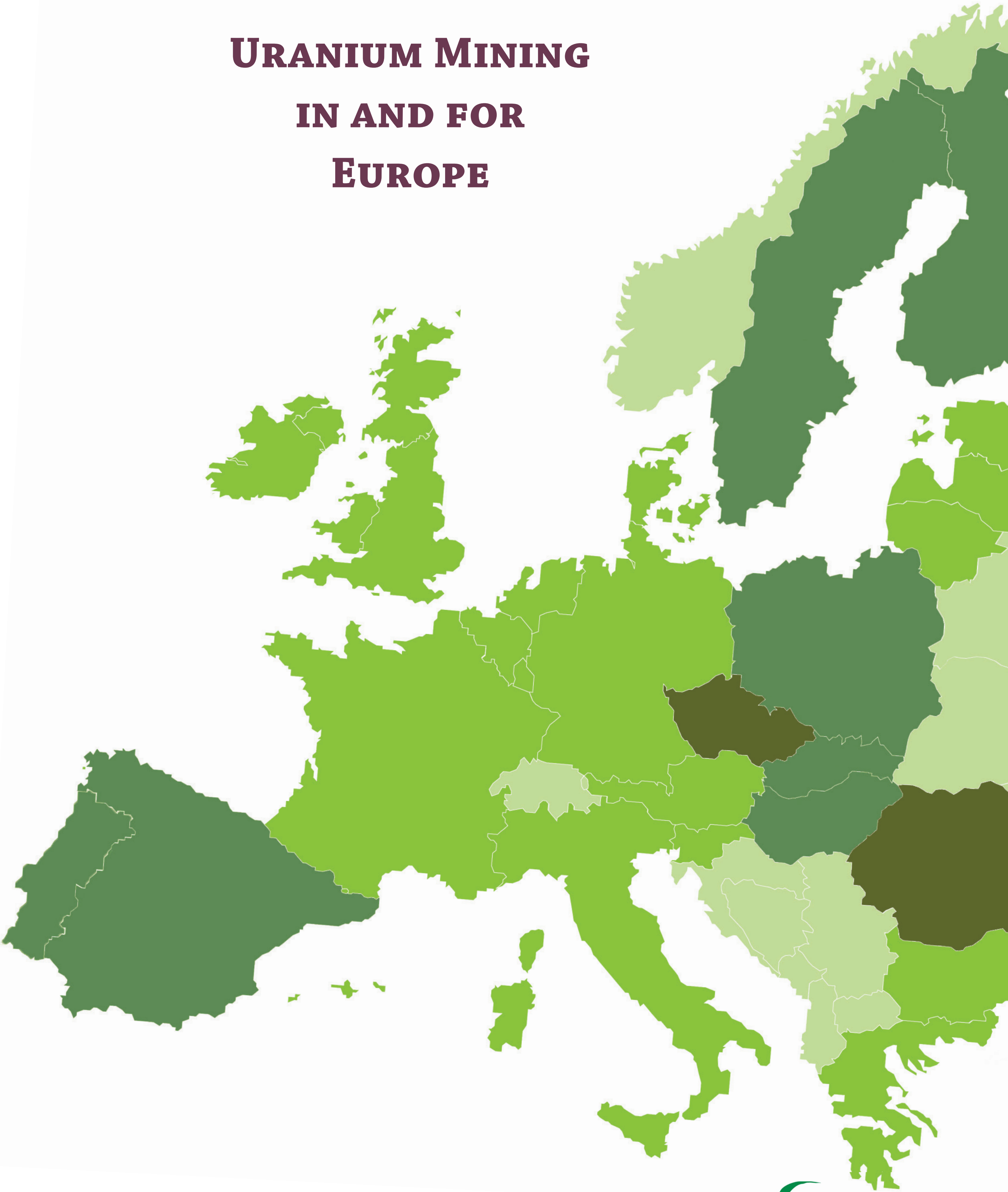
# Uranium Mining in and for Europe



Österreichisches Ökologie Institut

On behalf of

wiener umweltanwaltschaft

# Index

# Dear reader!

Since many decades nuclear energy is a controversially and often emotionally discussed issue. Reasons are mainly the recurrent catastrophes connected to nuclear power. With the booklet presented written by the Austrian Institute of Ecology the Vienna Ombuds Office for Environmental Protection (Wiener Umweltanwaltschaft) provides fact based information about an aspect of nuclear power generation not so well known to the broader public.

Uranium is a non-renewable resource. The effort necessary for mining and processing escalates as the availability goes down. The damage done to the environment and the people on the way from ore extraction to processing is increasing equivalent. In many cases the destruction proves to be irreversible.

This booklet will supply the reader with basic information about the production of nuclear fuel from the mining of Uranium to its processing and about the availability of Uranium.

Mag.ª Dr.in Andrea Schnattinger
Head of the Vienna Ombuds Office for Environmental Protection

The exhibition „Uranium Mining in and for Europe“ took place in the European Parliament in Brussels on September 25/26 2012.

This brochure sheds light on this highly topical issue with additional information to the exhibition but also as a stand-alone publication. It shows why uranium mining is again on the agenda in Europe and the risks resulting from a possible revival of this technology. After a short introduction on general aspects of nuclear energy our brochure focuses on uranium mining: necessary process steps, energy needs and $CO_2$ emissions and the environmental impacts. Several examples illustrate the current development in several countries of the European Union.

Our brochure is for all those who want to gain deeper understanding of nuclear energy. The panels of this exhibition are available for lending on request; the digital version can be found on the home page of the Austrian Institute of Ecology.

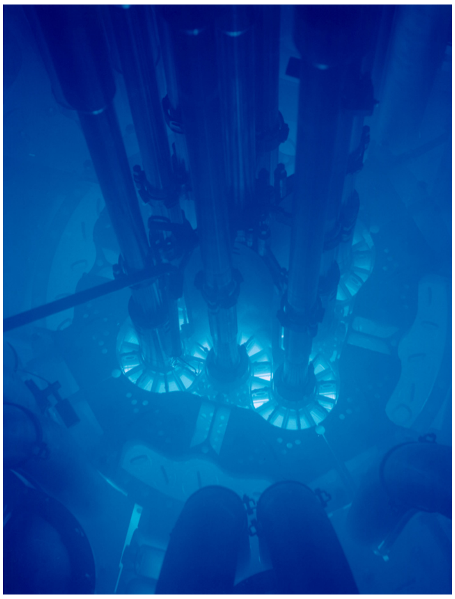
Special thanks go to Peter Diehl and a multitude of European NGOs, which provided their knowledge on current issues on uranium mining and that way made an important contribution to this brochure.

The exhibition and this brochure were commissioned by the Vienna Ombuds Office for Environmental Protection (Wiener Umweltanwaltschaft). Both are based on an earlier version of the exhibition which was titled “Return of Uranium Mining to Europe?” from 2008, developed in the framework of the Joint Project with the support of the Austrian Lebensministerium.[1]

We appreciate your interest in this important topic and hope you will find this brochure to be stimulating and informative reading.

Mag.ª Andrea Wallner
Austrian Institute of Ecology

# Introduction to Nuclear Energy



*Idaho National Laboratory's Advanced Test Reactor (ATR) core. Powered up, the fuel plates can be seen glowing bright blue. The core is submerged in water for cooling.*
Source: *Posted to Flickr, Urheber Matt Howard*

Nuclear reactors are designed to produce energy by nuclear fission which is then converted into electricity. Nuclear power plants (NPP) are thermal (caloric) power plants: the turbine is driven by the water vapor generated by the energy released from the nuclear fission process. The turbine drives the generator to convert the mechanical energy into electrical energy. Currently 429 nuclear reactors with a total electric net output of 362.5 GW are in operation in 31 countries worldwide - out of which 186 are in Europe (status of July 2012). [2,3] Lifetime of the nuclear power plants currently in operation reaches 30 – 40 years. For many NPP lifetime is coming to an end, which makes utilities in many cases consider lifetime extension or construction of new NPP.

Proponents of nuclear energy argue that nuclear power being "clean" energy can contribute to climate protection. However, taking into account the whole life cycle, nuclear power causes significant environmental damage and $CO_2$ emissions; uranium mining has a substantial share in it. An unsolved issue is the final repository for high-level active waste, which needs to be stored safely for hundreds of thousands of years.

There are more risks of nuclear energy: In case the chain reaction destabilizes severe accidents can occur – the possible impacts hundreds of thousands of people had to suffer in consequence of the accident at the Chernobyl NPP (1986). The severe accidents at Fukushima 2011 made the public again aware of the dangers of nuclear power. The probability of occurrence was however reduced by the modernization of nuclear power plants, but cannot be brought down to zero.

Another danger of NPP is the proliferation risk: Plutonium which is generated during uranium fission constitutes a possible basic material for nuclear weapons.

Nuclear energy has many negative aspects. This brochure focuses on one only: uranium mining.

# Uranium Mining in and for Europe

Proponents of nuclear energy like to argue that nuclear energy emits only very little $CO_2$ and other pollutants – nuclear energy the clean energy? No, this brochure reminds us, that the mining of the uranium needed for the operation of NPP causes significant impacts on the health and the environment.

## Comeback of Uranium Mining

When nuclear power is considered as future energy supply, the needed resource needs to be taken into account. The past decades saw a decrease in uranium mining, because secondary supplies like government inventories  and uranium from disarmed nuclear weapons was available. A comeback of uranium mining is a precondition to a comeback of nuclear energy. Several companies from Australia, Russia and Canada are trying to receive uranium mining licenses in the Czech Republic, Slovakia, Hungary, Poland, Sweden, Finland and Bulgaria.

## Uranium mining – a dirty business

Uranium as the basic resource for the nuclear fuel production, usually is imported from far away – Russia, Australia, Canada, Niger, where the tailings are left behind to pollute the local environment.

In the EU currently only two countries operate uranium mines, the Czech Republic and Romania, while all other mines were shut-down already decades ago. A return of uranium mining to Europe would also entail the return of health and environmental impacts in addition to the damage already done by past uranium mining.

## Energy balance

Even if the uranium prices would rise and therefore uranium deposits with low uranium ore content could be mined in an “economic” way, there are limits which turn this undertaking useless:  With the uranium content decreasing, more energy is needed for the production of the fuel rods. The higher the energy amount needed to produce the fission material, the more $CO_2$ is being emitted.

Deep Uranium Mine “HAMR 1” near to Stráz pod Ralskem
Photo: Vaclav Vasku

## This brochure

This brochure deals with issues of energy economy, the contribution to climate protection and health and environmental damages caused by uranium mining; it names the actual costs of energy gained from uranium for the landscape, for people, the environment and health and finally the tax payer.

# From Uranium Ore to Fission Product

The nuclear fuel chain generates large amounts of wastes – the highest volume results from uranium mining.

## Mining

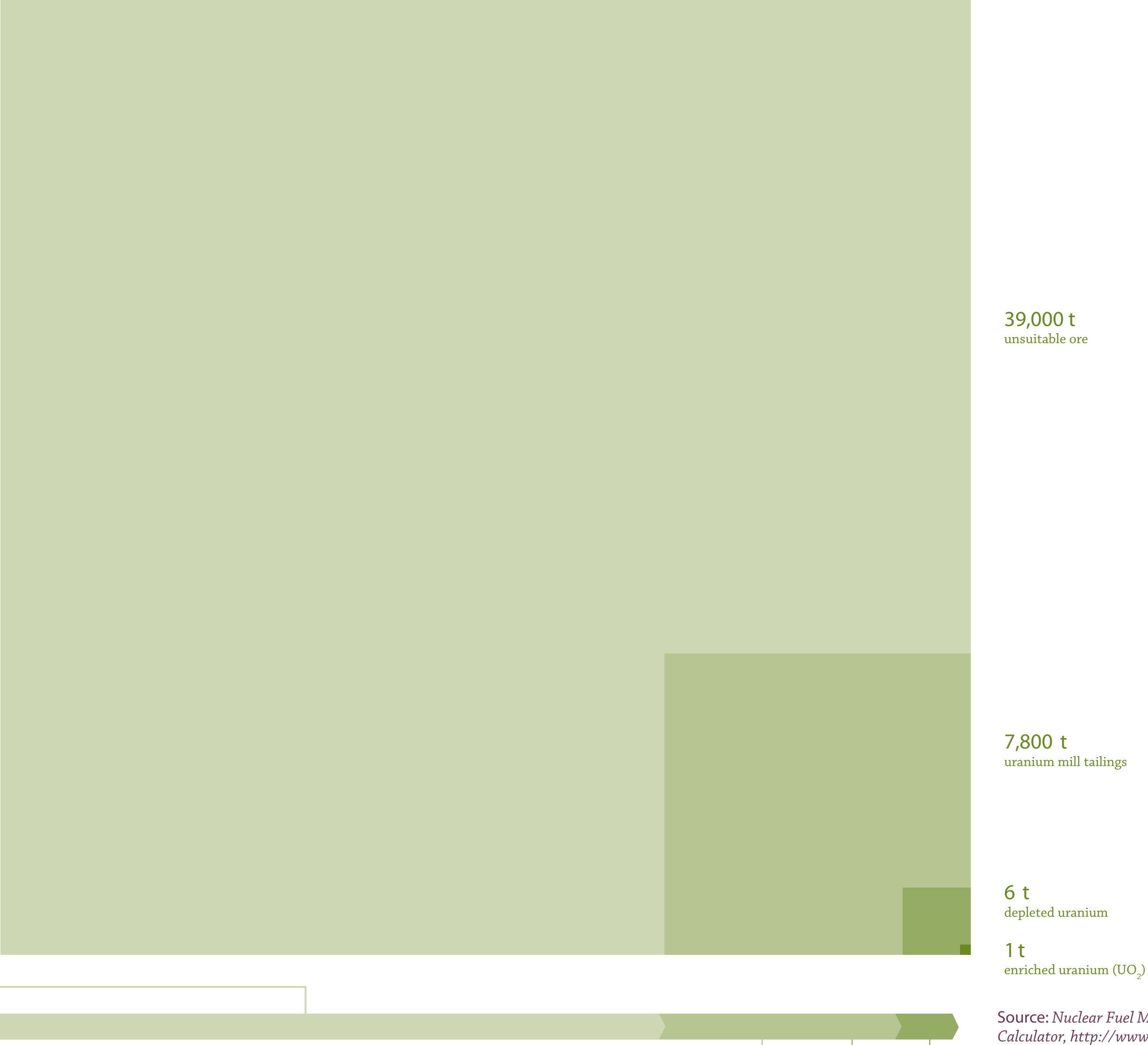
Several methods are used for mining uranium ore:

### Surface and underground mining

Surface and underground mining generate a large volume of waste rock, which contains no or only very little uranium and is left behind as a waste rock dump at the site of the mine. Most of the time waste rock however contains uranium fission products like e.g. Radium (radioactive) or Lead (highly toxic). The second step is the milling of the ore, when it is crushed and ground up. Chemical leaching follows; over 50 % of uranium ore is gained with classic mining methods.

### In-situ leaching

In-situ leaching (ISL) consists of chemical leaching which takes place already inside the uranium mine itself and the uranium does not need to be taken out of the mine before. It involves pumping fluid into the uranium bearing layers to dissolve the uranium and then pumping the liquid to the surface through wells. There the valuable resource separated out of the liquid. The left-over liquid is pumped back underground and the circle continues. The choice of chemicals used for leaching is based on the ground water and geology in the area: high calcium concentration of the ore body requires alkaline carbon solutions; in other cases sulfuric acid is used as leaching substance.




Source: *Nuclear Fuel Material Balance Calculator, http://www.wise-uranium.org/nfcm.html, Assumption: Ore Grade 0,1%, Waste Ore Ratio: 5; Rest: Default Settings of the Calculator*

## Yellowcake Production

Lye or acid plus an oxidizer are used to dissolve the uranium (extraction). First unsuitable byproducts need to be separated, then the uranium itself by e.g. adding ammonia. Due to its yellow color the product is called yellowcake; dried yellowcake typically contains 70 to 80 percentage of weight uranium and is stored in steel barrels. Uranium mill tailings still contain the largest share of the activity inventory of the original uranium ore, also in forms of decay products of the uranium like e.g. Radium, as well as heavy metals. They need to be stored in special pools for a long time.

## Conversion

The starting material for enrichment needs to be gaseous. The mining product yellowcake consists of uranium oxides and is converted into uraniumhexaflouride ($UF_6$), which is gaseous at low temperatures (56°C/134°F).

## Enrichment

Uranium enrichment is used to produce nuclear fuel for nuclear reactors and nuclear weapons. Uranium is the only heavy element, whose isotopes can be separated on an industrial scale. Natural uranium contains 99.3 % U-238 and 0.7 % of U-235. Most nuclear power plants operate with enriched uranium fuel (U-235). Two different enrichment methods are currently used: gas diffusion and gas centrifuges.

# Uranium Resources and Energy Balance

## Uranium demand vs. uranium resources

In July 2012 429 commercial nuclear power plants were in operation, generating a net output of 362.5 GWe.[4] Annually those plants use around 10,500t enriched uranium in the form of fuel rods.[5]

To produce this amount of fuel rods 59,000 t natural uranium are needed per year. Uranium mining covers approximately 2/3 of the demand, the rest comes from stocks and recycled uranium from fuel elements and depleted uranium from nuclear weapons programs. Those secondary sources however will come to an end in the future – uranium supply will have to be covered to a larger extent by uranium mining.[6] Long lead times of new mining projects suggest that supply crunches might occur.

Uranium is not a renewable resource therefore it is only a matter of time until the uranium resources are depleted. NEA (OECD Nuclear Energy Agency) in its "Red Book" gives the figures for known uranium resources 2009 with an estimated exploitation cost < USD 130/kg to amount to 5.4 million t. Only 2.5 million t of those count as „Reasonably Assured Resources" < $80/kg – and it those only which can be called assured resources.[7,8] The range of resources depends on the assumed volume of resources and the development of the installed nuclear power plant output. A few examples from literature to give an impression on when the worldwide uranium resources will be depleted:
2060 - 2070; 2042 ; 2030 - 2100.[9,10,11]
According to this data there will not be sufficient uranium fuel supply for the full lifetime of nuclear power plants built today.

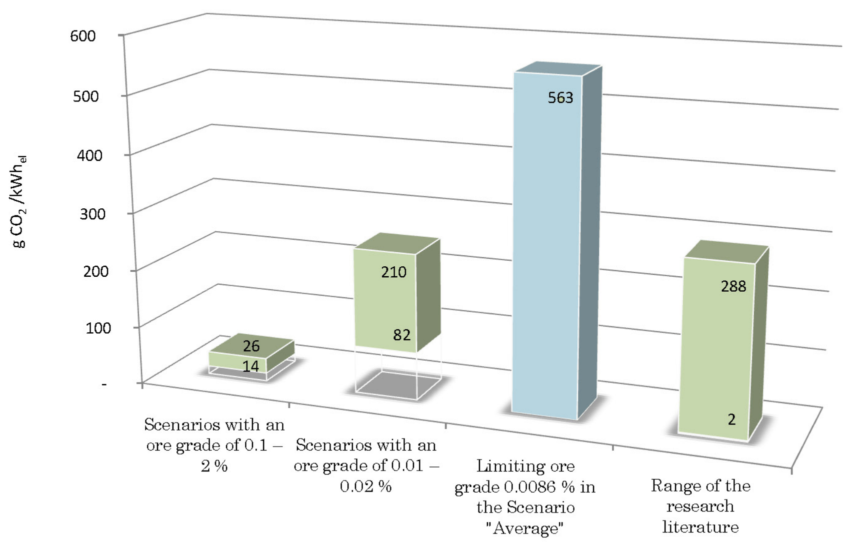
## Energy Input vs. Energy Output

How much energy can actually be produced from the uranium resources depends on the amount of energy used during the nuclear fuel chain (mining/milling/enrichment of uranium, manufacturing of the fuel rods, construction/operation/decommissioning of NPP etc.).

Following developments result in an increase in energy needed for the uranium mining in the future:

- *Certainly the possibility to find new resources exists, however, they are most likely in deeper layers than the current uranium resources and therefore more energy will be required for mining.*
- *Energy input for uranium mining highly depends on the uranium ore grade, which is of high importance because the forecast show a decrease in the average ore grade of the increasingly depleted uranium resource.[12]*

**$CO_2$ Emissions of the nuclear fuel chain** (Wallner et al. 2011)




$CO_2$ emissions of the nuclear fuel chain in relation to different ore grades according to Wallner et al. (2011) – own calculations compared to the range listed in the research literature.

## Nuclear power – energy production with a future?

The uranium ore grade has a significant impact on the amount of energy required to produce the fission material. With the uranium resources already very much depleted, even reserves with very low uranium content will have to be exploited.

Even if mining ores with low uranium grade would make economic sense for the mining company, it would not make sense to turn the uranium ore into fuel rods: to use them in NPP would not yield a surplus of energy compared to the energy used for producing them. Such a system cannot contribute to climate protection.

The assessment of energy used during the fuel chain from uranium mine to the NPP showed, that the uranium content lower then 0.008 % - 0.012 % results in a negative energy balance : the energy input for the uranium mining is so high, that the operation of the nuclear power plant does not produce any energy surplus any more. Uranium resources with ore grades lower than this therefore cannot be seen as an energy source.

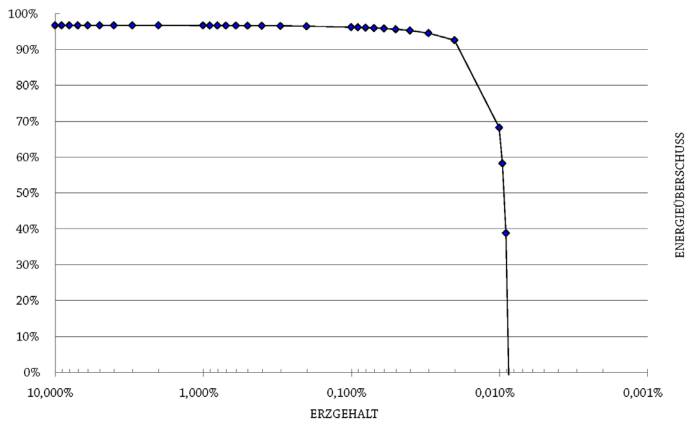
This is of particular importance, because 90 % of worldwide resources have an ore grade below 1 %, two-thirds even lower than 0.2 %. [14] Worldwide average ore grade arrived in the past five decades at a range of 0.05 % to 0.13 % $U_3O_8$.[15]

In the next 30 years the richest ores will be depleted and the average uranium ore grade will start decreasing. Once it is below 0.02 %, the net energy production of NPP will start to decrease quickly. This fact severly limits the range of uranium resources available for energy production.

This aspect also challenges the contribution of nuclear power to climate protection. Ore grades of approx. 0.01 % result in $CO_2$ emissions increasing up to 210 g $CO_2$ /kWh – compared to renewables emitting in a range of 3 - 60 g $kWh_{el}$.[16] In addition the deployment of nuclear power plants to mitigate greenhouse gases is slow and expensive.[17]

In an attempt to find an answer to the threat of supply crunches Generation IV reactors are being developed as reactors which should breed their own fuel to a certain extent. The development of those reactors however is at a very early stage, very cost intensive and afflicted with many unsolved problems, e.g. safety problems of fast breeders and thorium reactors.

Nuclear energy is under pressure from many sides including the problem of possible uranium supply crunches, scarcity of uranium resource as such and increasing $CO_2$ emissions and decreasing energy surpluses. Nuclear power plant is not even close to being a technology fit for the future.




Uranium Net Energy in Relation to Uranium Ore Grade
Source: *Wallner et al. 2011*

***$CO_2$- Emissions of Nuclear Energy according to var. Sources***

| | ***$g\ CO_{2-e}$ /kWh*** |
|---|---|
| Nuclear ore grade of 0,1 - 2 % Wallner et al. | 14-26 |
| Nuclear ore Grade of 0,01 - 0,02 % Wallner et al. | 82-210 |
| WNA (2009) | < 20 |
| Storm/Smith (2007) | 108 – 288 |
| ISA, Univ. of Sydney (2006) | 10 – 130, Ø 65 |
| EcoInvent (2009) | 8 – 11 |
| Sovacool (2008) | 2 – 77, Ø 66 |
| Fritsche (2006) | 8 – 125 |
| Vattenfall (2007) – KKW Forsmark | 3,7 |

A detailed comparison of various literature concerning $CO_2$-emissions of nuclear energy production can be found in Wallner et al. (2011) „Energiebilanz der Nuklearindustrie" Chapter 2.4.

***$CO_2$-emissions from other forms of electricity production according to Jacobson (2009)***

| | ***$g\ CO_2$ /kWh*** | |
|---|---|---|
| | ***MIN*** | ***MAX*** |
| Wind | 2,8 | 7,4 |
| Geothermal | 15,1 | 55 |
| Hydroelectric | 17 | 22 |
| Solar PV | 19 | 59 |
| Coal incl. CCS | 255 | 442 |

# Uranium Mining and Environment

Uranium mining does not bring only the intended heavy metal Uranium to the surface, butalso other dangerous parts of the rock.

## Shares of the different mining techniques used currently: [18]

| | |
|---|---|
| *Surface mining* | *27.3 %* |
| *Underground mining* | *32.0 %* |
| *In Situ Leaching* | *27.2 %* |
| *Uranium as by-product* | *8.9 %* |

## Environmental impacts of Surface and Underground Mining

Underground mining produces waste rock with insufficiently high ore grades, which need to be stored waste rock heaps. Large amounts of this waste product occur, because the majority of uranium resources have a natural uranium ore grade lower than 1 %. The waste rock contains radioactive and toxic decay products of uranium, like e.g. Radium and Lead. Waste rock heaps continuously emit the radioactive gas Radon (Rn-222), which can cause lung cancer. Wind spreads the contaminated dust in the environment. To keep a uranium mine dry while it is in operation, large volumes of contaminated water is pumped out of the mine and discharged in rivers and lakes in the surroundings.

## Environmental impacts of In-situ leaching

In-situ leaching is the other widely used mining method: the leaching fluid (sulfuric acid or ammonium carbonate) is injected through wells into the uranium deposit and again pumped up again. This method however cannot be applied anywhere: the uranium deposit needs to be in an aquifer in permeable rock, confined in non-permeable rock.

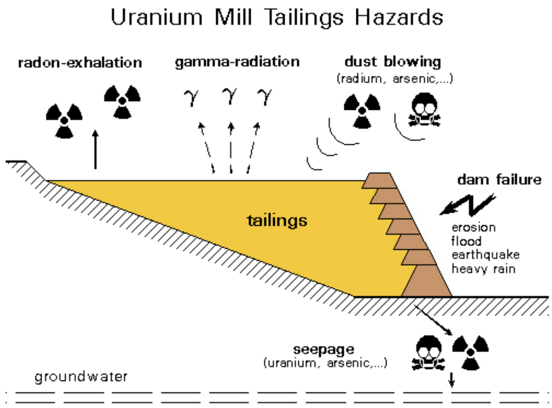
After the closure of the mine the leaching fluid stays enclosed in the porous rock. This leaching fluid contains large amounts of pollutants like cadmium, arsenic, nickel and uranium and poses a threat to the aquifer. In Stráž pod Ralskem in the Czech Republic, the contaminated fluid spread horizontally and vertically over the leaching zone and thereby contaminated over 200 million cubic meters of ground water. [19]

### Advantages of in-site leaching:

- *No waste rock heaps and very little dust formation.*
- *The landscape remains largely undestroyed.*
- *Radioactive exposure for the workers is lower than in underground and in surface mining.*

### Most important disadvantages:

- *Risk of leaching fluid leaks causing ground water contamination.*
- *It is not possible to re-establish natural condition in the mining area after the mining operations ended*




Dangers from uranium ore milling.
Source: *http://www.wise-uranium.org/uwai.html*

## Tailings from uranium ore milling – tailing ponds

During uranium extraction enormous amounts of sludge tailings are produced: The sludges produced almost equals the amount of mined ores. When the ore grade is 0.1 %, than 99.9 % of ore needs to be disposed of after extraction.

Surface as well as underground mining but also In-situ leaching produce so called tailings. They are pumped into sedimentation ponds and several million tons of radioactive tailings are stored there. The waste sludge contains longlived decay products like Uranium and Radium and Thorium, which constitutes 85 % or the original radioactivity of the ore. In addition leftovers from Uranium and other heavy metals like Arsenic and leftovers from chemicals used during uranium extraction are still present. [20] Those tailings pose an enormous threat to the inhabitants of the surrounding area: seepage can contaminate soil, water bodies and drinking water. In particular sulfurous ores like pyrite produce sulfuric acid in the seepage water, which signifcantly increases the leaching of pollutants into the seepage water.

## Water

The most important problem of uranium mining is the disruption of the hydrodynamic conditions of ground water and its contamination when it is discharged into surface water:

- *During underground mining large volumes of contaminated water need to be pumped out of the mine to keep it dry – this pit water is one of the main sources of natural radionuclides like Uranium, Radium and Thorium in the environment.*
- *During In situ leaching acid or lye is directly injected into the soil – a particularly high danger for the groundwater*
- *During heavy rainfalls seepage water from tailing ponds and the erosion of radioactive sludge can cause not only soil contamination, but also pollute water bodies and groundwater. A contamination of the food chain cannot be excluded.*
- *In the past, water broke through in the surroundings of uranium mines and dried up drinking water source, but also complete ponds and rivers.*

## Air

The large volume of mined rocks leads to dust formation and the release of the radioactive noble gas Radon. The wind spreads the Radon and dust in the surrounding environment.

## Stráž pod Ralskem (In Situ Leaching – Czech Republic)

The probably largest environmental damage in connection to groundwater pollution in Europe occurred due to In Situ leaching in Stráž pod Ralskem, where leaching fluid with sulfuric acid content was injected via 6,000 wells up to 220 m deep into the ground. Over 3,000 additional wells were used for the actual uranium mining. From the late 1960ies until the mid-1990ies four million tons of acid were pumped into the ground.[21] The operation of the former uranium mines (In situ leaching plus the neighbouring uranium mining in Hamr) contaminated approximately 270 million $m^3$ of groundwater with sulfuric acid.[22] Several square kilometer of this regions are severely contaminated. The state-owned uranium mining company Diamo is now decontaminating the area. The decontamination intends to clean the rock from the left over acid and its deposits and to introduce hydro barriers which keep the acids from leaking into the large drinking water reservoirs in this area or into the River Elbe. The remediation will take around 30 more years and cost in total 2.75 billion USD (2.24 billion euro).[23] Several tons of uranium, ammonium sulfate and aluminium sulfate are extracted per year as by-products from the decontamination.

The experience from Stráž pod Ralskem shows the existence following possible paths of environmental pollution:

- *Heaps of mined rock, radioactive dust blown away*
- *Sludge (tailing ponds and sedimentation ponds)*
- *Ventilation shafts, also after the uranium mine is shut down*
- *Due to In-situ leaching pollutants (solvents, chemicals, uranium left-overs and uranium decay products) are released into the environment*
- *Changes in the geological set-up*
- *Irreversible changes in the water regime*
- *Damages to and destruction of the soil profile*

## Mecsek (underground mining - Hungary)

In the past the Mecsek mine produced 21,000 t of uranium until it was shutdown in 1997. In 1998 the clean-up of the uranium mining legacy started: Closing of the underground mines, remediation of the rock heaps, the sedimentation ponds and the contaminated water and of the uranium mill. 62 ha of land needed to be cleaned and 700,000 $m^3$ of contaminated soil disposed of.[24] The costs were enormous; some funds were made available by the EU (PHARE) and amounted in total to approximately 100 million euro. The main remediation works at the Mecsek mine were completed in 2009. To prevent the contamination of drinking water for some 200,000 people with uranium mill tailings seepage however, continuous remediation efforts are necessary: 370 million forint (around 1.23 million euro) were allocated in the state budget for this purpose for the year 2011.[25]

„Recultivation“ with another toxic waste: At the former chemical processing plant „MAPE“ close to Temelin NPP ashes from coal plants and old tires are stored in existing uranium tailing ponds. Dangerous materials accumulate in addition to the 36 million tons of radioactive sludge.
Photo: *Vaclav Vasku*

# The Uranium Threat – Uranium Rush in the EU

Currently only two uranium mines are in operation in the EU (Czech Republic and Romania). However, the steep rise in uranium prices between 2004 and 2007 made uranium mining in Europe economically interesting to exploration companies. Even though the uranium price significantly dropped again since 2007, the companies stayed interested due to the possible uranium supply crunches.

The political reason given for a return of uranium mining to Europe is energy independence. Since most states however do not have enrichment or fuel fabrication facilities on their territory, the dependency on international suppliers would not be solved. International exploration companies are rather looking for new mining options to secure available deposits for themselves. They seem to be betting on a population which is not sufficiently informed about the impacts of nuclear power. At places where the companies find uranium resources, pressure is exerted towards governments and communities.

## Czech Republic

The Czech Republic is looking back at a long tradition of uranium mining. Since 1945 uranium has been exploited on an industrial scale – in total 23 uranium deposits were mined.[26] During the communist era the uranium was delivered as yellow cake into the UdSSR for the production of nuclear bombs and fuel for NPP. All Czech mines with the exception of the still operating underground mine Rožná in Dolní Rožinka were shut down for ecological reasons right after the revolution at the beginning of the 1990ies. The environmental damages are enormous and the clean-up still not completed and very costly.

- *1989: until the Velvet Revolution uranium is mined at 16 sites in the CR,*
- *1991: the new government decides to continue operation at only two sites - Rožná (underground mine) and Stráž pod Ralskem (chemical leaching).*
- *1996: under the new political conditions the danger posed by the uranium mining for drinking water at Stráž pod Ralskem is not bearable anymore and the government decided to shut it down. The cleaning up of the enormous environmental damage will take several decades – small amounts of uranium continue to be mined as a by-product of the cleaning process until today.*
- *2012: operation permit for Rožná, the last operating underground mine in Europe, has been been prolonged in the past years several times. The mining is allowed to continue as long as the operation covers the costs; according to estimates by the operating company Diamo this will be the case until 2017.*[27]

Until today no permits were issued for test drilling and even less for mining in the CR, however, this could change in the foreseeable future: While the Czech Ministry of Environment until now opposed a revival of uranium mining, the current draft of the new Czech energy strategy proposes the exploitation of domestic sources including uranium as a priority.[28] The exploration of new uranium mines by the state company DIAMO therefore seems likely. The affected villages have to accept the exploration activities, because in the CR the Ministry of the Environment issues the exploration licenses. Czech environmental organizations hope to prevent the revival of uranium mining, also with the support from Europe.

### Osečná-Kotel close to Liberec in North Bohemia:

Currently a much sought after site, because the deposit holds an estimated amount of 20,000 t uranium. Kotel is only in a few kilometers distance from Hamr, which is known for even better uranium deposits than Stráž pod Ralskem, also in the near neighbourhood of Stráž. In 2011 the mining request for Osečná-Kotel filed by the Australian-Czech Joint Venture „Urania“ was refused. Also at Hvězdov (Ploužnice) close to Stráž pod Ralskem a revival of the mining acitivities cannot be excluded.

### Brzkov/Horní Věžnice

In Brzkov, close to the uranium mine Rožná southeast of Prague, test mining took place in the past, currently however the mine is flooded and therefore closed. In close-by Věžnice only test drilling was conducted. Mining is possible at both sites only with high upfront investment, e.g. capacity enlargement of the tailing ponds at the uranium mill GEAM close to Dolní Rožinka. [29]

### Strakonice in South Bohemia

Uranium exploration licenses were also filed for the villages Mecichov, Hlupín, Bratronice, Nahošín und Doubravice close to Strakonice southwest of Prague. The Czech Ministry of the Environment rejected those requests until now.[30]

## Bulgaria

The Bulgarian uranium mines were closed down 20 years ago. There are not current efforts to re-establish uranium mining. [31]

## Slovakia

The Slovak Republic was free of uranium mining, because it was not considered economic during Communist time. However, this looks different today: The Canadian mining company European Uranium Resources Ltd. (before: Tournigan Energy Ltd.) informed its shareholder at the end of January 2012, that in Eastern Slovakia at the Kurišková (before: Jahodna) site already geological survey are taking place and this site would be among the best uranium deposits in the world.[32] The deposit holds estimated 8,747 t metallic uranium ore with an uranium concentration of 0,35 %. [33]

The mine is located close to a recreational area, only 6 km air distance from the East Slovakian metropolis Košice with 250,000 inhabitants. If uranium would actually be mined in the area, enormous amounts of radioactive waste rock and toxic substances would be left behind in this region with its vast forests.

Košice saw an enormous wave of protests and in whole of Slovakia in the end 100,000 signatures were collected under the petition against uranium mining. The protest bore fruit: The new law of 2011 makes it impossible for the Ministry of the Environment to permit uranium mining, unless the communities agree (by decision of the city council). In the mining requests the companies are required to name the concrete technology for the environmental impact assessment (EIA).[34] Uranium Resources Ltd. continues to develop its plans and announced to prepare an environmental impact report in cooperation with Areva to start the permitting procedure for the project. A Preliminary Feasibility Study was already completed.[35,36]

## Hungary

The interest of worldwide active uranium mining companies also focuses on Hungary, which produced uranium for the Soviet Union already during Communist times: In the Mecsek-Mine close to Pécs from 1958 to 1997 approximately 21,000 t uranium at 100 – 800 m under the surface were mined for export.[37]

Now the Hungarian uranium deposit in the Mecsek mountains could be re-opened for the uranium production of the Australian company WildHorse Energy. This would be in line with a well-known model: Uranium is for export, the destroyed environment would stay behind in Hungary, where the damages left behind from the past uranium mining still need cleaning up.

In 2008 WildHorse Energy Ltd., the Hungarian state owned company Mecsekérc Ltd. and Mecsek-Öko-Ltd. joined together to inquire the feasibility of re-storing mining activities in the Mecsek mountains.[38]

Until now three sites were examined in Mecsek mountains and its surroundings: Pécs, Dinnyeberki, and Bátaszék. Test drilling was performed in Pécs. This research delivered the following results: Due to cost reasons a re-opening of the mines in Dinnyeberki and Bátaszék was not recommended – the re-opening of the underground mining in the old mine in Pécs and the neighbouring areas might prove profitable. The ore grade of those mines is very low (about 0.06 %).[39,40]

However, also resistance is getting organized: In Bátaszék as well as in Pécs citizens´ initiatives were formed. Also the big environmental organizations like Energiaklub, Greenpeace and Friends of the Earth are campaigning against the threat of uranium mining coming back to Hungary.

## Romania

The uranium mine Crucea in Romania is one of the two last operating uranium mines in the EU. The state company Compania Nationala a Uraniului (CNU) is mining there a small amount of uranium with the support of state subsidies. The uranium is used for the operation of the natural uranium reactors in Cernavoda.[41]

But there is more to come: Close to Crucea at the Tulghes-Grinties site, where uranium was mined already in the 1980ies, a new mine is to be opened. The project is already fairly advanced: A feasibility study was conducted and the reports for the environmental permits will be presented to the public for commenting shortly after some issues related to property claims have been sorted out.[42,43]

## Poland

The companies European Resources Pty Ltd. and Whildhorse show interest in uranium mining in Poland. The potential sites for mining lie in Southwest Poland, in the foreland of the Sudeten Mountains, where after the II. World War at several sites uranium mining was conducted on small scale.[44] Kopaniec-Kromnów is one of the mining regions: Requests for exploration permits were filed in the villages of Lubomierz, Radków, Wambierzyce and Stara Kamienica. Until today only the permit in Stara Kamienica was rejected – the project developer appealed against this decision.[45]

# The Uranium Threat – Uranium Rush in the EU

This map shows exploration activities of uranium companies in the EuropeanUnion.
Some of the concerned countries have mined uranium before, but stopped the process later on.

## France

...had many mines, 200 sites in 25 departments were affected from uranium mining. The last mine was closed in France in 2001, since then the French Radiation Protection Agency is examining the environmental impacts of uranium mining. The French mining company AREVA however, moved its activities to Canada, Niger und Kazakhstan; on top of that AREVA is pursuing exploration activities in several countries.

## Schweden

The mine Ranstad produced 200 t of uranium in the 1960ies, but is meanwhile closed and clean up was completed.[46] The deposit has a very low ore grade and therefore mining costs would be as high as >USD 130/kg U.[47]

### New plans for mining::

- *Since 2005 several companies asked for uranium exploration licenses in Sweden and were granted permits. In some cases the representatives of local communities fought those permits.[48] Currently there are approximately 150 active claims in Sweden.[49]*

#### Häggån und Viken – Jämtland (Central Sweden)

- *Hundreds of test drillings were performed in this region already – these two projects are the most advanced uranium mining projects in Sweden.[50] The Australian Aura Energy company announced in August 2011, that Inferred Resources of 243,000t Uranium with an ore grade of 0.014 % are estimated in Häggån.[51] Continental Precious Minerals active in uranium exploration in Viken.*

#### Hotagen (Northern Sweden)

- *In the Region of Hotagen the HRU Sweden AB holds two small but strategic claims (Lill-Juthatten and Nöjdfjället). The bigger part of the Hotagen Region is claimed by the Euro Scandinavian Uranium AB, a subsidiary company of the European Uranium Resources Ltd.[52]*

#### Västergötland (Southern Sweden)

- *Continental Precious Minerals requested a permit for test drillings in Billingen-Falbygden region in Västergötland. In this region was the operating mine Ranstad.[53]*

## Finland

1958-61 a small mine was operating at Paukkajanvaara, which produced 30 t of uranium.[54] In the Eastern and Southern parts of Finland the rock contains uranium at some sites it is rich in uranium. This attracted uranium mining companies: Areva filed an exploration request for Ranua, south of Rovaniemi in Lapland.[55] Earlier requests were rejected in 2007.

In 2012 the last license for the co-mining of uranium was granted to the Talvivaara Mining Company Plc.: 350t uranium annually are to be produced as a by-product of the nickel and zinc production in Sotkamo in Northeastern Finland.[56]

## Ireland

In 2007 the Ireland decided, that permits for uranium exploration will not be granted. The Irish government declared that it would hypocrisy to allow uranium mining, while Ireland – like Austria - does not allow nuclear power plants.

## Spain

In 2000 Spain closed down its uranium mines and started the clean-up. However, in the past years several companies started to explore again: Berkeley Resources Ltd. Already conducted a feasibility study on the Salamanca 1 project with a positive result in phase 1 (mining at the sites Retortillo and Santidad) – the ore is to be processed with Heap Leaching. The permission process has already started and the mining is scheduled to start in 2014.[57] Further test drilling is foreseen (phase 2).

In addition Berkeley intends to mine deposits at Alameda and Villar– the mining license was taken over in July 2012 from the Spanish state company ENUSA.[58]

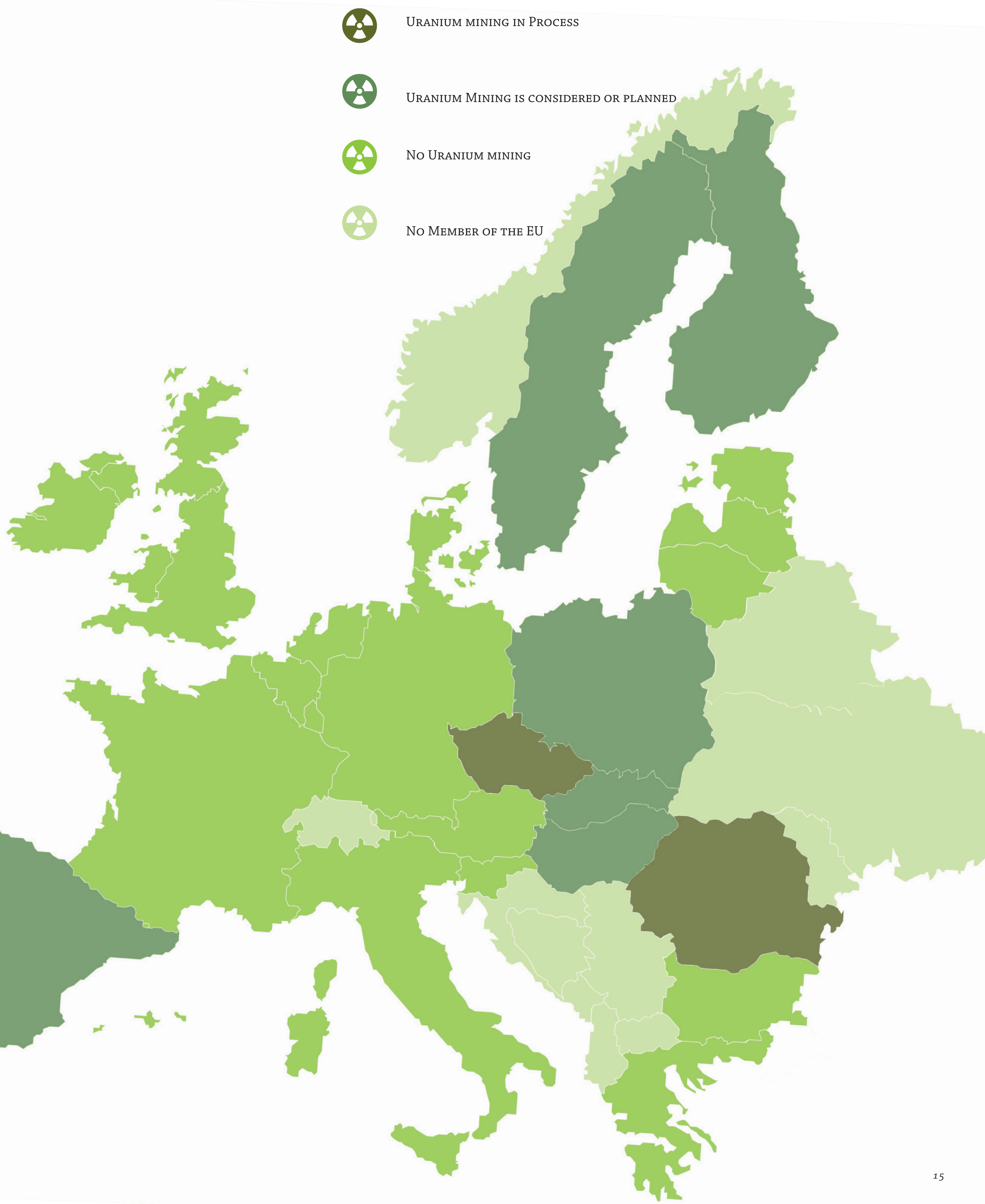
## Portugal

Portugal has uranium resources in the region Alto Alentejo, close to the village Nisa – since the end of the 1990ies there are attempts to mine uranium at this site. The population is against this plan: In 2008 300 people demonstrated against the Nisa project. Currently the project is not moving forward.

## Italy

Italy has known uranium deposits in the Lombardy in Novazza and Val Vedello. When the Australian company Metex Resources Limited applied for uranium exploration licenses in this region, it led to heavy resistance. In 2006 the Metex application was rejected and officially announced, that also future applications for uranium exploration will not be granted. The result of the July 2011 referendum, when the Italian population clearly spoke out against the re-start of the nuclear program, is additional confirmation for the anti-uranium position. The company Metex (now Energia Minerals Limited) continues to pursue uranium exploration in Italy (status: July 2012).[59]

## Map Legend


URANIUM MINING IN PROCESS
URANIUM MINING IS CONSIDERED OR PLANNED
NO URANIUM MINING
NO MEMBER OF THE EU

# Worlwide Uranium Mining for Europe

The impacts of mining the uranium needed in Europe will be felt in the following countries (not only there) for several decades to come:

Europes uranium reserves as well as its mining capacities are insufficient to cover the operation of its nuclear power plants. A substantial share of uranium is imported from countries outside of Europe. In 2010 France alone needed 8,992 tons of uranium to supply its NPP.[60]

Mining and the subsequent environmental damage are moved to other countries of the world.


Kakadu National Park uranium mining Controlled Area
Source: *Bidgee Date=2009-08-07*

## Australien - Ranger Mine

The Ranger Mine in Australia is located directly in the Kakadu National park. Again and again conflicts arise with the aborigines living in the neighbourhood of the mine. The local Mirrar aborigines have been protesting for years against the bad information policy of the mine operator ERA (Energy Resources of Australia) and complain about a lack of respect for them and their living space.

Since 1979 the Australian Ministry of the Environment (DSEWPaC) registered over 150 violations of the environmental directives.[61]

In combination with the Monsoon rainfalls and the inadequate protection measures the tailing ponds are flooded and the radioactive water contaminates the area.

In December 2009 a badly constructed dam broke and 6 million liters of contaminated water were discharged into the Gulungul Creek. The company ERA admitted the construction deficiencies and promise improvements. However, in April 2010 another incident occurred: At Magela Creek in the middle of the National park and a living area of the aborigines, radiation exposure increased.[62]

ERA considers it „possible“ that the Ranger Mine is responsible for this pollution of the environment.

## Kazakhstan – environmental damage due to uranium tailings

Uranium mining tailings pose a problem for Kazakhstan in the long term.

When the surface of the tailing ponds dries out, the very fine radiating material is dispersed by the wind over large areas. Strongly affected is the city of Aktau (156,000 inhabitants), where the radioactive dust from the Koshkar-Ata mill tailing deposit regularly settles.

Another major problem is the groundwater contamination caused by seepage water from the tailing ponds and the acid, which is injected directly into the ground during In-situ leaching.

The clean-up of old uranium mines also turns out to be difficult – Kazakhstan does not have any plans for cleaning up the tailings from the uranium mining during the Soviet times; even less so for the tailings from the current increasing uranium mining.

The state uranium mining company Kazatomprom praises a very special solution for this problem: its studies found out, that the soil in Kazakhstan has a unique property of self-cleansing.

According to this statement a clean-up after the mining will not even be necessary.[63]

## Namibia - Rössing: Radioactive dust and lack of water

Over 30 years uranium has been mined in the Rössing mine in Namibia. The surface mining requires blasting works which leads to the spreading of radioactive arsenic dust in the surrounding; the same effect is caused by the sedimentation ponds.

For a country as dry as Namibia however, the most urgent problem is the enormous water consumption needed for the ore processing. The water is gained by tapping the episodic water bodies Riviere Khan, Swakop and Kuiseb. The tapping of groundwater of course has far-reaching impacts on the local flora and fauna.[64]

Most affected by the uranium mining is the indigenous tribe of the Topnaar-Nama. The enormous water demand of the Rössing mine dries out their agricultural land and hunting grounds. In addition they are exposed to a constantly increased radiation levels caused by the radioactive dust. The government of Namibia ignores their protests and refuses to negotiate with their chiefs.[65]

The British economic analyst Roger Murray explained at a conference on uranium mining in Namibia: What is attractive about Namibia is next to the political stability the “relatively unbureaucratic granting of prospecting and mining licenses”.[66]

The mining at the Rössing mine is not subject to radiation regulations.

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