Fact Sheet 1: Safe Energy

Climate protection is feasible

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Climate protection is feasible

The latest global climate report of the Intergovernmental Panel on Climate Change (IPCC) of the UN made unquestionably clear that climate change is happening (1). Prompt and worldwide action could limit the CO_2 concentration in the atmosphere at 400 ppm and thus limit the global warming to a maximum of 2 °C. If we exceed this limit of temperature increase, the consequences are projected to be unmanageable. Leading scientists say that we only have 10 years left to change this trend. Keep in mind: climate change affects us all: every individual, every community, every business and every country.

The fossil fuel energy sources: coal, oil and gas currently account for more or less 80-90% of the total global energy production. 30 million tons of CO_2 are emitted worldwide; 75% of these derive from fossil fuels. We need a fundamental change in how we deal with energy and resources. The CO_2 emissions have to be reduced as quickly and effectively as possible, through energy savings and adoption of renewable energy sources for electricity, heating and transport.

Through energy conservation, a great deal of CO_2 reduction can be achieved in a relatively short period of time. In the middle and long term it is necessary and strategic to replace nuclear power generation by renewable energy sources. The commitments for CO_2 reductions that have been made by some regions are setting a good example, especially some areas in the south of Germany. They want to provide for their total energy needs in a local and sustainable way, to strengthen the regional economy and create new jobs. An advantage of this is an example of the Starnberg region which approved a local governmental decree, in which the goal of complete adaptation of the region to renewable energy is by 2035, through:

- Reduction of energy use;
- Introduction of innovative and efficient energy sources;
- Sustainable use of all local energy sources.

A detailed study of energy use and the potential of renewable energy sources and its potential for the Starnberg region showed that the final conclusion is feasible. Still, three percent of the total energy use per year should be saved. The remaining energy gaps can be closed by renewable energy sources like water, wind, sun, thermal and biomass from sustainable forestry. Solar energy as well as electricity and heat from enhanced geo-thermal systems make up the biggest regional resources.

Climate protection- saving energy

We have the opportunity and the awareness of the options to meet the climate change challenge. We have significant potential to reduce CO_2 emissions. In all areas of society, including corporations, public facilities like Kindergardens, schools, high schools, recreation facilities such as swimming pools, governmental buildings, sport parks, churches, clinics, elders residences, and last but not least private households - energy efficiency and saving measures can be realized everywhere by use of energy saving appliances, optimized heating systems, housing improvement (insulation, ventilation, windows etc.), avoidance of energy losing stand-by-modes, the construction of passive houses (ultra-low energy buildings) etc. Additionally, reducing use of motorized transit, driving fuel-efficient cars and using public transit will all help our climate.

Climate protection- expand renewable energy sources

Renewable energy sources are essential in order to be able to cope with the challenges of the climate change and the shrinking fossil fuel resources. The options are numerous. Ireland, for example, is blessed with thermal heat, and Norway with hydropower, countries with a lot of sun can use solar thermal power plants. In Germany the north is suitable for wind power, whereas the south would benefit more from solar power. The renewables' share in Germany's energy provision is already considerable. In 2006, for example, renewables' share in electricity production was 12%, in heat production 6% and in fuels 6.6%. The release of 100 million tons of CO_2 was avoided. In coming years a rapid expansion, especially in the electricity and heating sector, is expected to occur.

Worldwide the greatest amount of energy is used to provide for heating and transportation. Growing fuels in households, industries, power plants and cogenerations (CHP's) as well as biofuels for engines, currently contribute considerably to these sectors. However, expansion of agro-fuels production potential is limited due to its competition with food production, nature conservation,its often net energy loss in production as well as social problems.

One important possibility for sustainable heat production is solar heating systems. Solar collectors can provide the heating of both water for domestic use and heating water as well as the heating for water in swimming pools and thus eliminate the use of oil and gas. With the quickly rising prices of fossil fuels, one can anticipate increased demand for solar heating.

A relative newcomer is the usage of geothermal heat from inside of the earth in the 'Nahwärmeversorgung', where, in contrast to the heat supply of entire cities or districts, the access to and distribution of heat takes place in the immediate vicinity of the site of energy production (e.g. individual geothermal heating production for some homes in the neighborhood or for business building.)

Although its current global share is relatively small, photovoltaic systems, which transform sunlight directly into electricity, are also a promising alternative for the future. Solar energy is available in abundance, and one may assume that photovoltaic systems, together with the energy generation from solar thermal power plants will, at the end of this century, contribute greatly to the total electricity supply (4). Like wind energy, which is currently in wide use around the world, photovoltaic systems are a fluctuating energy generator, and thus not constantly available. Energy can only be produced when the sun shines or the wind blows. Thus, plans to combine different renewable energy sources should be made in order to create comprehensive and consistent access to energy to meet global needs.

Base load capable combined heat and power stations using regional geothermal energy or locally available sustainable biomass from forestry and residues would be sufficient. In addition, the base load can be fed by the traditional but irregular power supply from water. The need for regulation of the power supply will become more relevant with the growing influence of solar and wind power. This may affect the security of supply. Local examples of a fundamental change in energy supply, such as Starnberg in Germany, show that a regionalisation of power supply leads way from a centralised to decentralised structure. Then, it is the question of combining the decentralised power plants to a "virtual power station" that is capable of creating a secure supply system for an entire region (5).

The resource distribution conflict for the fossil fuels is becoming ever more acute as China and other developing countries join the fray. Future or current resource wars (such as Iraq) create huge suffering and costs. Instead, the same money should be used to expanded programmes for global sustainable and renewable energy supply – a far more meaningful purpose.

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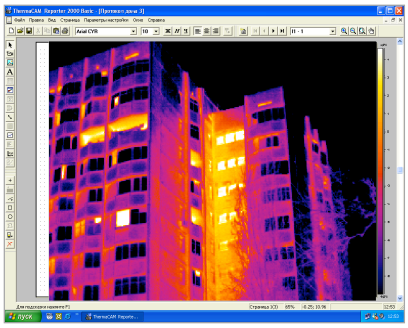

picture 1:
Kyrgyz women construct a solar heater
source NGO BIOM, Kyrgyzstan
picture 2:
Kyrgyz Men learn about solar cookers
source NGO BIOM, Kyrgyzstan
picture 3:
infrared picture - showing the heat losses of a department building in Odessa, Ukraine, huge potential for energy efficiency
source NGO MAMA86 Odessa, Ukraine

Fact Sheet 2: Safe Energy

This is not the way to protect the climate

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This is not the way to protect the climate

The UN World Climate Report clearly states that climate change is happening (1). Immediate and global action can stabilise atmospheric CO_2 concentrations at 400 ppm (parts per million, 1 ppm = 0,0001 %) and therefore produce no more than 2 °C increase in global warming. Above this limit the consequences would become uncontrollable. The global community has only 10 to 15 years to affect this outcome. That is why power utility companies offer low carbon technology to solve the problem.

Coal, the climate killer, to the rescue

Carbon Capture and Storage (CCS) is the technology that is supposed to clean up the most carbon intensive of all the fossil fuels. The process: CO_2 is split from the coal firing and stored underground, for example in disused natural gas depositories. Since 1991, huge sums have been invested in researching "CO_2 free" power stations. The enthusiasm could be over soon. Because climate friendly electricity from coal will most probably never be competitive. The necessary infrastructure for the transportation of the carbon dioxide to the underground storage sites along with the additional fuel needed for the CCS technology would lead to considerably higher costs. In addition, the gas is not fully combusted during the process. The CO_2 emissions are only reduced by around 75 %. So far nobody has any experience with storing the aggressive carbon gas. It is unclear whether the leakage unit can be kept so small that an effective storage of the climate gas is possible. And if the technology is only ready in 15 years instead of now, then it will be too late. (2,3)

Nuclear power, to the rescue

Electricity from nuclear power stations produces less CO_2 than from fossil fuels (4). But the risks of using nuclear energy are so high that it does not offer a viable solution. With increased use the risks would increase as well. Along the entire process chain, from the uranium mining and processing, the fuel element production and power production to the decommissioning and disposal. This is in addition to the danger of terrorism and proliferation, especially through military use (North Korea, Pakistan, India, Iran). The central question is, do we want to continue exposing ourselves to the risks. And, nuclear energy does not have the potential to be a serious solution to climate change. Globally, it is insignificant and only cover two to three percent of the worldwide total final energy consumption. Renewable energies cover 20 percent, the large remainder is produced with climate relevant fossil fuels. At the moment, there are 439 nuclear power stations in operation worldwide. Most of them aging. Only 33 stations are less than 10 years old. To achieve the goal of the International Atomic Energy Agency (5) of raising nuclear power to four to six percent by 2030 would require the construction of about 1000 power stations over the next 13

years – also to compensate for the aging power plants. Doubt with regards the implementation are viable as it can take up to 10 years from the planning to the commissioning. Nuclear power is not an option for solving the global warming.

Drawing fast breeders from hat

Even the nuclear fuel uranium is finite (6,7). The uranium resources that can be mined economically and are used at current rates will last about 70 years. With every additional power plant brought online the duration will shrink. Nuclear power leads the way into the same dead-end road as the burning of finite fossil fuels.
A massive expansion of nuclear power use would mean that the supply could not be maintained. These options would become necessary: a switch to Thorium as a fuel source, the expansion of the risky and environmentally harmful reprocessing of used fuel elements or the even more dangerous widespread use of breeder reactors. Some time ago, "fast breeders" were created as a solution to the then perceived uranium shortage. Breeders did not become viable, not only because they were uneconomic, but also due to the immense safety problems. Besides the health risks, the large scale production of plutonium also leads to risks of proliferation. Old technology such as breeders and the German thorium high temperature reactor, that never got beyond the test phase, are now being proclaimed as 4th generation

nuclear reactors. These reactors are supposed to be safe, to produce less waste and to pose no risk with regards to proliferation and use as nuclear weapons. And they are supposed to be economically viable and quickly to commission. Until now, this could not be realised.

No where to be seen: nuclear fusion as climate protector

Far in the future, is a technology that carries the highest expectations for covering the global demand for energy – nuclear fusion. Despite huge R&D investments, the need for further research is still immense. A fusion reactor is not free of radiation problems and carries the dangers of nuclear weapons production. The technology has been researched in the largest industrialised countries since the 1960's. Then it was thought that the technology would be ready within 30 years. Today, the general hope is that it will be ready in 50 years. In reality, nobody can say for sure whether nuclear fusion will ever be commercially viable or which risks and problems will come with it.

Instead of investing in CCS, the extension of nuclear power, 4th generation reactors or nuclear fusion other energy sources should be used. Ones that are quicker to realise and cheaper to develop: renewable energies and the massive potential of energy efficiency.

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Fact Sheet 3: Safe Energy

Radiation protection: Equal rights for women and men? Experiences from Germany

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Radiation protection: Equal rights for women and men?

The perception of equal rights with regards to radiation protection is quite different. Some see it as equal job opportunities for women and men working in nuclear research and technology and others see it as equal protection from radiation for women and men.

Radiation protection in Germany

In 2001, Germany amended its Radiation Protection Regulation (Strahlenschutzverordnung) (1). Now, pregnant women are "allowed" to work within the radioactive control area – all in the spirit of equal rights. A working ban or working restrictions as a protection for the unborn child have been scrapped with the argument that these restrictions discriminate against women in these jobs. Pregnant women can be exposed to 1 mSv through their occupational work from the first mention of their pregnancy to its end. If the woman works for 1000 hours in a radioactive area, then the child will also be exposed to 1 mSv during this time. The exposure is equivalent to roughly 10 times the amount of the average background radiation. A number of academic research has shown that the effects of low level radiation on a foetus can be terminal. After the accident in Chernobyl, Germany witnessed a highly significant correlation between the caesium exposure of pregnant women and prenatal mortality seven months later (2). A local connection between caesium soil exposure in Bavarian districts and the increase in still birth rates in 1987 was reported (3). In an area of Bavaria with a 0.5 mSv per year increased background radiation the infant mortality is significantly higher (15.7 %) than in the rest of Bavaria (4). As a consequence of the above ground nuclear tests, West Germany showed a marked increase in prenatal mortality around the year 1970 against an otherwise steady downwards trend. The deviation from the trend correlates with the calculated strontium concentration process in the pregnant women (5). The cancer rate in small children under fives years of age near to nuclear power plants (0 – 5 km) is significantly high at 53 %. Leukemia rates are also significantly higher (6,7).

New insights into radiation protection

On the 19th of June 2007 in Berlin, Germany, the International Commission for Radiation Protection (ICRP) presented the new basic recommendations and the latest academic research results into radiation induced cancer and connections to radiation sensitivity. The German Environment Minister, Sigmar Gabriel, demanded the rapid implementation of the new knowledge within the radiation protection law.

The focus lays on these aspects:

<u>Cancer development in nuclear plant workers</u>
The effect of low exposure is double underestimated. Already, the life span working dose, that are within the current threshold limits, lead to increased cancer rates.
<u>Lung cancer through radioactive radon gas in houses</u>
The radon induced lung cancer risk increases by roughly 8 % per 100 Bq/m^3. An increase between 100 and 200 Bq/m^3 shows additional cancer illnesses.
<u>Sensitivity to radiation</u>
The radiation sensitivity depends on the age and sex. It is especially high for the unborn child. The sensitivity of women is about double as high as for men with regards to the relative risk. The same goes for all female organs.

Radiation is believed to be stronger than previously thought and can be dangerous even in low doses. Official radiation protectors have played down the significance of serious evidence in this direction. Especially the ICRP has been slow to adopt new evidence and their recommendations are years behind current academic research.

The latest research clearly shows that the current radiation protection is insufficient to protect the unborn child effectively. Even though the relative biological effectiveness has not been determined yet. Radiation-biological research focuses mainly on deformities that may occur during the organ formation weeks three to seven (8); mental retarding, which usually occurs during week 8 to 15 or in a weaker form during week 16 to 25 (9) and cancer in children, especially leukemia, that may occur during the entire pregnancy and is induced by low radiation doses (6,7). The higher sensitivity of women is a result of, among others, hormones and cell growth in certain tissue, for example in breasts or sex related oncogene.

The current radiation protection does not consider that women are relatively twice as much at risk than men. Instead, an "average" sensitivity is calculated and is equally applicable to men and women. Women are afforded less protection than men. Seeing that averaging the risk does not make sense from a scientific point of view, a sensible approach would be to differentiate within the calculation basis.
During the conference, the ICRP chairman, Lars Holm, saw a difficulty in respecting the higher radiation risk of women and unborn children within the current radiation protection. If women were subject to different threshold limits they would be discriminated against in

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their profession. The right to equal opportunity would be breached. The Umweltinstitut München (Environmental Institute Munich) has protested vehemently against this absurd interpretation of equal rights. Correctly interpreted equal rights can only mean equal risk – and this can only be achieved through better protection of women. They are discriminated against, if the variation in radiation sensitivity is not included in radiation protection.

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Fact Sheet 4: Safe Energy

Catastrophe free nuclear power – wishful thinking

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Serious nuclear accidents

Windscale: October 1957
Fire in the reactor lasts many days, radioactive cloud reaches Northern Europe
Mayak: September 1957
Accident, more than 100 dead through radiation, 217 cities and villages with a total population of 270.000 people were affected
Idaho: January 1961
Accident, three dead
Detroit: October 1966
Cooling system failure, reactor core melts
Three Mile Island (Harrisburg):
March 1979 Worst nuclear disaster in the USA, surrounding area evacuated
Saint Laurent: January 1980, Tear in a line, radioactive leakage
Chernobyl: April 1986
Worst nuclear accident in the world, number of dead unclear
Tokaimura: March 1997
Explosion, 35 workers receive high doses of radiation;
September 1999, Critical accident, 600 people exposed to strong radiation, two dead
Paks: April 2003
Overheating of 30 fuel elements, radioactive leakage
Tokyo: August 2004
Accident, four dead
Kashiwazaki-Kariwa:
July 2007, Earthquake, transformer fire and radioactive leakage

There is no guarantee against nuclear accidents

Atomic power stations use radioactive material including uranium and plutonium for energy production. Nuclear fuel, as well as other radioactive fission products, which are produced during the process of energy generation are extremely dangerous for the environment. Since ionizing radiation harms all forms of life, it is essential that these substances do not leave the power station and enter the environment. Human and technical errors may occur. A 100 percent guarantee against accidents is not achievable even with the existing comprehensive safety systems. A danger remains, but we are told it is „so small", that society should accept the risk.

The history of nuclear energy production clearly shows that serious accidents, either in nuclear power stations or other nuclear plants, can not be prevented. Little was known about the dangers of accidents and radiation, when the first nuclear reactors where built during the 1950's – mainly for military reasons. Over the years, serious accidents such as in Mayak or Windscale (today known as Sellafield) were played down or covered up. Not until the nuclear accidents in Harrisburg, Pennsylvania and especially in Chernobyl, Ukraine, did the public become significantly alarmed. After that, the further global expansion of nuclear power for civilian use was dramatically slowed down.

The global reactor inventory is 'aging'

Nuclear reactors were designed to run for 30-40 years. Most of the active nuclear power stations are now older then 30 years. Aging leads to wear and tear and changes in the used material. These processes are difficult to anticipate and to detect. They include high temperatures, strong mechanical forces, an aggressive chemical surrounding and the continuous neutron radiation from the nuclear fission impact on essential safety components. Corrosion, brittleness, and surface tears along welds of central components have occurred again and again in the past. Anyone who thinks about a 60 year life-span must consider that these dangerous conditions will increase. In addition, the liberalisation of the energy markets in many countries leads to more financial pressures. The consequences: less staff, fewer safety checks, and more time pressure during repair work and routine exchange of fuel rods. In order to produce more electricity, the burning of fuel and the performance of the reactors are increased by 10 % through structural measures. The components are under more stress and the safety margins become narrowed, placing everyone at more risk.

The probability of serious accidents is increased

„An accident such as Chernobyl can not occur in Western reactors." This is stated again and again. But the fact that no accident of this magnitude has occurred is probably pure luck. A safety report of nuclear power stations written after

Chernobyl (1) shows a continuous number of abnormal occurrences. Recently, such occurrences have been increasing.
This is documented in the following examples:

Great Britain: Leakage in the control rods of the most recent British reactor Sizewell B (commissioned in 1995)
Germany: A too low boric concentration in the emergency cooling system of the German reactor Philippsburg-2 (August 2001) A heavy hydrogen explosion in a pipe of the German boiling water reactor Brunsbüttel close to the pressurized reactor chamber (December 2001)
The regular quick shut down of the German reactor Krümmel could not proceed due to a transformer fire, which resulted in the failure of the emergency power supply (June 2007)
Bulgaria: While shutting down the WWER (water-water-energy-reactor - certain type of reactor) Kosloduy-5, control rods were stuck in upper position (March 2005)
USA: A long undetected corrosion on the pressurized reactor chamber of the US reactor Davis-Besse. Only the presence of the thin stainless steel coating of the reactor tank prevented a massive leakage (March 2002)
Japan: Manipulation of safety data during a 25 year period within the Japanese nuclear power company Tepco (discovered in August 2002)
Sweden: An external short circuit and failure of the emergency diesel electricity in the Swedish nuclear power station Forsmark, core meltdown was prevented only through the actions of a station worker (July 2006)

Targets for terrorist attacks

The "new" threat dimension: terrorists could target nuclear power stations, reprocessing plants and above ground storage sites as targets for attack and accept their own death in the process.

Following the attacks on the USA in 2001, the vulnerability of power stations to air attacks was assessed in Germany (2). The results: older power plants are vulnerable to any kind of aircraft regardless of size, type or speed and an impact would lead to a nuclear inferno. Either the safety container would be broken or the piping system would be destroyed by the concussion or kerosene fire. In any case, an impact would most likely result in core meltdown and widespread radioactive contamination. The newer reactors are equipped with a sturdier containment, but an impact might still result in a disaster. Nuclear energy with its highly dangerous facilities offers terrorists additional targets of opportunity.

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Fact Sheet 5: Safe Energy

The unsolved problem: nuclear waste

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The Unsolved Problem: Nuclear Waste

The radioactive waste from nuclear power plants is a serious danger to humans and the environment. Due to the long half-life of some of the substances the waste remains a danger for extended periods of time – in some cases for millions of years. Very small quantities are enough to cause a catastrophe, if they enter into drinking water supplies. By stopping the use of nuclear energy, the continuous production of radioactive waste from civilian use will come to an end.

Toxic Almost Forever

Uranium is the fuel used in nuclear reactors. The fission of uranium-235 produces different radioactive products; the non fissionable uranium-238 breeds so called transuranes including the highly toxic plutonium. Therefore spent fuel rods are highly radioactive. On average, an atomic power plant produces 30 tonnes of high level waste per year. Over a 40 year life span this results in roughly 1200 tonnes of highly radioactive waste. Germany, alone, has generated 13,000 tonnes of spent or partially spent fuel since the beginning of nuclear power there. So called "low level nuclear wastes" such as protective clothing and cleaning materials are added to the waste pile along with high-level radioactive materials such as used pipes or valves. All in all, a power plant produces nearly 100 tonnes total of nuclear waste every year that requires safe storage. (1) Nuclear waste is not just produced from active power plants. The largest volume of radioactive waste comes from decommissioned nuclear power plants.

Reprocessing: A Dead End

The idea of a "closed nuclear fuel cycle" remains a fiction. The proposal was for commercial nuclear reactors to produce fissionable plutonium from reprocessing of high level waste that would be used in fast breeders reactors: plutonium reactors where non fissionable uranium-238 would, in turn, supply more and more plutonium – that was the dream, at least. However, it was not to be. Between very high costs, poor technological development, questionable safety, and dangerous vulnerability of diversion to military use, breeder reactor technology never gained momentum or public support. And, without the breeder reactor, the main incentive to separate plutonium from high level nuclear waste from power plants for civilian use is gone.

Despite this fact, France, Great Britain, Russia and Japan still have reprocessing programmes in order to use the separated plutonium in MOX fuel elements and then to feed them back into civilian reactors. (2) The reprocessing of used fuel elements produces plutonium (1 %), highly radioactive waste that requires storage (4 %), and depleted uranium (95 %). The reuse of the separated uranium in new fuel rods remains an exception. The fact is, the separated uranium fraction is actually more nuclear waste.
Reprocessing also requires a lot of transportation and puts additional radiation into the environment.
Reprocessing is not waste disposal. It is merely a possibility to gain more time until a solution is found.

Final Storage: Still Elusive

The unsolved problem of nuclear waste disposal is still with us today, even a greater challenge than 50 years ago when the first reactor went online. There is not a single functioning final storage site for high level radioactive waste any where in the world. The general perception holds that nuclear waste storage in deep geological formations is the least dangerous method – even though this final storage is not without risk. Whether granite, salt, clay or other geological formations are capable of housing highly radioactive and heat generating material over long periods of time safely is not decided.
Bit by bit, it is becoming clear that the selection of a final storage location is not merely a technical and scientific problem. None of the attempts to find a designated site, starting in the 1970's, has led to a final, approved storage site.

In Germany, for example, there was no transparency in the siting process and social opposition to the plan was ignored for a long time. The attempt to learn from previous mistakes, led to a multi-tier selection process with continuous public participation. But it is uncertain whether

Fact Sheet 6: Safe Energy

Uranium Mining: Health Risks and Environmental Consequences

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Nuclear energy has never been "safe" or "clean"

Whoever praises nuclear energy as "clean" energy is ignoring the complete path of the nuclear fuel chain from uranium mining to nuclear waste disposal. In particular, the production process of uranium generates massive problems to human health and the environment. Between the mining of uranium and its use in a nuclear power plant, many steps are necessary including mining, milling, enrichment, production of fuel rods, and transportation, all of which could lead to severe environmental destruction and damaged health for the people affected.

Uranium mining

Uranium is located in the earth's crust. However, it is not evenly spread, so it is only mined in the most profitable mineral deposits. Vast amounts have to be mined, since most rock contains very little uranium ore (below 0.5%). Radon gas and contaminated water leak from giant waste dumps and threaten the health of human and surrounding ecosystems. Large amounts of contaminated water can seep into the ground water and further contaminate rivers. Underground and surface workers are exposed to radioactive substances and suffer the risks of lung and other cancers.

The processing of uranium ore

Usually taking place close to the mines, the processing of the uranium ore is known as "milling". The ore is chopped, the uranium extracted and finally ground to yellow powder, which is called "Yellow Cake". The "tailings", remain of the milling process, consist of mud, which settles in a sedimentation tank and remains there. It still contains 85% of the original radioactivity with long living isotopes as Thorium-230 or Radium-226, heavy metals, harmful substances like arsenic and other additives from the processing. Due to the escape of radon gas and the eolian erosion of toxic dusts the contamination is being spread over large distances. Another problem is the seeping water, as it is a hazard for the ground and surface water supplies.

The enrichment of uranium

To enrich uranium, the "Yellow Cake" has to be transformed into uranium hexafluoride (UF6), a very toxic, chemically aggressive substance. The enrichment is necessary, because natural uranium mainly consists of not fissionable Uranium-238 and only for about 0.7% of fissionable U-235. However, most nuclear power plants need fuel which contains 3-5% of fissionable material. (For the production of atomic bombs an enrichment level about 90% is necessary.) The process of enriching the uranium also produces more radioactive waste material. One such waste product is depleted uranium, which, for example, is used to coat ammunition to give it "armor piercing" abilities.
Such depleted uranium weapons were used in the Kosovo and first Gulf Wars.

Uranium stockpiles

Uranium is a limited resource, just like fossil fuels, and is going to run short sooner rather than later. The status report of the Federal Republic of Germany for the Energy Summit 2006 (1) states that the uranium resources will last for about 70 years globally, at constant demand. The German Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) describes the uranium resources in their energy study 2005 (2) as sufficient for "the next decades". Including the resources that are not accessible right now, but geologically listed, at today's demand, uranium could be available for 150 to 200 years at most. Developing new uranium mines would not only be a major investment, but also take a lot of time. Furthermore, only a little part of all uranium resources lie in so called "rich-ore reserves". This is why mining would have to shift production more and more to "smaller ore deposits" - with less then 0.1% of uranium present. That would lead to even more environmental destruction.

Production capacities

As of today, the global mining companies already cannot meet the need for the global consumption of uranium. The output of mined uranium per year is about 32 000 to 42 000 tons, by a yearly consumption of about 60 000 tons (2). The production gap is being met partly by prior developed civil holdings, increasingly also by military holdings, due to the nuclear disarmament of Russia and the USA. The uranium reserves are not evenly spread around the globe. The majority of uranium production is centred in Australia and Canada, followed by Kazakhstan, Russia, Nigeria, Namibia and

Uzbekistan (3). The principal customers are the USA, France, Japan and Russia. Additionally, there are now new demands from countries like China and India, who want to develop nuclear energy, but do not hold significant natural uranium reserves themselves. The bulk consumers USA, France, Japan, Great Britain and Germany only have limited national production and are increasingly dependent on imports to meet their needs The dependence on imports in Germany, for example, is 100%.

As always, there is radioactive waste. The uranium production, on its own, proves that nuclear energy is not a "clean" and everlasting energy source. The only thing "everlasting" about nuclear power is the radioactive waste products that are harmful to human and planetary health.

Furthermore, the safe closing of exploited uranium mines – if carried out at all – costs billions of dollars, which mostly has to be paid by the taxpayer. The shutdown of the Wismut-Mines in the former German Democratic Republic is a good example:
After the USA dropped the nuclear bombs on Hiroshima and Nagasaki in August 1945, the Soviet Union made an extreme effort to keep up with the USA in the nuclear arms race. In an area of 40 square kilometres in the former German Democratic Republic, between the provinces of East Thuringia and West Saxony, the third biggest uranium mine in the world was built to provide raw material for the Soviet Union's nuclear weapons.

The uranium production did not cease until 1990 after the reunification of East and West Germany. The succeeding company, the Wismut GmbH, was now assigned to rehabilitate a large contaminated area and to dispose of 5 million tons of radioactive waste. By 2010 the clean up operations, with a budget of 6 billion Euros of German government funds, are supposed to be finished. Today the ones who suffer, the former workers fight for the acceptance of their illnesses as industrial diseases. Only patients with lung or bronchial cancer have a chance of acceptance so far. Also,
the local residents were constantly exposed to radioactive hazards from escaping radon gas. In bedrooms and living rooms a radon level of up to 1000 times higher than the usual numbers of that region have been measured.

If even in a highly developed and financially secure industrial country like Germany it is that difficult to deal properly with the clean up and reclamation of uranium production facilities and surrounding areas it is hard to imagine how a production shutdown in poor, socially weaker regions would be dealt with. Probably not at all.

Environmental injustice

Nuclear power carries an inherent injustice to the land-based indigenous peoples of the world on whose territories the uranium is mined and the nuclear wastes are most often stored. Often, economic incentives are provided to poor communities to encourage them to take the nuclear risk. This is not only unethical, but also unnecessary as there are better alternatives available than nuclear power to solve our climate crisis.

As we have shown by all the reasons stated above, the health environmental risks of mining, milling and production, and the limited, at best, amount of uranium reserves that are available on the planet, it is clearly best to leave the uranium right where it is: under the earth.

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Part about Environmental injustice:
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Translation: WECF

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(3) Mythos Atomkraft – Ein Wegweiser. Hrsg: Heinrich Böll Stiftung, Berlin, 2006

the waste storage concept, completed in 2002, will ever become reality. (3)
The final storage plans for Finland and the USA are quite advanced yet. The proposed siting of a gigantic nuclear waste storage site in Yucca Mountain, Nevada, on the lands of the Western Shoshone Indian Tribe, is very controversial and is at the center of an ongoing dispute between the State of Nevada and the federal government in Washington, D.C. The completed storage site in Olkiluoto, Finland, on the other hand, has experienced relatively little opposition.
Additionally, the waste sites in Finland as well as one in Sweden, are located near the coast. This clearly is not a good solution, because the ground on which the plants are sited is not stable enough which can lead to erosion and entry of salt water in the waste storage area.

The Idea of Transmutation

The process of transmutation is seen as one possible future for nuclear waste disposal. Here, long-lived radio nuclides are separated from the waste and transformed into shorter lived, and therefore less dangerous, substances. This technology, however, will not be available within the immediate future years on any large scale. The process requires new and environmentally harmful reprocessing plants that would have to be built along with an arsenal of fast breeders or special reactors, which do not yet exist. All of this would increase already existing risks making it a less than desirable solution. A final storage site is nevertheless desperately needed. (4)

The unresolved problem of nuclear waste should prevent any further consideration of expanding the development of nuclear energy. More nuclear power means more wastes that would be on the planet, threatening the integrity of our fragile ecosystems and human health for thousands of years without adequate storage. We are leaving future generations with a massive burden to cope with – this action does not acknowledge our own responsibility in having created a problem that for which we have no good solution.

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Translation: WECF

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Fact Sheet 8: Safe Energy

Mayak – lessons are not learned

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30 years prior Chernobyl: Mayak, Production Unit

If it weren't for the Chernobyl accident, the world might have never known that deep in the heart of Russia, at the foot of the Ural mountains, where Europe meets Asia, there had already been an accident similar to the latter in its scale.

The location of that first nuclear catastrophe remained confidential for a long period of time. It never had an official name, and was thus only known as the 'Kyshtym crash', after a small old town not far from the secret city of Chelyabinsk-65 (today known as Ozersk) where the said tragedy took place.

Long before it was decided to use nuclear power for energy production, scientists had discovered its horrifying destructive force for arms production. Nuclear arms production. Weapons which, if used, could destroy the very life on Earth. Thus, before the Soviet Union produced its first nuclear bomb, scientists built a factory in the Urals to manufacture its core. That factory was named Mayak During the production of the materials needed for the manufacturing of a nuclear bomb, scientists did not worry about environment or health issues. They were more afraid to fail a state assignment. To obtain the necessary substances for an atomic bomb – uranium and plutonium – they had to conduct many a chemical reaction. As a result, they acquired not only the above-mentioned chemicals, but also large amounts of radioactive water (i.e. fluid radioactive waste).

Even then the scientists had already divided radioactive waste into three categories, depending on the level of radioactivity: Highly Radioactive Waste (HRW); Medium Level Radioactive Waste (MRW) and Low Level Radioactive Waste (LRW). The waste contained large amounts of traces of uranium, strontium, caesium, plutonium and other radioactive elements.

At first the radioactive water was dumped directly into the river Techa, on the bank of which the factory stood. However, when deaths occurred in the villages on the banks of Techa, scientists decided to limit the wastage dumped into the river to the Low Level Radioactive Waste. The Medium Level Radioactive Waste was now dumped into the lake Karachai; while the Highly Radioactive Waste was kept in special corrosion-proof containers – "tanks" – that were located in concrete basement storage areas. As a result of the radioactivity of the substances, however, these tanks heated up immensely and were thus required to be cooled down with water over their entire surfaces.
Every "tank" had its own cooling system and control system, to keep its content under control.

Towards the autumn of 1957, the performance of the measuring devices that were borrowed from the chemical industry and were kept in the storage areas grew unsatisfactory. As a result of the highly radioactive nature of the cable conduits in the storage areas, the latter were not renovated.

At the end of September 1957 a serious brake-down of the cooling system as well as the control system on one of the tanks occurred. That day, factory workers who were conducting check-ups on the tanks discovered that the tank was highly heated. However, they were not able to report this to the management. The tank exploded.
The self-combustion of the 70-80 tons of highly radioactive waste mainly consisting of nitrate-acetate compounds, resulted from a malfunction of the cooling system because of corrosion and failure in the control system of one of the containers (with a volume of 300 cubic metres). On the 29th of September 1957, at 4 P.M. local time, the evaporation of water, drainage of the remains and its heating up to 330-350OC resulted in the explosion of the contents of the container. The force of the explosion that was similar to a gunpowder explosion was judged to have been up to 70-100 t. of trinitrotoluene.

The complex containing the exploded container was an underground concrete construction with cells (i.e. trenches for the instalment of 20 containers). The explosion completely destroyed the corrosion-proof container located in a concrete trench 8.2 metres deep in the ground. It also tore off and threw the concrete cover of the trench to a 25 m distance.

20 million curies (Ci) of radioactivity was thrown into the air of which 18 million (90%) landed within the Mayak complex. Radioactive pulp of 2 mln Ci with a volume of 250 cubic metres was thrown up to 1-2 km into the air and created a radioactive cloud consisting of liquid and firm aerosols. The south-western wind with a velocity exceeding 10m/sec that was present in the top layers of the aerosols spread the latter around. Four hours after the explosion the radioactive cloud moved a 100 km, and after 10 -11 hours the radioactive trace was completely shaped. The two million Ci that descended onto the ground formed a polluted area that spread out for 300 - 350 km to the north-east of the Mayak factory. The border of the polluted area was traced along a chorisopleth with a pollution density of 0.1 Ci/m2 and a territory of
23000 m2 . As time went by, these borders were blurred as a result of the movement of radionuclides by air.

Soon after the territory was named Eastern Ural Radioactive Trace (EURT), while the main part of it that was most polluted (700 km2) received the status of Eastern Ural national reserve.

The maximum length of the EURT is 350 km and is just a small distance away from one of Siberia's largest cities: Tyumen. The EURT's width reaches as much as 30-50 km at places. Within the margin of the chorisopleth of 2 Ci/m2 on strontium-90 there is a territory of almost 1000 km2 (105 by 8-9 km).
The radioactive pollution zone contains a territory invading three provinces: those of Chelyabnisk, Sverdlovsk and Tyumen with a population of 270.000 people previously inhabiting 217 cities and villages.

23 villages were evacuated and destroyed; wiped off the face of the earth. Cattle was killed, clothes burnt, food and demolished buildings dug into the earth. Ten thousand people who had suddenly lost everything were left helpless and departed to their relatives.

An investigation on the part of the nuclear industry after the crash concluded that the most probable cause was the explosion of dry salts of nitrate and sodium acetate that were formed as a result of the evaporation of the solution in the container because of its self-combustion after a malfunction in the cooling system.

However, so far no other, independent investigation was carried out and many scientists believe that the Mayak explosion was a nuclear one. Fifty years after the crash the technical or chemical reports of it have not been published.

4 P.M. on the 29th of September 1957 have come to constitute a black page in the history of the Urals. At the time 272 000 people lived on the polluted territory. It is a day that divided the lives of the people of Ural into two: before and after the crash.

Hundreds of thousands of people were needed in order to liquidate the consequences of the crash, i.e. to wash the industrial territory of Mayak with water and discontinue any economic activity in the polluted zone. Young men from close by cities and towns of the Chelyabinsk and Sverdlovsk provinces were mobilized for the liquidation unwarned of the dangers. Whole military units were brought to surround the territory of the liquidation and were prohibited from telling where they had been. Children of 7-13 years of age from the surrounding villages were sent to dig radioactive crops into the ground, as it was autumn. Mayak even used pregnant women with any period of pregnancy for liquidation-related works.

The consequences for the people

In the Chelyabinsk and in the atomic city of the region the death rate was immense. People died at work; deformed babies were born; whole families died out.

Nadezhda Kutepova, representative of the "Ecodefence" group in Ozersk:
'My father was 17 years old and studied at a technical school in Sverdlovsk (now Ekaterinburg). On the 30th of September 1957 along with fellow students he was put on a truck and brought to Mayak to liquidate the consequences of the crash. They weren't told anything about the gravity of the danger of radioactivity. They worked for days. They were given individual dosimeters, but over-dosage was punished, so many left their dosimeters in their clothes boxes, to not 'have a too high a dosage'. In 1983 he was diagnosed with cancer and referred to Moscow for surgery, but died three years later as metastases started to appear all over his body. We were told then that it wasn't because of the crash, and only later the disease was officially recognized to have been a consequence of the Mayak accident. My grandmother also participated in the liquidation works and received a dose of 770 rem (Roentgen Equivalent Man). I never saw her because she died of lymphatic cancer long before I was born (eight years after the crash).'

Gulnhara Ismagilova, inhabitant of the Tatarskaya Karabolka village:
'I was nine years old and was studying at school. They gathered us and said that we will be harvesting. It appeared strange to us that, instead of harvesting, we were told to dig the crops into the ground. Meanwhile police had surrounded us so that we couldn't run away. In my class the majority of the students later died of cancer, and the ones that were left were

very ill, the women suffering from infertility'

Natalia Smirnova, inhabitant of Ozersk:
'I remember that in the city there was a horrible panic at the time. On all streets cars were driving around and washing them. We were told on the radio to throw away everything that we had in the house and to wash the floors constantly. Many people, workers at Mayak, fell ill with the acute radiation sickness, everyone was afraid to say or ask anything out of fear to get fired or even arrested'.

P. Usaty, Novo-Pavlovka village, Krasnodarski region:
'I served as a soldier in the closed zone of Chelyabinsk-40. On his third shift, a fellow countryman from Yeysk fell ill; when we came back from work he died. At the transportation of cargoes in train carriages we stood on posts an hour each until our noses bled (a sign of acute irradiation - author's note) and our heads hurt. On the sites we stood behind a two meter high led wall, but even that didn't help. During the demobilization we had to sign a non-disclosure form. Out of the conscripts there are just three of us now – all handicapped.'
It was an enormous catastrophe. Yet it was hidden. Because the state did not need people, it needed bombs. The latter, not even having become bombs, killed and continue to kill large amounts of people.

Only after the Chernobyl disaster many in the Chelyabinsk region understood that they could now talk about the Mayak disaster. Thus, in the early 90s, over 30 years after the crash, a report of it was published for the first time. To at least compensate the harm somehow, a law was passed on social security for those harmed by the catastrophe. However, no-one will ever know exactly how many people died because of it, as, until now, the Tatarskaya-Karabolka village with its 7(!) cemeteries and 400 inhabitants is still left on the radioactive trace. Because of the genetic harm of radioactivity three, four and even five generations of people exposed to radiation will fall ill with untreatable illnesses. According to the new law currently under consideration in the Russian Duma those harmed as a result of the explosion at Mayak have a right to a compensation of 37 roubles (approx. EUR 1-M.O.) A MONTH for food.

Today, 50 years have passed. Mayak is still working. The people working there and living near it are accumulating plutonium, caesium and strontium in their bodies. As before, every second, every minute, and even as you are reading this lesson, Mayak is producing tons of radioactive waste that remains after the processing of fuel from the nuclear power stations. And, as before, it dumps the waste into the water, only not the river Techa, but the lake Karachai. This means everything can repeat itself. Do we need that?

P.S. In one of the villages left on the polluted ground, children wrote the following poem:

The beams of Mayak are not those of salvation,
Strontium, Cesium, Plutonium are its executioners.

The Planet of Hopes,
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April 2007

Fact Sheet 7: Safe Energy

The "Dual-Use" of nuclear technology and its proliferation risks

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The civil-military complexity

Under the slogan "Atoms for Peace" in the early 1950's, US President Eisenhower made it possible for all countries to participate in the so called peaceful use of nuclear energy and to acquire nuclear know-how. Years later the United States began to realize the consequences of their nuclear politics: not all partnering countries used the new technology for only peaceful purposes. In many cases they started nuclear weapons programs under the cover of research reactors and civilian nuclear power development.

The Non-Proliferation Treaty

Until the beginning of 1967, only five countries possessed an atomic bomb: The USA, France, Great Britain, China and the former Soviet Union. To prevent other countries from becoming nuclear powers, in the late 1960's the Non-Proliferation Treaty (NPT) for nuclear weapons was created. It was based on three points:

• Only the five nuclear powers are allowed to hold nuclear weapons.
• Every country becoming a party to the treaty is allowed to use nuclear energy for peaceful purposes.
(Article IV)
• The five nuclear powers promise to "honestly" negotiate an end to the arms race and commit to complete total nuclear disarmament.
(Article VI)

Many other countries considered this arrangement as discriminatory, and the US President George Bush declared a third category of countries, the so called rogue states. Those countries should neither have nuclear weapons nor access to sensitive nuclear technologies, like the enrichment of uranium. In the long run such a three-category-system cannot be stable. For example, Iran has signed the NPT and consequently it has the right to use nuclear energy for peaceful purposes. The global community, however, is concerned that this country would choose a military path by developing its own uranium enrichment plant, which is a key technology for building nuclear weapons.

Trade and proliferation of weapons capable material

Although most countries signed the Non-Proliferation Treaty, it could not prevent some other countries to develop the atomic bomb, like India and Pakistan. Israel is regarded as a nuclear power since the late 1960's, even though the government has neither confirmed nor denied it so far. In 2005 North Korea declared its possession of the bomb, although it has never given proof. In 1991 a long-time, secretly developed nuclear weapons program in Iraq was revealed. Also Libya, South Africa, Argentina, Brazil and Taiwan have had military nuclear projects at one time. These countries have since discontinued nuclear weapons development. (1).

By revealing the nuclear black market in Pakistan it became clear how the secret development of nuclear weapons in several countries was possible, despite the Non-Proliferation Treaty. In the 1970's the "father" of the Pakistani atomic bomb, Abdul Qadeer Khan had purloined blueprints from the Dutch nuclear company Urenco and so enabled his home country to build the atomic bomb. Khan has admitted to having provided other counties with the bomb plans.

The official nuclear powers bear a large part of the blame for the negative effects of proliferation due to their unreasonable lack of effort to meet their disarmament commitments. Further, it is known that the USA still makes contingent nuclear war plans and even considers pre-emptive strikes (2). That is why many countries desire their own nuclear weapons, as a deterrent against possible attacks.

The dual-use of nuclear technology cannot be avoided. Whoever promotes civil nuclear technology, unwillingly also enables nuclear weapons programs to emerge. Proliferation not only permits the illegal construction of atomic bombs, but also makes more likely the possibility of terrorist strikes with so called "dirty bombs" - bombs with radioactive content. Small amounts of secretly diverted radioactive material can already be used effectively when blended with conventional explosives.

The RERTR-Program

The concern of possible misuse of civil nuclear technology has alarmed the global community since the late 1970's. With the disarmament program RERTR (Reduced Enrichment for Research and Test Reactors), weapons capable highly enriched uranium (HEU) was supposed to be withdrawn from civilian use. For that purpose fuels with low enrichment but high density were developed. The program was successful: many research reactors were able to switch to materials that were not "weapons capable" e.g., LEU or "low enriched uranium", (enrichment below 20%). With the exception of a few "black sheep", the global community was able to stick to this program. Those countries who did not go along include Libya, China and Germany.

FRM-II - a harmful precedent

The German Research Reactor München II (FRM-II) in Garching near Munich is a harmful precedent. To get an especially powerful reactor, the builders of the FRM-II abused the disarmament program: They developed a highly dense fuel, combined with high enrichment. The project is much disputed internationally because all efforts to disarm are being undermined (3). If the FRM-II had been built in a politically unstable country, the global public would not have tolerated it.

The operating license of FRM-II was obliged to convert to lower enriched uranium by 2010. However, it is known that the operators' efforts to develop a new fuel are everything else but ambitious. They will probably try to delay a conversion by any means possible.

Proliferation hazards are one more reason why nuclear energy is not a viable solution to climate change. To be climate relevant, several thousand new nuclear plants would have to be built. They would not only be located in rural areas, but also in densely populated ones. They would be built in developing and emerging nations, without sufficient financial strength and questionable security standards. Furthermore, in politically unstable regions they could easily become military targets.
By continuing to spread nuclear technologies, the access to nuclear weapons capable material would become easier and the danger of illegal nuclear proliferation would dramatically increase. The world would not become more secure. Far from it!

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Translation: WECF

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