in. Just like ordinary hydrogen and water, the human body incorporates tritium and tritiated water in all organs and even directly in the genes, where their radiation may cause diseases and genetic defects.

#17 Hot rivers

Hot waste water discharged from nuclear power plants deprives fish of the oxygen they need.

Nuclear power plants are energy wasters: they heat up mainly rivers with their effluent, which may be as hot as 33 degrees Celsius. This makes it impossible for fish to breathe for two reasons.

First, hot river waters carry less oxygen than cold waters. Second, a larger number of plants and small animals die in hot water, and their biomass consumes additional oxygen during decay. This share of the oxygen is no longer available to fish.

#18 Radiant jobs

Thousands of unskilled labourers do the dirty work at nuclear power plants, often poorly protected against radiation.

They work for contractors and are called in whenever things are getting "hot": thousands of unskilled labourers earn their living from clean-up, decontamination and repair in the nuclear power plant areas with the highest radiation levels. According to statistics published by the German Ministry for the Environment in 1999, these "floaters" are affected by radiation four times higher than the doses the employees of the nuclear power plant operator are exposed to. A popular expression in France refers to them as "radiation fodder".

Workers report on bursting nuclear waste bags full of dust, coffee breaks next to casks emitting radiation and jobs done with incomplete personal protective equipment right in the reactor vessel. Some of them put off their dosage meters before commencing work because they would no longer be allowed to enter the control area when they reach their maximum dose. None of them wants to lose their job, after all.

#19 Self-protection

Chief executives of big nuclear power companies steer well clear of their facilities.
On the professional level, the chief executives of the "Big Four" in Germany, EnBW, E.ON, RWE and Vattenfall, argue vehemently in favour of nuclear power. In their private lives, however, the big bosses steer well clear of their facilities: Hans-Peter Villis, Jürgen Großmann and Tuomo Hatakka have chosen places to live that are located far away from their nuclear power plants.

#102 Chernobyl

The Chernobyl reactor accident has ruined the lives of hundreds of thousands of people.
After the unprecedented reactor disaster at the nuclear power plant in Chernobyl, Ukraine, the former Soviet Union ordered about 800,000 "liquidators" to the site for disaster relief and clean-up work. Today, over 90 per cent of them are disabled. 20 years after the reactor blow-up, 17,000 Ukrainian families received government support because their fathers died, having worked as "liquidators" after the accident.

Between 1990 and 2000, the cancer rate in Belarus increased by 40 per cent. According to a forecast published by the World Health Organisation, over 50,000 children in the Gomel region alone will develop thyroid cancer in the course of their lives. Abortions, early deliveries and stillbirths increased dramatically after the accident. 350,000 people who lived near the reactor had to leave their homes for good.

Even at a distance of 1,000 kilometres from the site, in the German state of Bavaria, up to 3,000 cases of radiation-induced abnormalities were reported. According to estimates, the increased post-Chernobyl infant mortality documented in several European countries left a death toll of about 5,000.

Like many other consequences of the accident, the burden imposed on future generations due to, for instance, possible genetic defects is very hard to estimate. One thing is for certain, though: the 1986 disaster will continue to have a long-term impact.

 # 20–41 & 103-107
Accident & Disaster Risk

#20 Unsafe conditions

Today, none of the 17 nuclear power plants in Germany would get an operating permit.
Whether the absence of a containment shell, worn-out electrical systems or brittle steel: not a single nuclear power plant in Germany complies with the state of the art in terms of safety, which the Federal Constitutional Court is actually upholding. Even millions of euros invested in retrofitting programmes do not rectify this situation.

If newly built, none of the 17 nuclear power plants in Germany would get an operating permit today because of the existing major safety deficiencies.

#21 Ageing risk

The longer a nuclear power plant has been in service, the riskier its operation becomes.

Equipment and electronic systems are not built for eternity - even less so in a nuclear power plant. Pipes become brittle, control systems no longer work, valves and pumps fail to function properly. Cracks propagate, metals corrode. At the Davis Besse nuclear power plant in Ohio, United States, pitting of the 16 cm thick steel of the reactor pressure vessel occurred but went unnoticed. Only a thin layer of stainless steel on the inside prevented leaking of the reactor.

The longer a nuclear power plant has been in service and the older it is, the riskier its operation becomes. This fact is also underscored by reportable incident statistics: old reactors, such as Biblis and Brunsbüttel in Germany, are listed much more frequently than newer plants.

#22 Reportable incidents

Every three days, a "safety-relevant incident" occurs at a German nuclear power plant.

Every year, the incident reporting unit of the Federal Agency for Radiation Protection receives 100 to 200 reports on incidents and other events relevant to nuclear safety that occur at German nuclear power plants, totalling a number of about 6,000 cases since 1965. Each year, some of these reportable incidents may potentially lead to a severe accident. In several cases, the fact that no worst-case accident has occurred in Germany up to now was due to pure chance.

#23 Shortage of spare parts

New errors are easily committed during repair activities at nuclear power plants.

The nuclear power plants currently in service in Germany were commissioned between 1974 and 1989. Many components are no longer available, which means that makeshift solutions are required for repair purposes. A risky approach because major consequences may arise if spare parts do not always show a behaviour exactly identical to that of the original components.

#24 Stone-age technology

A 30-year old technology - scrapping it is the only option!

Construction activities for the currently operated nuclear power plants in Germany commenced between 1970 and 1982. Nobody in their right mind would ever claim that a car like the 1970 Volkswagen 411 still represents the "state of the art in terms of safety" - even if shock absorbers were replaced, brakes exchanged and seat belts retrofitted. And anybody telling us that they wanted to upgrade their Commodore C64 home computer (built from 1982 to 1993) to current standards would just be laughed at.

The only exception to this view are nuclear power plants - according to their operators...

#25 Earthquake hazards

Nuclear power plants are insufficiently protected against earthquakes.

Fessenheim near Freiburg, Philippsburg near Karlsruhe and Biblis near Darmstadt – all three nuclear power plants are located in the Upper Rhine Graben, i.e. the most seismically active zone in Germany. Despite this location, their degree of earthquake protection is low, as is the

protection of all other reactors in Germany.

For instance, the Fessenheim nuclear power plant would withstand an earthquake of the magnitude of the 1356 disaster that destroyed the city of Basel only if its epicentre were at least 30 kilometres away from the site. Will the underground forces really comply with this requirement at all times?

The Biblis nuclear power plant has been designed to withstand a gravity acceleration of only 1.5 m/s². Seismologists, however, expect quakes of a significantly greater magnitude to occur between Mannheim and Darmstadt. In addition, the groundwater in the calcareous soil underneath the Neckarwestheim nuclear power plant washes out up to 1,000 cubic metres of new cavities each year.

#26 Plane crashes

Nuclear power plants are not protected against plane crashes.

No nuclear power plant would withstand a direct hit of a fully fuelled passenger aircraft. The German Society for Nuclear Safety explained this finding in more detail in an (initially secret) expert opinion submitted to the Federal Ministry for the Environment.

Seven reactors even have concrete walls that are so thin that even a crash of a fighter jet or an attack using armour-piercing ammunition may trigger a disaster.

#27 Collapsing new buildings

Even new reactor types are unsafe.

Even the European pressurised-water reactor (EPR), which presumably is a cutting-edge design according to the nuclear industry and which is currently being built in Finland and France by French nuclear group AREVA, poses the risk of a severe accident, including a core meltdown. Large amounts of radioactive substances may be released into the environment. The Finnish, UK and French nuclear energy authorities considered the systems to be used for controlling the reactor and shutting it down safely in the event of an emergency so risky that they submitted a joint objection.

This supposedly super-safe new reactor is not even protected against a simple plane crash. Instead of stopping its construction, the French government had nothing better to do than to declare the report submitted by the authorities classified military material.

#28 Insurance cover

Taken together, 50 cars have better insurance cover than a nuclear power plant.

A worst-case accident occurring at a nuclear power plant in Germany would cause damage to health, material damage and financial loss equivalent to 2,500 to 5,500 billion euros. Prognos AG arrived at these figures in an analysis submitted to the Federal Ministry of Economics in 1992 when the German Liberal Democrats controlled the ministry.

In total, the liability insurance taken out by all nuclear power plant operators covers an amount of only 2.5 billion euros, i.e. 0.1 per cent of the expected damage. Taken together, 50 cars parked at the premises of a nuclear power plant have better insurance cover than the power plant itself!

#29 Worst-case accident

A worst-case accident may occur any day.

The "Deutsche Risikostudie Kernkraftwerke Phase B" (German Nuclear Power Plant Risk Study, Phase B) published in 1989 mentions a likelihood of 0.003 per cent per year for a worst-case accident to happen due to technical failure at a West German power plant. This appears to be low but there are (as at the end of 2007) 146 nuclear power plants in the EU alone. Assuming a period of operation of 40 years, the likelihood for a worst-case accident to happen would thus exceed 16 per cent. Many possible accident scenarios and dangerous deficiencies existing due to obsolescence of the reactors have not even been taken into account in this consideration. Nor have accidents been included that occur as a result of human failure, such as at Harrisburg (Three Mile Island) and Chernobyl.

#30 Safety ranking

German nuclear power plants are unsafe even on an international scale.

German nuclear power plants are "among the safest in the world"?

Think again! In an international report on nuclear safety published by the OECD in 1997, the German reference power plant (Biblis B) was considered the worst in terms of its level of protection against core meltdown.

The experts considered hydrogen combustion particularly likely and found the steel containment to be markedly unstable: in Biblis, the "risk of a massive fallout is particularly high in the event of a core meltdown."

#31 Violent storms

Even a thunderstorm may cause a nuclear disaster.

Power failure at a nuclear power plant, i.e. an event requiring emergency power supply, is considered one of the most dangerous situations during reactor operation. If the emergency power supply does not work properly, cooling systems will fail soon after the incident, entailing the risk of a subsequent core meltdown. A simple thunderstorm may suffice to trigger such an accident.

Between 1977 and 2004, eight events occurred where thunderstorms or lightning strikes triggered an outage of important control systems at West German nuclear power plants, led to the dreaded case of emergency power supply or even to total failure, such as on 13 January 1977 at the Gundremmingen A facility. Flood risks also exist: at the French Blayais nuclear power plant on the Atlantic coast, such incidents regularly cause partial cooling system failures.

#32 Greed for profit

There's no doubt: profit is superior to safety at nuclear power plants – even after explosions.

With deathly pale faces, a group of inspectors left the Brunsbüttel nuclear power plant in early 2002. Right next to the reactor pressure vessel, they had inspected a pipeline - or rather the remnants of it: 25 pieces of debris. On 14 December 2001, a hydrogen explosion had torn a 3 m long section of the 5 to 8 mm thick pipe into pieces.

HEW, the operator at the time of the incident (today Vattenfall), reported a "spontaneous seal leakage", blocked the pipeline - but continued reactor operation. After all, the incident happened in winter when electricity prices reached a record high at the energy exchange. Only when the

State Ministry for Social Affairs in Kiel put massive pressure on the company did HEW shut down the reactor in mid-February to enable an inspection. Thereafter, the nuclear power plant had to stay off grid for 13 months.

#33 The human factor - a safety risk

People commit errors, which might be fatal at nuclear power plants.
Incorrectly operated valves, overlooked alarm signals, forgotten switches, misunderstood instructions, inappropriate responses - there are dozens of cases in which humans, instead of technology and equipment, cause extremely risky situations at nuclear power plants. The human factor poses a safety risk that cannot be quantified.
However, in the event of an accident, exactly these people (i.e. the staff operating the plant) are also entrusted with implementing important emergency measures that deviate from the normal operating procedures in order to prevent a core meltdown from occurring.
Nuclear power requires 100% error-free, perfect people, but these do not exist - even less so in extremely stressful situations encountered during an accident at a nuclear power plant.

#34 Boric acid

Several nuclear power plant operators have systematically violated operating procedures for many years.
For 17 years, the Philippsburg nuclear power plant had been started up without sufficient boron concentration in the emergency tanks whose content should flood the reactor core in the event of an accident. If the water to be used for emergency flooding lacks boron, core flooding has the same effect as pouring fuel into the fire.
The operators did not care at all. Instead, they wilfully violated the procedures set forth in the operating manual. According to investigations, the emergency cooling systems of other nuclear power plants had not been fully functional for several years either due to insufficient boron concentration.

#35 Spaghetti syndrome

Faults in electrical systems are widespread at nuclear power plants - with grave consequences.
In summer 2006, Europe was dangerously close to a nuclear disaster. Due to cabling design faults, emergency power supply systems at the Forsmark nuclear power plant in Sweden could not be started after a short circuit and mains failure. Only a few minutes later, the core would have started to melt. This is by no means an isolated case: at the Brunsbüttel plant, faults in electrical systems that had persisted since its commissioning in 1976 prevented sufficient emergency power supply to emergency and secondary cooling systems. At the Biblis nuclear power plant, a whole series of incorrectly connected or loose cables or sloppy electrical work had to be reported.

#36 Worse than Chernobyl

A worst-case accident occurring at a German nuclear power plant would have much more severe consequences than the Chernobyl blow-up.
The reactor cores of nuclear power plants in Germany do not contain graphite that might catch

fire, as in Chernobyl. For this reason, the radioactive cloud would not rise to similarly high air strata after an explosion. However, the degree of radioactive contamination would increase massively within a radius of several hundred kilometres. Germany has a population density seven times higher than the region surrounding Chernobyl. The population density is even 30 times higher in the Rhine-Main area. Thus a significantly larger number of people would be exposed to higher radiation doses than after the Chernobyl disaster.

#37 Cancer for millions

In the event of a worst-case accident in Germany, millions of people are expected to suffer severe damage to their health.

A study commissioned by the Federal Ministry of Economics estimated the damage to health to be expected after a severe nuclear accident in Germany, taking into account the Chernobyl data. For example, 4.8 million additional cases of cancer were anticipated in the event of a worst-case accident at Biblis, plus all other direct and indirect health damage due to radiation exposure, evacuation and loss of the people's homes.

#38 Loss of home

In the event of a worst-case accident, an area of tens of thousands of square kilometres would become permanently uninhabitable.

After a worst-case accident at a German nuclear power plant, millions of people would be unable to return to their homes, apartments, places of work. Where should they live, work, find a new home? Who will be taking care of their health? Who will compensate them for the damage suffered? The big energy suppliers? Certainly not – they will have gone bankrupt long before.

#39 Evacuation

It is impossible to evacuate an entire region within only a few hours.

Emergency response plans for nuclear power plants assume that operators will be able to keep the radioactive cloud inside the reactor for several days after the initial accident - time for evacuating the regional population.

However, what if an aircraft, earthquake or explosion destroyed the nuclear power plant? What if the containment melted through within minutes, as may well be possible at the Krümmel site? In such a case, only a few hours are left to evacuate entire regions, depending on the weather.

New dispersion simulations show that radiation exposure would increase so significantly within a few hours even 25 kilometres away from the site or when staying in one's house that it would be lethal in 50 per cent of all cases. But the radioactive cloud won't stop there, and there are no evacuation plans for all other regions farther away from the nuclear power plant.

#40 Iodine shortage

Iodine tablets are useless if one needs to leave the home to get them.

In the event of a nuclear accident, iodine tablets should reduce exposure to radioactive iodine, yet such tablets have been distributed only to households in closest proximity to nuclear power plants. In all other areas, iodine tablets are stored in the town hall or still need to be delivered by plane. Picking up the tablets will be difficult because people should not leave their homes according to the emergency response plan.

#41 Economic collapse

A worst-case nuclear accident causes the economy to collapse.

In a country like Germany, a worst-case accident would cause damage and loss equivalent to 2.5 to 5.5 trillion euros. Prognos AG arrived at these figures 20 years ago in a study commissioned by the Federal Ministry of Economics. Adjusted for inflation, an even higher amount should be assumed today.

Compare this to the stimulus packages adopted by the 20 largest economies of the world to mitigate the recent economic crisis, which amount to a total of 3.5 trillion euros.

#103 Fibrous beds in the core

Loose insulation materials may obstruct the cooling channels of the reactor.

On 28 July 1992, a small leak at the Barsebäck nuclear power plant in Sweden nearly caused a nuclear disaster: the leaking water entrained some insulation material whose fine fibres obstructed the suction screens through which the water was to be pumped back into the reactor.

It was found that this "sump screen issue" could also potentially render the core cooling systems of other reactors inoperative in the event of an emergency. Experiments resulted in an even more disconcerting finding: extremely fine fibres may pass through the screens and enter the reactor core, where they form a debris bed that clogs the thin cooling channels.

At the end of 2008, the German Reaktorsicherheitskommission (Commission on Nuclear Safety) declared that the efforts undertaken during several years in order to arrive at a fundamental solution to this problem were unsuccessful. Despite this situation, all nuclear power plants remained connected to the grid.

#104 Clams and leaves

Even minor amounts of plant debris may cause a core meltdown.

"Partial clogging" of the cooling system necessitated an emergency shutdown of the Fessenheim nuclear power plant situated in the French Alsace region at the end of 2009: a relatively large amount of plant debris carried by the Rhine river had advanced deeply into the pipe system of the cooling circuit. The nuclear safety authority convened its emergency response group. Shortly before, debris from the Rhône river had also clogged the cooling system of the Cruas nuclear power plant.

The Asiatic clam (Corbicula fluminea) is even more persistent: this invasive species imported from the Far East is now also rapidly spreading across Central European rivers. Its extremely small larvae pass any filter. Swiss nuclear power plant operators still use their high-pressure cleaners whereas in the United States, a nuclear power plant had to be closed down as early as in 1980 due to the impact of these clams.

#105 Botched-up construction work

Conditions on the nuclear power plant site in Finland are worse than during the construction of the Cologne underground line.

4,300 workers from 60 countries are working on the prototype of the "European pressurised water reactor" (EPR) on the construction site in Olkiluoto, Finland. Conditions on the site are

appalling: part of the reinforcement is missing in the concrete, foremen do not speak the languages of the operatives they supervise, welds are tearing apart, inspectors issue instructions to pour concrete onto defective spots. Add to this 16-hour shifts, wage dumping, hire-and-fire practices - a true "slave reactor".

To date, the Finnish nuclear safety authority has identified over 3,000 construction defects - from using an inappropriate concrete grade for the foundation to incorrectly welded cooling pipes.

#106 Rapidly propagating cracks

Important pipelines of nuclear power plants are cracking - without anyone noticing.
Cracks propagating in pipes, tanks, containers, welds and fittings: they caused the shutdown of the Würgassen nuclear power plant, accelerated the shutdown of the Stade plant and caused many years of downtime of the Krümmel and Brunsbüttel reactors.

In the past few decades, experts claimed various steel grades to be crack-resistant but these assumptions were all incorrect. The truth of the matter is that even smallest cracks may rapidly propagate from one moment to the next, posing the threat of pipe bursts and leaks - the perfect recipe for a core meltdown disaster.

Even more disconcerting is the fact that most of the cracks were discovered by pure chance, for example during longer shutdowns (such as at Krümmel): there is no time for more thorough checks during normal operation.

#107 Retrofitting

Internally, even representatives of the German Christian Democratic Union (CDU) admit that the most obsolete nuclear power plants exhibit safety deficits that cannot be rectified.
Three days after the Bundestag elections in 2009, the then CDU Prime Ministers Roland Koch (State of Hesse) and Günther Oettinger (State of Baden-Württemberg) submitted a comprehensive "Nuclear Energy Strategy and Progress Paper" to the top representatives of the Christian Democrats (CDU and CSU). This paper was to pave the way toward extended periods of service of nuclear power plants. It also mentioned the "safety-relevant differences", i.e. deficits, identified for the older reactors whilst clarifying that these could not be rectified even by a major overhaul or retrofitting programme. Rather, "the existing plant design imposes limitations on retrofitting".

 # 42–65 & 108-113

Nuclear Waste & Disposal

#42 Mountains of nuclear waste

Nuclear power generates a huge amount of nuclear waste.
To date, German nuclear power plants have produced about 12,500 tonnes of highly radioactive spent fuel elements. 500 additional tonnes are generated each year. Add to this thousands of cubic metres of low and medium-level waste, and the amount of radioactivity released to both

air and water, plus the waste from reprocessing, the tailings from uranium mining, the depleted uranium from enrichment plants, and the nuclear installations themselves because they also need to be "disposed of" at some point in time.

#43 The big lie about waste disposal

To date, not a single gram of nuclear waste has been safely disposed of.
Nuclear waste would serve "to keep your food fresh" - such were the promises given by experts in the mid-1950s to counter critical questions regarding its disposal. They built one reactor after another without taking care of the disposal issue. Up to now, not a single gram of the many million tonnes of radioactive waste has been disposed of safely.

From a legal point of view, no nuclear power plant may be operated in Germany unless the safe disposal of the nuclear waste is ensured. As "proof of disposal precautions", various options were offered by the nuclear industry: the leaking Asse II nuclear dump site, which is on the verge of collapse, the exploration works carried out at the Gorleben salt dome, the construction of a "facility for controlled interim storage" of spent fuel elements in Castor containers in above-ground factory buildings.

#44 No technical solution

There is not even a technical solution to the repository problem.
70 years after the discovery of nuclear fission, we don't even know how to store the highly radioactive waste so as to ensure that it does not pose any risk to humans and the environment, let alone the identification of an appropriate location.

Contrary to what nuclear lobbyists are trying to tell us, many safety issues arising in conjunction with a final repository for nuclear waste are still unresolved. For instance, the United States recently decided against the Yucca Mountain repository project due to severe hazards to human health and the environment. The Swedish concept of storing nuclear waste in granite mother rock is going to be abandoned, too (see also #61). Finally, ground water flows above major portions of the Gorleben salt dome. In the light of the Asse II experience including frequent cases of water inrush, this fact should put an end to any further attempt at discussing the "suitability" of Gorleben as a final repository.

#45 1,000,000 years

Nuclear waste remains a radiating threat for a million years.
It takes about one million years for the radiation of the radioactive waste generated by nuclear power plants to decrease to a large extent. For this incredibly long period, the waste needs to be kept separate from humans and the biosphere. Provided the Neanderthal men had operated nuclear power plants 30,000 years ago and buried their waste somewhere in the ground, it would still emit lethal radiation - and we would have to know the places to avoid under all circumstances when digging holes in the ground.

#46 Asse II nuclear waste dump

After only 20 years, the Asse pilot repository facility is on the verge of flooding.
Between 1967 and 1978, nuclear industry and research disposed of 126,000 casks of nuclear waste at the Asse II "pilot repository facility" - almost free of charge. Experts vehemently

claimed that this former salt mine would be safe for thousands of years, excluding the risk of water inrush.

20 years later, 12,000 litres of water flow into the tunnels every day. Today, some casks are leaking, and the mine is on the verge of collapse.

To prevent extensive groundwater contamination, all the waste needs to be taken out again. Costs of these remedial activities are estimated at up to 4 billion euros. However, they are not to be borne by those who caused the current situation but by all taxpayers. Exactly for this purpose, the ruling coalition of Christian and Social Democrats amended the Nuclear Energy Act in 2009. Asse II was officially considered a "pilot project" preceding the proposed large-scale repository in the Gorleben salt dome.

#47 No final repository for nuclear waste

There is no safe final repository for highly radioactive waste anywhere in the world.
A final repository for nuclear waste would have to be geologically stable for an extremely long period. Its environment should not react chemically with the stored waste and the containers. The location to be chosen would have to be far away from the biosphere, potential raw material sources and human impact. No water from the area should drain into the sea.

On a worldwide scale, nobody has ever discovered such a location. It remains more than questionable whether it actually exists.

#48 Not in my backyard

Nobody wants to keep the nuclear waste.
Since 2005, spent fuel elements have been stored in Castor containers in buildings adjacent to the nuclear power plants, which makes it very hard for the proponents of nuclear power across Germany to come up with sound arguments in favour of the technology. Under no circumstances should nuclear waste be stored close to where they live, they demand. Yet the power plant (which provides the local community with welcome cash) should continue to run no matter what happens…

Members of the Christian-Social Union of Bavaria are also strongly in favour of nuclear power - but please avoid storing any nuclear waste close to Bavaria, they say. Debates over possible final repository sites, they warn, "add fuel to the fire in the entire republic".

#49 Playing tricks with Castors

Nuclear waste containers have been insufficiently tested.
Castor containers are safe, they say. Yet not each and every model undergoes real-life testing. In many cases, smaller samples are dropped or burned, or the "tests" are restricted to mere simulations.

In some cases, however, test findings are very hard to reconcile with reality, such as in spring 2008 when a new Castor type was tested using "freely selected parameters" that were introduced by the manufacturer to better align measured values with practical results. Even the Federal Institute for Materials Research and Testing objected to this approach and initially withheld its approval, which is why no Castor transports were allowed in 2009.

#50 The big reprocessing lie I

The so-called reprocessing of fuel elements adds even more nuclear waste.

"Reprocessing plant" - this term sounds as if a recycling centre were meant. In actual fact, only about 1 per cent of reprocessed nuclear waste is incorporated in new fuel elements: plutonium. The bottom line is that reprocessing adds even more nuclear waste. In France, reprocessing plants are thus simply called "usines plutonium" (plutonium factories).

Moreover, reprocessing plants are the worst radioactive polluters of the world. The so-called MOX fuel elements containing plutonium from reprocessing present much greater hazards during production, transport and use at the nuclear power plant than new fuel elements that contain only uranium. Also, the "plutonium factory" supplies the raw material needed for nuclear bombs.

#51 Nuclear waste on the beach

Reprocessing plants are radioactive polluters.

The reprocessing plants at La Hague in France and Sellafield in the UK release large amounts of radioactive substances into the air and into the water of the Channel and the Irish Sea. Close to the facilities, the leukaemia incidence in adolescents is up to ten times higher than the national average.

A couple of years ago, members of Greenpeace took several sludge samples from the Sellafield drain pipe. Upon their return to Germany, the samples were seized immediately by the authorities - no wonder because it was nuclear waste.

#52 The big reprocessing lie II

Enormous amounts of nuclear waste are still stored at the reprocessing sites in France and the UK.

During the past few decades, nuclear power plant operators have shipped several thousand tonnes of spent fuel elements to the La Hague and Sellafield reprocessing plants. Only a minor portion of this waste has been shipped back to Germany in Castor containers whereas all the rest is still stockpiled abroad.

#53 Morsleben nuclear waste dump

West German groups of companies operating nuclear facilities had no qualms about dumping their waste into the East German repository at Morsleben.

At the end of the 1980s, there were whole mountains of casks with nuclear waste building up at the West German nuclear power plants. Luckily enough, Germany was reunified, and Angela Merkel appeared on the scene in her capacity as Federal Minister for the Environment. Together with her departmental heads, Walter Hohlefelder and Gerald Hennenhöfer, she issued the permit to the big nuclear power plant operators to dump their radioactive waste into the former East German repository site at a ridiculously low price. Today, the facility is on the verge of collapse, and its remediation incurs costs of over two billion euros of taxpayers' money.

Merkel became Federal Chancellor, Hohlefelder was appointed chief executive of E.ON and president of Deutsches Atomforum (German Nuclear Forum), the nuclear industry lobbying organisation. Since the end of 2009, Hennenhöfer has again been head of the German authority for nuclear safety.

#54 Schacht Konrad nuclear waste dump

Right underneath the city of Salzgitter, 865 kilograms of plutonium are supposed to be stored.

The Federal Radiation Protection Agency intends to dump more than 300,000 cubic metres of low to medium-level nuclear waste, including up to 865 kilograms of highly toxic plutonium, into "Schacht Konrad", a former iron ore mine situated right underneath the city of Salzgitter. Decisions in favour of using "Schacht Konrad" as a final repository have always been politically motivated. No comparison whatsoever of various sites was carried out in accordance with clearly defined criteria. From the point of view of the nuclear industry, "Konrad" was an attractive site particularly because of the extraordinarily large hoisting shaft that could also accommodate bulky nuclear waste.

The long-term safety forecast for "Schacht Konrad" mainly relies on theoretical assumptions. Simulations were carried out applying outdated methods that are no longer considered scientifically sound.

#55 Interim storage

Highly radioactive nuclear waste is being stored in buildings not entirely dissimilar to barns.

The fact that nuclear waste emits a high degree of radiation makes the outside of the Castor containers extremely hot. The interim storage buildings at Gorleben, Ahaus and the nuclear power plants thus have large venting slots in order for air to flow past the containers. If one of them leaks, there is no further barrier preventing radioactivity from being released into the site surroundings.

#56 Castor radiation

Castor containers emit radioactive radiation.

During the Castor transport in autumn 2008, environmentalists measured alarmingly high radiation levels close to the passing nuclear waste train. The authorities did not carry out more comprehensive checks and measurements upon reloading of the containers: they simply did not have their own measuring devices. And GNS, the interim storage company, stated that it did not want to "expose its staff to radiation unnecessarily".

#57 Short-term disposal

According to official statements, the Castor containers in which nuclear waste is stored have a planned service life of just 40 years.

Pursuant to applicable legislation, nuclear power plants may be operated only if the safe disposal of their waste is ensured. Nuclear waste will still emit radiation in a million years from now. The Castor containers separating the waste from the environment are supposed to have a service life of 40 years. No problem from an official point of view...

#58 Gag order on experts

To pave the way for Gorleben as a final repository for nuclear waste, the Federal government issued a gag order to its geologists.

In 1983, Professor Helmut Röthemeyer, then the highest-ranking government expert on nuclear repositories, concluded after a large number of exploration drillings that the rock interspersed with a glacial channel located above the Gorleben salt dome was not capable of "keeping contamination separate from the biosphere in the long term". Together with his colleagues, he thus intended to recommend the supplementary exploration of other sites. The Federal government (at that time, a coalition of Christian and Liberal Democrats) intervened. Upon its pressure, the recommendation was deleted from the report. Even today, Christian and Liberal Democrats and nuclear lobbyists claim that the Gorleben salt dome is an appropriate final repository.

#59 Water in Gorleben

There is water in the Gorleben salt dome, too.

Water gets into contact with the nuclear waste casks not only at the former Asse II pilot repository. The Gorleben salt dome is not dry either. When the Gorleben "exploration mine" was constructed, workers were faced with several cases of water and brine ingress. The Federal Agency for Geosciences and Raw Materials located a brine reservoir of up to one million cubic metres.

The fact that there are no protective clay beds above the salt (the 300 m deep Gorleben channel filled with debris runs right through this area) means that the salt is in direct contact with groundwater. Contrary to the situation at Asse II, no nuclear waste has been dumped into the Gorleben site yet – thanks to the stubborn resistance of the local population.

#60 Nuclear waste destroys final repository

Radioactivity decomposes saline rock.

Radioactive radiation decomposes saline rock, which was proven by the Groningen professor Henry Den Hartog. This might have disastrous consequences for a nuclear repository embedded in a salt deposit, as proposed at Gorleben. To date, the relevant authorities have not drawn any appropriate conclusions.

Saline rock is also disputed as a final repository for other reasons: the plastic rock compresses the storage chambers, which causes the containers to burst, steadily rises due to the existing pressure and is extremely water-soluble. In addition, carnallite, which is a type of saline rock also found in the Gorleben salt dome, begins to melt at a temperature as low as 300 degrees Celsius. Such temperatures may well occur in a final repository.

#61 Cracks in granite

Even granite is too flexible for nuclear waste.

The Swedish repository concept, which has been considered the most advanced in the world, is proving to be fractured in the true sense of the word: geologists identified traces of earthquakes in the mother rock that has supposedly been stable for 1.6 million years. 58 quakes occurred in the last 10,000 years alone, up to a magnitude of 8 on the Richter scale. Luckily enough, at that time, no nuclear waste had been deposited in the rock.

#62 Radioactive cooking pots

Nuclear power plants are converted to cooking pots.

"I was a nuclear power plant" – this statement might be printed on pans and pots in the future. To save on the costs of disposing of nuclear installations, the Red-Green government watered down the German ordinance on radiation protection. A major part of the radioactive demolition waste may now be disposed of or recycled as "household waste".

Enjoy your meal!

#63 Uranium waste for Russia

The Gronau uranium enrichment plant dumps its waste in Russia.

The Gronau enrichment facility operated by Urenco has shipped many thousand tonnes of depleted uranium to Russia. Officially classified as "nuclear fuel", the radioactive waste was deposited in "no-go cities" in the Ural region, where the corroded containers are stored at outdoor facilities.

However, Tenex, the Russian nuclear company, did not have to pay anything for taking the supposedly valuable material. Rather, Urenco paid a price for getting rid of its dirty stuff.

#64 Moonshine fantasies

The moon is too far away.

First off, they said that nuclear waste wouldn't pose any problem. Then scientists came up with a whole series of bright ideas for its disposal: letting it seep into the ground, creating a "sump" in "nuclear ponds", draining it into the groundwater, discharging it into rivers, dumping it into the sea, depositing the waste in the desert. Digging holes in the ground, storing it in old bunkers or welded steel boxes, letting it freeze in Arctic ice, shooting it into space or to the moon.

The latter was too far away, which is why this suggestion was discarded. Some others were implemented in the past or are still being used.

#65 Nuclear alchemy

Transmutation does not solve the nuclear waste problem either.

Some people consider transmutation the universal remedy for nuclear waste disposal. Neutrons are to convert long-lived isotopes to short-lived isotopes or elements that are not radioactive anymore. To achieve this goal, the highly radioactive "cocktail" would have to be properly split into its individual constituents first. Then each portion would have to undergo a specific treatment in specially designed reactors requiring enormous amounts of energy. Bottom line: the procedure is extremely complex, dangerous and expensive; its technical feasibility is questionable. Also, there is still residual nuclear waste at the end of the process.

#108 Cold war

The State of Lower Saxony used Gorleben as the revenge for the leaking East German repository at Morsleben.

Geologist Prof. Gerd Lüttig, who was commissioned with identifying a final repository in the 1970s, reported after his retirement why the Prime Minister of Lower Saxony, Ernst Albrecht (CDU), had chosen the Gorleben salt dome as a final repository site although it had only been the "third option" from a geological point of view: it was an act of revenge for the fact that those in the "Eastern Sector" had commissioned the East German repository at Morsleben, close to the border, which posed a threat of contamination to Lower Saxony, too. Albrecht's motto: "Now let us show them what WE can do!"

#109 Skeletons in the dump site

The nuclear industry even dumped parts of corpses of contaminated workers into the Asse site.

Almost everything the nuclear industry wanted to get rid of rather sooner than later was dumped into the Asse II site camouflaged as a "pilot final repository". This included contaminated parts of corpses of the two workers that were killed in an accident on 19 November 1975 at the Gundremmingen A nuclear power plant. Their remnants were incinerated and put into casks at the nuclear waste incineration plant at the Karlsruhe Nuclear Research Centre.

#110 The big exploration lie

The "exploration" of the Gorleben salt dome is a programme to camouflage the construction of a final repository.

In secret talks, the Federal government agreed, in 1982, to not only "explore" the Gorleben salt dome, as was claimed officially, but to install a full-fledged final repository there. For this reason, the shafts and tunnels at Gorleben are about twice as large compared to the size required for an exploration mine, which incurred additional costs of about 800 million euros to date.

Back then, this trick enabled the government to circumvent the procedure required under nuclear energy law to build a final repository. Even Environmental Minister Norbert Röttgen (CDU) intends to apply the age-old framework operating plan of 1983 to the further expansion of the shaft system because this would be the only option to avoid further involvement of the public.

#111 Licence to kill

Nuclear waste repositories need not be tight, the Federal Ministry for the Environment decided.

A final nuclear repository is considered "safe" even if it does not reliably separate the radioactivity from the biosphere. This statement is included in the safety requirements for final repositories published by Sigmar Gabriel (Social Democrats), Federal Minister for the Environment, in 2009. Rather, every thousandth inhabitant may develop cancer or suffer other damage to health due to the radioactivity released into the atmosphere. Many people should be considered "inhabitants" because the radioactive substances spread over large areas, carried by the groundwater – at least during the next 1,000,000 years.

#112 Breaking glass

Nuclear dirt enclosed in glass may burst.

The waste generated during reprocessing of spent fuel elements is highly radioactive, liquid, strongly self-heating and prone to explosion. It order to make this "nuclear soup" somewhat easier to handle, it is melted into glass, which is supposed to create a very stable chemical compound. However, chemists found that even these glass enclosures may burst when in contact with water, and the highly hazardous materials may be washed out. So PLEASE keep the repository dry at all times!

#113 Studies made to measure

The fact that there is no protective clay bed above the salt dome in Gorleben is used to claim that it would no longer be required for a final repository.

In 1995, the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR; Federal Agency for Geosciences and Raw Materials) evaluated the suitability of 41 salt domes in Northern Germany for establishing a nuclear waste repository. This study explicitly referred to the high significance of "the barrier function of the overburden" that should protect the salt dome located underneath against water ingress. The Gorleben salt dome with its water-filled channel above the deposit was not considered – it would have been ruled out right away.

 # 66–71 & 114

Climate & Electricity

#66 Security of supply

Nuclear power plants are the exact opposite of reliable electricity suppliers.

Electricity from nuclear generation – this may quickly cause your lights to go off. Due to safety deficiencies, the Biblis A nuclear power plant did not produce a single kilowatt hour of electricity in 2007. During the same period, Biblis B had been out of operation for 13.5 months. As early as at the beginning of 2009, the two plants were shut down again for 13 and nine months, respectively. And both the Krümmel and the Brunsbüttel plant have been disconnected for three years already…

During some parts of 2007 and 2009, seven out of 17 reactors were shut down for repair purposes. Also, nuclear power plants are useless in summer because their output needs to be reduced due to overheating of the rivers.

#67 Overcapacities

Nuclear power plants are superfluous.

Germany exported large amounts of electricity even in 2007 and 2009 when seven out of 17 reactors were temporarily shut down. Both the Federal Environment Agency and the Federal Ministry of Economics confirmed in two studies conducted independently of each other that there is no electricity gap. The lights would not go out even if nuclear generation were phased out. Shut-down nuclear power plants can be replaced with renewable generation, energy efficiency programmes and combined heat and power.

#68 Greenhouse effect

Nuclear power is not carbon-free.

Uranium mining, uranium ore processing and uranium enrichment generate a significant amount of greenhouse gases that are detrimental to our climate, which is why nuclear power – even today – has a higher carbon footprint than wind power and even power generated by small gas-fired combined heat and power plants. In the future, this situation will get even worse: the lower the proportion of uranium contained in the ore, the more (fossil) energy uranium mining consumes.

#69 Climate protection

Nuclear power does not save the climate.

Nuclear power covers only slightly more than two per cent of global energy consumption. We won't save the climate with such a niche technology.

On the contrary, nuclear power blocks the expansion of the renewable energy sector, prevents energy transition, triggers electricity wastage and ties up capital that we would need for creating sustainable, future-proof energy systems.

#70 Efficiency? What efficiency?

Nuclear power is a pure waste of energy.

For physical reasons, nuclear power plants can convert only about one third of the energy released by nuclear fission to electricity. The other two thirds adversely affect the environment by heating up rivers and the atmosphere. Even coal-fired power plants are more efficient.

#71 Waste of electricity

Nuclear power triggers energy wastage.

Nuclear power plants are profitable only if they are operated continuously. At night, however, less electricity is needed. No wonder that the big nuclear power companies have advertised electrical night storage heaters for decades but these systems are predominantly used in winter. Where to supply nuclear power in summer then? French nuclear group Électricité de France (EdF), the industry leader, has developed a brilliant business opportunity also for this purpose: they are promoting – you guessed it – air-conditioning systems.

#114 The fusion illusion

Nuclear fusion can be used even today – in the form of solar energy.

Nuclear fusion relies on the principle of generating energy by fusing atomic nuclei. The crux of the matter is that this process requires temperatures of up to 150 million degrees Celsius – ten times as hot as the sun. To date, the only example of man-made nuclear fusion has been the hydrogen bomb. Despite many billions of subsidies, researchers have not made any progress in designing a terrestrial "fusion power plant", which was promised as early as in the 1960s. If there were one, many tonnes of radioactive tritium would be required to fuel the reactor, and the plant would generate new hazardous nuclear waste. Up in the sky, however, the biggest

fusion power plant in our planetary system is working: the sun. It supplies an amount of energy many thousand times greater than we will ever consume, and we can utilise this capacity without any risk, beginning today!

 # 72–79

Power & Profit

#72 Subsidies

The nuclear industry cashes in billions of subsidies.

Nuclear technology research and development has been funded mainly by the government. A lot of taxpayers' money was also used for constructing the first nuclear power plants, followed by the demolition of the nuclear ruins.

Add to this tax benefits, government grants, coverage of nuclear waste rehabilitation costs, government credits and export guarantees. From 1950 to 2008, direct and indirect subsidies totalled 165 billion euros; another 93 billion euros are expected to be spent.

The European Atomic Energy Community (EURATOM) distributed about 400 billion euros to the nuclear industry. Also, approx. 200 million euros of taxpayers' money are used for the funding of new nuclear projects and research each year.

#73 Tax-free fuel

Uranium consumption is tax-exempt.

To date, uranium has been the only tax-exempt fuel – a concession to the big nuclear players that is worth several billion euros per year. Nor do the nuclear operators have to purchase carbon certificates for the greenhouse gas emissions caused during the production of the nuclear fuel.

#74 Non-taxable provisions

Big nuclear businesses are exempt from paying taxes on billions of euros of their income.

For decades, nuclear power plant operators have been benefiting from generous non-taxable provisions for the dismantling of the power plants and storage of radioactive materials. Even the accrued interest is tax-exempt. Instead, they are using this amount (currently about 28 billion euros) as their "war chest" to acquire other companies and invest in new lines of business.

Due to this tax exemption, the Federal Ministry of Finance has lost income amounting to 8.2 billion euros to date.

#75 Putting the brakes on research

Abandoned nuclear facilities absorb billions of euros of the federal research budget.

Reactors for research and training purposes, pilot and demonstration plants, fast breeders, hot cells, a pilot reprocessing plant: the Federal government alone has invested many billion euros

in nuclear research and technology since the 1950s. Shut down a long time ago, these radioactive ruins are still eating up big chunks of the federal research budget.

To date, the Federal Ministry for Research had to pay almost three billion euros for demolition, decontamination and disposal. The same spending is anticipated for the coming years – money that is not available for science and research.

#76 Profit prolongation

Only the big electricity players benefit from extended periods of operation of nuclear power plants.

The German nuclear power plants have long been written down and are thus sources of cheap electricity, all the more so because there is no liability cover and no fuel tax whereas provisions continue to be tax-exempt. The crux of the matter: consumers do not notice any related effect.

This is because electricity prices are determined at the energy exchange and defined by the peak load price, which nuclear power plants can never generate because they are way too inflexible. Bottom line: only the big power suppliers benefit from nuclear power profits generated by their old plants – the longer nuclear power plants have been in service, the higher the profit. From 2002 to 2007, EnBW, E.ON, RWE and Vattenfall tripled their profits.

Question: Have electricity prices fallen anywhere?

#77 Electricity prices

Nuclear power drives prices up.

Electricity prices have been rising for years – despite nuclear power generation. One of the major reasons for this situation is the market power of the big four energy suppliers that dominate the electricity supply at the Leipzig energy exchange. From 2002 to 2008, EnBW, E.ON, RWE and Vattenfall generated profits of almost 100 billion euros. During the same period, they increased their electricity prices by clearly more than 50 per cent.

Nuclear power plants perpetuate the market power of the big corporates and guarantee profits in the billions. By contrast, renewable energies already have a price-dampening effect. Wind power enables consumers to save several billion euros per year as a result of the merit-order effect.

If the enormous benefits and subsidies granted to nuclear power were eliminated (for example, by assuming realistic amounts for the liability cover of nuclear power plants, making provisions taxable or introducing a fuel tax), nuclear power would become unbearably expensive. Back in 1992, Basel-based Prognos AG calculated a realistic price of about 2 euros per kilowatt hour.

#78 Not commercially viable

New nuclear power plants are not commercially viable.

In the past 20 years, hardly any nuclear power plant has been commissioned in market economies although the total installed power plant capacity increased by many hundreds of thousands of megawatts during the same period. This trend demonstrates that new nuclear power plants are not commercially viable.

This situation does not change either because of the two most recent nuclear power plant construction sites in Finland and France. The Finnish reactor was a dumping offer at a

subsidised fixed price (supported by the State of Bavaria by loans granted by Bayerische Landesbank at favourable terms) but costs have long exploded. In France, the nuclear industry (AREVA) and sole electricity supplier (EdF) are controlled by the government, which is why market economy considerations are of minor importance.

One E.ON manager frankly admits: "No nuclear power without government funding."

#79 The power of big nuclear

Nuclear power perpetuates the centralised energy supply structure and power of the big electricity companies.

Four big power companies control the German electricity market. They own the grids, operate the power plants and determine electricity prices and even energy policy to an incredibly large extent. Nuclear power strengthens the dominating market position of the "Big Four". Highly efficient, environmentally friendly decentralised power plants owned by the citizens or local communities make the big players less powerful, which is why the nuclear power plant operators try to prevent such plants from being installed at any cost.

 # 80–87 & 115

Freedom & Democracy

#80 Deprivation of freedom

Nuclear power deprives us of our freedom and curtails our civil rights.

Whenever demonstrations against Castor transports are forthcoming, the authorities restrict the right to assemble on many square kilometres or use brute police force to combat peaceful protesters. Streets are blocked to cut off entire regions. People are arrested for hours at temperatures below zero, in some cases even without toilets provided. For years, the police have been treating opponents of nuclear power like terrorists, spying on them, tapping their wires and searching their apartments. Thousands of protesters are illegally arrested by the police in detention cells, barracks, garages, gyms or even metal cages, in some cases for several days without involving a judge to evaluate the case.

Whose rights are enforced in violation of our civil rights?

#81 Right to life

Nuclear power violates the basic right to life.

Nuclear power plants pose a threat to our basic right to life and physical integrity. In its "Kalkar" judgment, the Federal Constitutional Court has thus linked the operation of nuclear power plants to a "dynamic protection of civil rights".

According to this ruling, the first requirement is that any safety precautions must always comply with the state of the art in science and technology. Also, the reactors must be protected against any conceivable risks and hazards. None of these two requirements is currently being met.

Despite this fact, no supervisory authority has revoked a nuclear power plant operating permit yet.

#82 Brute police force

The government uses violence to curtail protests against nuclear power.
Those who lack compelling arguments use violence as the last resort: the police has harmed tens of thousands of ordinary people by batons, kicks, fists, water cannons, painful grips, pepper spray and gas grenades. Two people were even killed. What did they do? They just demonstrated against nuclear power.

#83 Fifty years of dispute

Nuclear power has been dividing society for decades.
Nuclear power has been heavily disputed since the 1950s when the construction of the first nuclear reactors began in Germany because nuclear power is life-threatening. Nothing has changed, which is why this conflict can be resolved only by permanently and irrevocably phasing out nuclear power.

On 15 June 2000, the big electricity suppliers agreed to the so-called "nuclear consensus", committing to a gradual nuclear phase-out and documenting this commitment by signing this accord. In return, a lot of concessions were made to them. If EnBW, E.ON, RWE and Vattenfall were trying to withdraw from this nuclear phase-out, they would be in breach of the "consensus" and thus their own agreement.

#84 Corporate policy

The influence of big energy suppliers on policy makers is intolerably high.
There is hardly any area other than the energy sector in which industry and policy makers are intertwined so closely. Many high-ranking officials started with shaping politics as desired by the big industry players and were then rewarded with well-paid corporate positions or contracts: Wolfgang Clement, Joschka Fischer, Gerald Hennenhöfer, Walter Hohlefelder, Joachim Lang, Otto Majewski, Werner Müller, Gerhard Schröder, Alfred Tacke, Bruno Thomauske, Georg Freiherr von Waldenfels. MPs (e.g. Rezzo Schlauch, Gunda Röstel) are also subsequently hired by big energy suppliers or their subsidiaries.

The power of big corporates undermines democracy.

#85 Stupefaction of the people

For over 30 years, the big electricity players have been repeating their mantra that "the lights go out without nuclear".
"Even in the long term, solar, hydro and wind power will not be capable of meeting more than 4 per cent of our electricity demand". This is what the big German electricity suppliers still claimed in 1993 in big adverts published in national newspapers. In reality, the situation looks different: in 2009, over 16 per cent of the electricity consumed in Germany was generated from renewables. By 2020, this share may have increased to almost 50 per cent. A shift to 100 per cent renewable generation is achievable by the middle of this century.

Irrespective of this situation, the big electricity providers fighting for an extension of the residual service lives of their nuclear power plants still love to tell the fairytale of supposed "power outages lasting several days". Should we still believe this story?

#86 Unwanted

Nobody wants to live next to a nuclear power plant.
According to surveys initiated by Deutsches Atomforum (German Nuclear Forum), nuclear power will soon be widely accepted again. More honest and reliable, however, are the responses to a survey by Emnid, the market research company, in the middle of 2008: more than two thirds of the respondents rejected the construction of a new nuclear power plant at their place of residence even if they got electricity free of charge for the rest of their lives.

#87 Ethics

The use of nuclear power is unethical.
Nuclear power plants provide benefits to only a few people for a few years but pose severe risks to life and health of a large number of people. They generate waste that must be safely stored for hundreds of thousands of years: an incredibly high burden imposed on the coming 40,000 generations.

#115 No protection

Before the courts of law, future generations are not protected against nuclear risks.
If a nuclear repository leaks, this causes damage mainly to future generations. However, nobody would be in a position to take legal action if the relevant authorities worked sloppily when assessing long-term safety today because those lodging their claims would not be affected themselves if the radioactive waste reached the surface again after 1,000 years. Compensation for damage to future generations may not be claimed in court, as was decided by the Oberverwaltungsgericht Lüneburg (Lüneburg Higher Administrative Court) in the dispute over the planned Schacht Konrad nuclear repository and upheld by the Federal Constitutional Court. Bottom line: nuclear waste renders the rule of law ineffective.

 # 88–93 & 116
War & Peace

#88 Camouflage programme

Civilian and military use of nuclear energy cannot be separated.
Any uranium enrichment plant is also capable of producing highly enriched uranium for use in bombs. A nuclear reactor may also "breed" a particularly large amount of plutonium. A "hot cell" can also be used to produce bombs. Reprocessing plants extract plutonium for bombs from the waste generated by nuclear power plants.

Many governments have used civilian nuclear power as a camouflage to develop nuclear weapons, some of them very successfully. The larger the number of nuclear power plants, the higher the risk of military or terrorist abuse.

#89 Fast breeders

"Fast breeders" multiply the threat of proliferating nuclear weapons.
Nuclear power plants of the "fast breeder" type are considerably more hazardous than conventional reactors and pose a higher accident risk. Also, they do not use uranium but plutonium. If "fast breeders" were used as a large-scale technical solution, enormous amounts of plutonium would be circulated and traded as an asset. It would be very easy to hide or steal a few kilograms to build a bomb.

#90 Dirty bombs

Radioactive material from nuclear facilities can be abused for dirty bombs.
Blended with conventional explosives, a very small amount of radioactive fission product from any nuclear facility suffices to build a so-called "dirty bomb" whose explosion would atomise and disperse the fission product and contaminate the surroundings even more – a horrible threat indeed.

#91 Targets of attacks

Nuclear power plants are targets of attacks.
No nuclear bomb is required to harm or kill millions of people or render entire regions uninhabitable. An attack on a nuclear power plant is sufficient.
In a top-secret flight simulator experiment conducted on behalf of the Federal government, volunteers succeeded in letting a jumbo jet hit a nuclear reactor in every second attempt. A terrorist attack on a nuclear power plant "must ultimately be taken into account" according to the assessment by the Bundeskriminalamt (Federal Agency for Criminal Investigations).

#92 Uranium ammunition

Waste from uranium enrichment is used as radioactive ammunition.
Many armies, including the US army, use ammunition consisting of depleted uranium. Upon hitting the target, it atomises, explodes and contaminates the surroundings. Radioactive particles cause severe damage to the health of soldiers and civilians alike. Military representatives stress the high penetration force of this extremely dense material, and the nuclear industry benefits from a low-cost "disposal" of its radioactive waste.

#93 War over uranium

The hunger for uranium of the nuclear industry is fuelling new conflicts.
Uranium deposits, for instance in African countries, have been triggering related conflicts for decades. The larger the number of nuclear power plants, the greater the dependency on the radioactive raw material. Uranium has long become a subject of speculation. If it becomes scarce, a war over uranium is as realistic as the war over oil.

#116 Bomb stuff on the campus

Munich University of Technology keeps military-grade uranium on stock – as the fuel for its reactor.

Despite protests in many countries, Munich University of Technology insisted on operating a reactor for research purposes that requires highly enriched, military-grade uranium as its fuel. Up to 400 kilograms of the hot material are stored on the Garching campus. About 15 kilograms would be sufficient even for amateurs to build a nuclear bomb. Spent fuel elements from Garching can also be used to fabricate nuclear weapons. Where does the university store this hazardous waste? In the Castor building at Ahaus, with no sophisticated safety precautions.

 # 94–100

Energy Transition & Future

#94 Renewable energy

100 per cent renewable energy generation is possible.

Even today, renewable energy sources supply more than one sixth of global energy consumption. We are running out of oil, gas, coal and uranium while global warming is getting more severe. Solar, wind, hydro, biomass and geothermal energy will be available as long as our planet Earth exists. Many (also government) studies show that the transition to 100 per cent renewable generation is possible, which is the only option left to humankind.

#95 Not compatible

Nuclear power and renewables do not get on well with each other.

Just recently, big electricity players E.ON and Électricité de France (EdF) threatened the British government with not investing in new nuclear power plants if the government supported renewable energy sources because expensive nuclear power plants are commercially viable only if they can produce and sell their electricity around the clock.

Only power plants that are quick and easy to control are suitable for a combination with renewables because their only purpose is to complement environmentally friendly electricity generated from solar, wind and hydro power. For technical reasons, however, nuclear power plants are extremely inflexible.

Thus nuclear power and renewables will never play in the same team but always oppose each other: those building nuclear power plants block the expansion of renewable generation, or vice versa, as demonstrated above.

#96 Barrier to investment

Nuclear power prevents innovation and investment.

Renewable energy is one of the most dynamic and promising industries worldwide. As a result of the booming renewables sector in Germany, many German businesses have invested in research and development. In many areas, they have become world leaders due to the technologies they offer – with an extremely promising outlook: wind and hydroelectric turbines, biogas plants and photovoltaic modules made in Germany are sold across the world. In 2008,

every third newly installed wind turbine came from Germany.

Despite the economic crisis, investments in renewables rose by one fifth to 18 billion euros in 2009.

Any extension of the periods of operation of nuclear power plants makes investments in renewable energies less secure and reliable, which obstructs research and innovation. Those focusing on nuclear power undermine the position of renewables as THE booming, environmentally friendly, export-driven industry of this century.

#97 Two per cent technology

Nuclear power is unable to make a significant contribution to energy supply.

The electricity produced by all 438 nuclear power plants in the world meets only slightly more than two per cent of world energy demand. This share is ridiculously low.

If this share were to increase even to ten per cent, about 1,600 additional nuclear power plants would have to be built if energy consumption remained constant. In this case, the existing uranium reserves would be exhausted in about ten years. Alternatives would have to be sought thereafter, such as renewable energies.

#98 Phase-out model

On a worldwide scale, nuclear power is on the verge of being phased out.

In Europe, only 18 out of 46 countries use nuclear power. New reactors are currently under construction in only two of them. Across the 27 EU member states, both the number of reactors and the share of nuclear in electricity generation are decreasing.

On a worldwide scale, 35 new reactors with a total installed capacity of 26 gigawatts have been connected to the grid during the past ten years. Out of the currently operated 438 reactors, however, 348 (with a total installed capacity of 293 gigawatts) have been in service for more than 20 years. From now to 2030, a new reactor would have to be connected to the grid every 18.5 days to just replace these nuclear power plants, which is far from being realistic.

#99 Jobs

Nuclear power puts jobs at risk.

Renewables are the biggest job driver in Germany. More than 300,000 sustainable, future-proof jobs have been created within only a few years, of which slightly more than 50,000 in the last two years alone – despite the economic crisis. Compare this to the nuclear industry employing just 35,000 people. Forecasts anticipate the creation of 200,000 additional jobs in the renewables sector by 2020 if green power continues to enjoy priority in the grid.

By contrast, any extension of the period of operation of nuclear power plants or a complete withdrawal from nuclear phase-out jeopardises energy transition and thus hundreds of thousands of jobs.

#100 Energy transition

Nuclear power blocks energy transition.

Nuclear power undermines all efforts undertaken to reshape our energy supply system. Nuclear power ties up capital, blocks power lines and prevents the decentralised expansion of renewables. Above all, however, it generates billions of profits and a great degree of influence

for exactly those groups of companies that have been obstructing renewable energies and energy saving efforts for decades.

#101 You are right!

Your own good reason is still missing.

We are sure that there are many other good reasons against nuclear power. Therefore #101 is reserved especially for you. If you are aware of a new good reason, just submit it to info@100-gute-gruende.de together with relevant references.

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