NUCLEAR ENERGY IN POLAND
SHORT REVIEW OF THE CURRENT STATUS, PLANS FOR THE FUTURE AND ARGUMENTS FOR AND AGAINST

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1. Introduction

Introducing nuclear energy in Poland has become the burning issue in the last few months. In January 2009 the Polish government confirmed its intention to have the country's first nuclear power plant in operation by 2021 or 2022. Concerns of the society must be now confronted with rising problems of further use of fossil fuels, especially coal, for energy production.

Energy production in coal power plants and thermal power plants would be weighted with increasing costs due to the environmental damages (mainly CO_2 emission). With growing demand for electricity, in the long-term consideration, there is also a problem of the limited amount of fossil fuels.

At the same time plans based on the renewable sources encounter more and more problems. In Poland use of solar or wind power is significantly limited by poor resources, but also by the high costs of the more advanced technology. These methods can also cause many operational, as well as environmental, problems.

This situation forces all the countries without nuclear power plants to reconsider all the aspects of introducing this type of energy. Negative image of nuclear energy which comes mostly from Chernobyl event, but also from Hiroshima and Nagasaki, maintained for many years is now dramatically changing. Basing on the worldwide experience, now we can evaluate problems of safety and economical advantages in scientific way. However, for a successful construction of the first nuclear power plant in Poland, a special legal act as well as a long term strategy for safe management of spent nuclear fuel and of radioactive waste has to be established.

2. Types of reactorcs

In this chapter we briefly present the division of the nuclear reactor types and the most common reactors that are used commercially in the World. There are several different kinds of reactors which are used worldwide. The first division can be done according to the type of nuclear reaction: *nuclear fission* or *nuclear fusion* (some people also distinguish *radioactive decay reactors* which are used in thermoelectric generators or atomic batteries). Most (all commercial) of the reactors are fission reactors and on them we will focus now.

The energy production is based on nuclear fission phenomena. In most cases uranium is used as a fuel (but thorium can be also used). They can be divided into two subgroups: *thermal reactors* and *fast reactors*.

a) Thermal reactors

   They use *slowed-down* or *thermal* neutrons. For slowing neutrons down special *moderator* material is used. It slows the neutrons until they reach their kinetic energy equals to the average kinetic energy of surrounding particles (of moderator). It is done due to the fact that thermal neutrons have significantly higher cross section (probability) of fissioning U-235, Pu-239, Pu-249 nuclei and lower of being captured by the U-238, in comparison to the fast neutrons. This effect allows us to use low-enriched or even natural uranium as a fuel.

b) Fast reactors

   They use fast neutrons to cause fission. Because neutrons do not have to be slowed down, they do not contain moderator. But to maintain the fission chain reaction highly-enriched uranium fuel should be used (20% and more). They produce smaller amounts of radioactive waste because all of the actinides are fissible by the fast neutrons. But on the other hand they are more difficult to build and more expensive. There are 4 fast reactors being operated now and 4 more being under construction. Most of them use sodium as a coolant.

The most popular fission reactors are those which use thermal neutrons. Below is a short review of the basic thermal reactor types:

a) *PWR – Pressurized Water Reactor*

The most popular reactor used commercially worldwide. In this type of reactor as a moderator and coolant superheated light water is used. It is pumped under high pressure to the core of the reactor and heated up there. Then it transfers the energy to a steam generator. The steam generator is a heat exchanger where heat is transferred to the lower pressure secondary coolant (water-steam mixture). The steam then is passing through the turbine which drives electric generator which generates the electric current. Then the steam is cooled down in a condenser and converted back into the liquid.

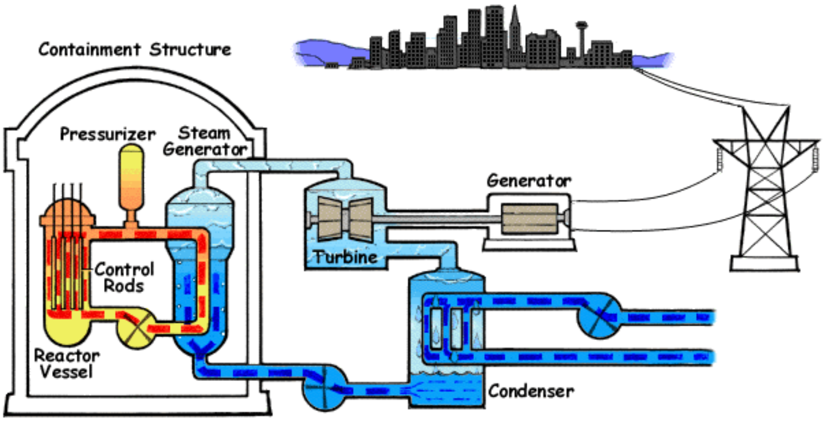


Fig1. Scheme of PWR reactor. [1]

b) *BWR – Boiling Water Reactor*

BWR is the second most popular reactor in the World. It also uses light water as a coolant and moderator. But the difference is that here water boils in the reactor core due to the heat produced by the fission reaction. Then the steam produced is used directly to rotate the turbine and produce electric current. After that it is cooled down in a condenser and converted back into the liquid. The pressure of the coolant is about 7.5 MPa (and boils at the temperature of 285 ^{o}C) while in PWR 16 MPa.

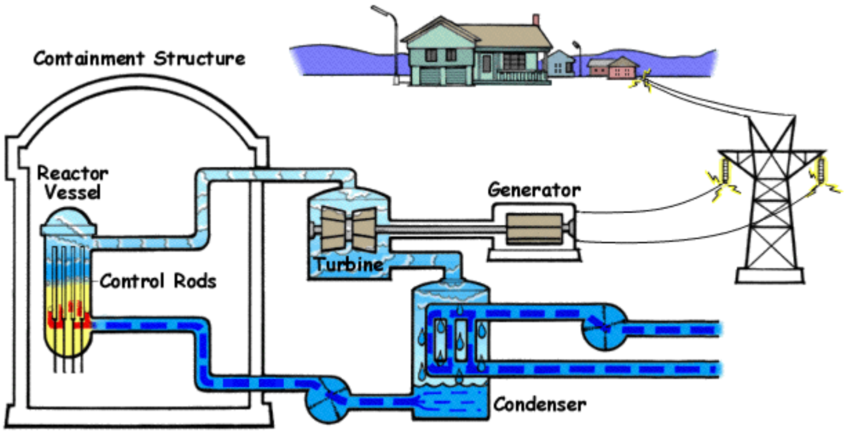


Fig.2. Scheme of BWR reactor. [1]

c) *CANDU – CANada Deuterium Uranium reactor*

It is a pressurized heavy water reactor developed in Canada. In general it is similar to the PWR but it differs in the details. As a coolant and moderator heavy water (D_2O) is used. Water is kept under heavy pressure to avoid boiling and steam formation. After the water has been heated up it is passed through the heat exchanger where it heats the light water in the secondary cooling loop. This works the same as in the typical PWR reactor. Another difference is a design of the reactor vessel. In the PWR and BWR rods are placed vertically while in CANDU horizontally.

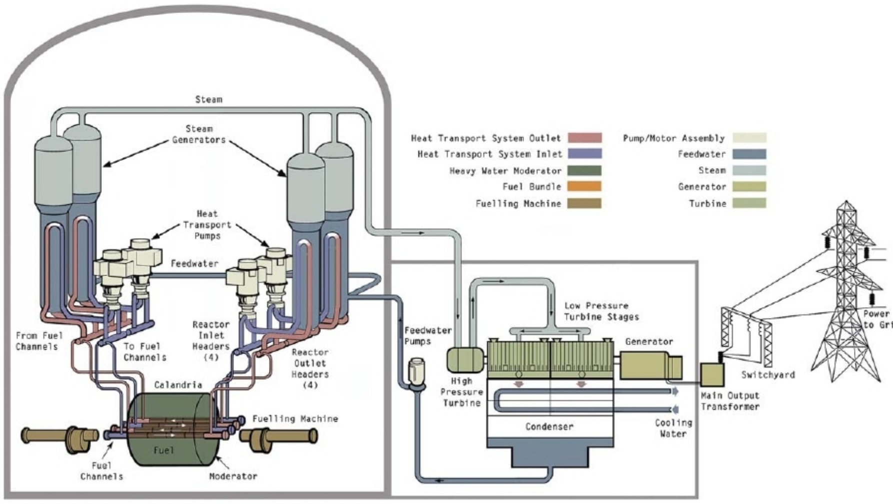


Fig. 3. Scheme of CANDU reactor. [2]

Canadians use heavy water because of the usage of natural (not enriched) uranium. Heavy water has a lower cross section for the neutron capture than light water. For Canadians it is economically more profitable and that is why they use CANDU heavy water reactors. There is also a variation of the CANDU reactor called ACD (*Advanced CANDU Reactor*) which uses light water and uranium enriched only a little bit (2,2%).

d) *RBMK – Reaktor Bolshoy Moshchnosti Kanalniy (High Power Channel-type Reactor)*

It is a Soviet Union made reactor which uses graphite as moderator. This is the type of the reactor which was used in Chernobyl. RBMK reactors were built only in the Soviet. As it has been mentioned, graphite is used as a moderator and as a coolant – light water. RBMK has long (7 meters) pressure tubes with graphite and pressurized light water which can boils (like in BWR reactors). Due to the fact that the moderation is done by the fixed graphite, excess of the coolant does not inhibit the fission reaction (neutrons are still being slowed down in the moderator) and a positive feedback arises. It can lead to the uncontrolled fission reaction and disaster.

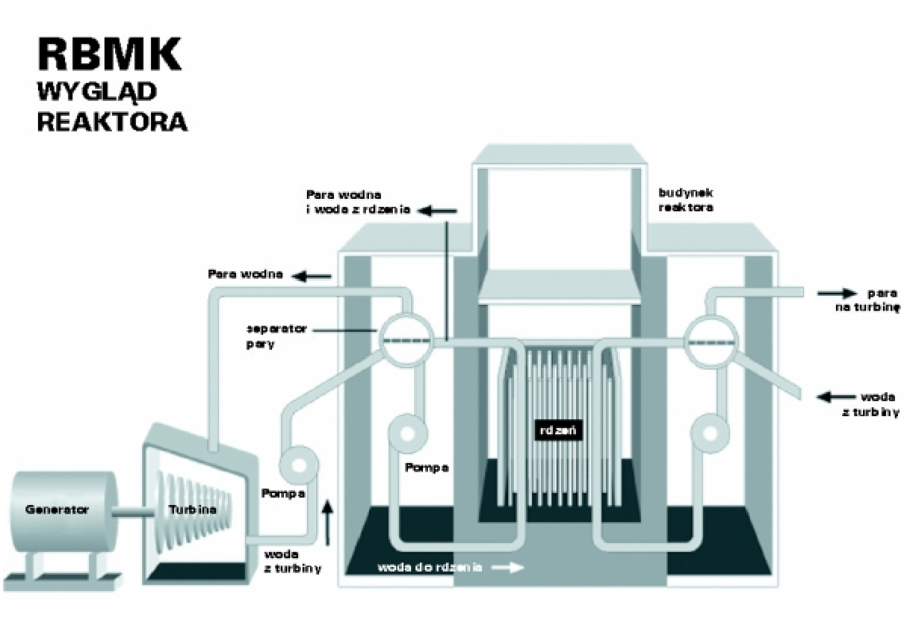


Fig. 4. Scheme of RBMK reactor. [2]

There are still 12 RBMK reactors operating in the World (mostly in Russia).
Nowadays there are advanced studies on a modified reactor called MKER (English translation of the acronym: *multi-loop pressure tube power reactor*). MKER is a development of RBMK (uses graphite as a moderator) but modern safety issues are applied. The first of the MKER reactors is now being under construction at the Kursk Nuclear Power Plant.

e) *HTR – High Teperature Reactor*

High Temperature Reactors or Very High Temperature Reactors are the IV generation reactors which use graphite as a moderator. The reactor core is designed as a prismatic block or *pebble-bed*. Prismatic block configuration means that there are special hexagonal graphite blocks which are fitted in a pressure vessel which has a circular shape. Pebble-bed means that the uranium fuel is located in the center of them which is covered by the graphite (moderator). As a coolant a neutral gas is used – usually helium which is heated up to 1000 ^{o}C. As a coolant molten salt can be also used.

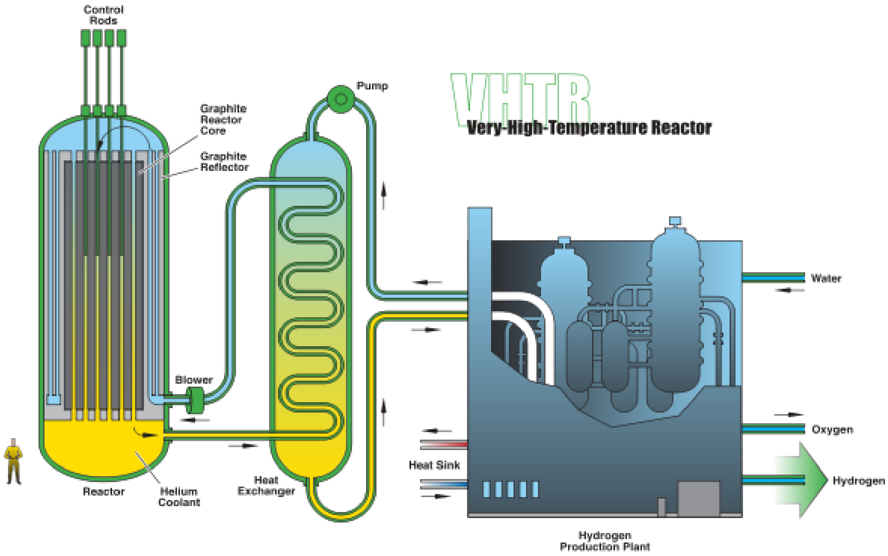


Fig. 5. Scheme of HTR reactor. [1]

There is also an important international project called ITER (*International Thermonuclear Experimental Reactor*) which is an experiment that could help make fusion power able to be used in electricity production. It will be located in Cadarache, south France. The temperature at which the fusion reaction occurs is so high that reactants are in the form of plasma. That is why the reactor is designed as a *tokamak* (it is the name of a machine which produces a toroidal magnetic field to confine fusion fuel as a plasma). ITER will use deuterium and tritium fusion which is given by the reaction:

$${}_{1}^{2}D + {}_{1}^{3}T \rightarrow {}_{2}^{4}He + {}_{0}^{1}n + 17.6 MeV$$

It will produce 500 MW of power sustained for up to 1000 seconds by the fusion using about 0.5 kg of deuterium/tritium mixture in a reactor chamber. Although ITER will generate few times more energy than amount needed for the heating up the reactants, it will not be used for generating electricity.

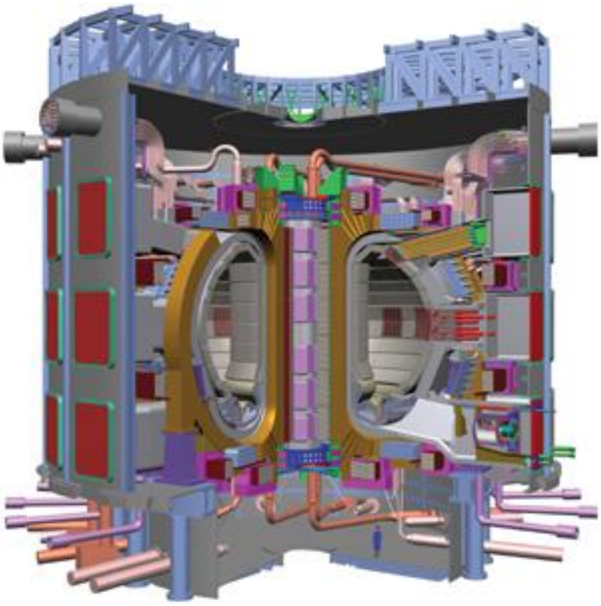


Fig. 6. Scheme of ITER vacuum vessel. [3]

3. Building first nuclear power plant in Poland

a) The government decision

The idea of return to nuclear energy appeared officially in 2005. The document *Energy policy up to 2025*, which was accepted by Poland's Council of Ministers, was based on the long-term forecast for fuel and energy demand. The forecast for national energy demand by 2025 was prepared in four different variants (the demographic macroeconomic, ecological and methodological conditions and assumptions were taken into account) . In all variants the introduction of nuclear power program is foreseen after 2020; this is justified by the need to diversify primary energy sources and the need to restrict the greenhouse gases and sulfur dioxide emissions to the atmosphere. Prognostic calculations indicate that the nuclear power program should be started in the last five years of the period under consideration. Commissioning of the first nuclear power plant before 2020 is deemed to be impossible, as the estimated duration of investment process in a country practically deprived of any experience in this area is 10 years, plus 5 years for public campaign preceding the investment, to secure the acceptance of nuclear power program.

The document adds: *At the assumed GDP volume increase and foreseen energy demand increase it has been assumed that by 2025 year Poland would be much closer to the energy-consuming standards attained in highly developed countries.*

b) A road to the first nuclear power plant in Poland

On 13th January 2009 the Council of Ministers adopted *The Council of Ministers resolution about beginning works over Nuclear Energy Program for Poland and nominating a proxy for Polish Nuclear Energy Issues*.

The main goal of the program is to start up the nuclear power plant in 2020. Ms. Hanna Trojanowska was nominated as a proxy and the main investor has been chosen – PGE (*Polska Grupa Energetyczna S.A.*). In 2010 special Nuclear Energy Development Agency will be formed for public information purposes.

In July 2009 the Ministry of Economy published frame schedule for nuclear energy in Poland. Schedule divides all actions into four stages:

1. Stage I – until 31.12.2010

Development and acceptance by Council of Ministers polish nuclear energy Program, and final decision about introducing nuclear energy in Poland.

2. Stage II - 1.01.2011 - 31.12.2013

Decision about the localization and negotiation of contract for building first nuclear power plant.

3. Stage III - 1.01.2014 - 31.12.2015

Technical project has to be done and all permissions should be obtained.

4. Stage IV - 1.01.2016 - 31.12.2020

Building the first nuclear power plant in Poland.

c) Main tasks for the government

The first planned stage is to create new legislation which will create a possibility to build modern nuclear power plants. New procedures and safety rules must be developed. This includes:

- Adjustment of the legal system for efficient introduction of nuclear energy in Poland
- Education of the staff working in the nuclear industry. Before nuclear power plant will start operating there should be personnel with appropriate knowledge to work there.
- Choosing the localization for the first nuclear power plants.
- Choosing the localization for the repository sites.
- Educating staff for institutions responsible for supervision of power plants.
- Developing research institutes for nuclear energy program basing on the existing ones
- Providing large information campaign to educate the society

d) Education

Once the decision on nuclear power program is taken, from the point of view of nuclear regulatory body, the education/training programs for nuclear industry should be organized in three separate groups:

1. Education of educators.
2. Training of nuclear inspectors.
3. Training of nuclear power staff (at the beginning – for the construction period, later – for nuclear power plant operation).

To run such education activities there is need for:

- Special nuclear engineering courses at universities.
- Nuclear research and development programs at the universities and the research laboratories.
- The assistance from international organizations (IAEA, NEA/OECD) and from countries which are advanced in nuclear energy.

e) Localization

Right now it is difficult to name even the most probable places for the first nuclear power plant or for the repositories. Many communities are trying to get the privilege to build such plant on their territory, but in the same time there are mixed feelings about such decisions in the society. Most of the Poles are agreeing to develop nuclear industry in their country, but at the same time most of them does not want the power station in their neighborhood. To change this public campaign must be conducted, to extend the knowledge of society about this type of energy.

Today, in the discussion of the power plant localization, first-choice, Żarnowiec, is usually mentioned. Żarnowiec Power Plant was supposed to be the first nuclear power plant in Poland. Due to changes in the economical and political situation in Poland after 1989, as well as public protests in the late 1980s and early '90s which escalated in the wake of the Chernobyl disaster, the construction was cancelled. Nevertheless, all important measurements were made and the grounds for power plant were prepared.

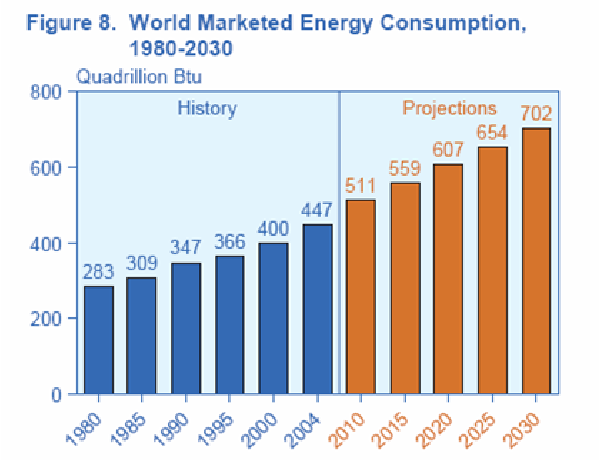
On the map below some places taken into the consideration in the '80s are shown.

Fig. 7. A Set of places with possibility to build nuclear power plant in Poland, basing on the research from '80s.

4. Arguments for nuclear energy

a) The World needs energy

The world will need greatly increased energy supply in the next 20 years, especially cleanly-generated electricity.



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2004* (May-July 2006), web site www.eia.doe.gov/iea. **Projections:** EIA, System for the Analysis of Global Energy Markets (2007).

The *2008 World Energy Outlook*, published by the International Energy Agency, predicts that world demand for energy in the coming years (see diagram).
Increasing energy demand is coming from different sources. Businesses and factories in particular, require significant amounts of energy in the form of both electricity and petroleum-based fuels in order to operate. As economies industrialize, energy demand increases.
Increased demand is most dramatic in developing countries and that is projected to increase further, as the following graph indicates. Currently about two billion people have no access to electricity, and it is a high priority to address this lack.
When economies grow, their energy needs grow. Consumers want cars, air conditioners, refrigerators, and other energy hogs that those of us in the developed world take for granted.

b) Fossil fuels?

While energy demand is rising in the same time “traditional” power plants are becoming less and less profitable. Carbon and hydrocarbon resources have many other uses that generating power on a large scale. Coal and other fossil fuels are required in much larger quantities than uranium to produce the equivalent amount of electricity. Nuclear power already has substantially reduced the use of fossil fuels. There are particular questions of ethics and opportunity cost in the use of gas to generate base-load power.
Increased awareness of the dangers and effects of global warming and climate change has led decision makers, media and the public to realize that the use of fossil fuels must be reduced and replaced by low-emission sources of energy. Heavy contributions must be paid for emitting CO_2 into atmosphere. Moreover we must realize that the amount of fossil fuels is limited. It is not only the question of the amount, that we can use to generate power, but also predatory diminishing not renewable resources that future generations can use for much greater good.

c) Renewable sources?

Technology to utilize the forces of nature for doing work to supply human needs is as old as the first sailing ship. Now attention again turned to the huge sources of energy surging around us in nature - sun, wind, and seas in particular. There was never any doubt about the magnitude of these; the challenge was always in harnessing them.

Today we are well advanced in meeting that challenge. Wind turbines have developed greatly in recent decades, solar photovoltaic technology is much more efficient, and there are improved prospects of harnessing tides and waves. Solar thermal technologies in particular (with some heat storage) have great potential in sunny climates.

But is it the answer for increasing demand for electricity? It is true, that solar panels and wind turbines efficiency improved over last years. They are all very expensive in comparison to fossil fuels and nuclear energy, but it is not the biggest issue. Real problem is the fact, that these types of energy are capricious. We can build thousand of windmills, but how it would help, if there will not be any wind? The same problem we have with solar energy. Even with ultra-modern (and ultra-expensive) power grid controlling the capacity such unstable sources cannot produce majority of the electricity.
Moreover, Poland lies in a very poor zone for using renewable energy sources: winds are weak, climate zone does not favor solar energy (especially in winter) and tides are not spectacular. In the same time we must remember, that even Denmark, which has the strongest winds, and is well-known for its windmills, has problem with meeting all energy needs. Luckily for them, Norway has many water power plants which can be instantly turned on to help neighbor in need.
For Poland most interesting renewable source is geothermal energy. In the same time we must realize that this technology is not widely developed. Geothermal energy in Poland has probably bright future, but right now country is too poor to risk and develop new technology from scratch.

d) Nuclear power: the only realistic answer

Nuclear power is green energy: it does not emit any harmful for the environment gases into the atmosphere. In the same time it needs very little space (comparing to solar or wind power plants), and generates very little wastes (comparing to fossil fuels).

It is steady, reliable source of power, cheap and with possibility to meet very big energy needs. Thanks to the fact, that we can find uranium all over the world we can be sure, that there will not be any “cut-off” from the source of the fuel. Moreover, there are even more amounts of thorium in the World, that can be also used instead of uranium for the electricity production.

It is very profitable, both economically and for the environment. All its advantages make it best choice as energy source for Poland.

The main obstacle to introduce nuclear energy is the poor knowledge of society. Most of the people tend to think that nuclear power is dangerous, and is connecting it with Chernobyl disaster. Therefore, changing this and teaching people (which do not have the knowledge about energy production) should be the main goal for us – the specialists who will probably build the first nuclear power plant in Poland, and for the Polish government.

5. Arguments against nuclear energy

In the beginning we should plainly say: we are not against nuclear power. It is not easy for us to write arguments of nuclear power critics, but we tried to step into their shoes. Therefore we focused on a Greenpeace report (see Ref. [4]) and in some cases expanded their arguments with the facts found by us on the Web. We focused only on issues of environmental pollution and people poisoning connected somehow with the physics of the nuclear energy production, nuclear fuel cycle, waste storage and transportation. We did not focus on other (i.e. economics) problems.
In the picture below a chain of generating electricity from the uranium is shown. There are shown also possible ways of pollution.

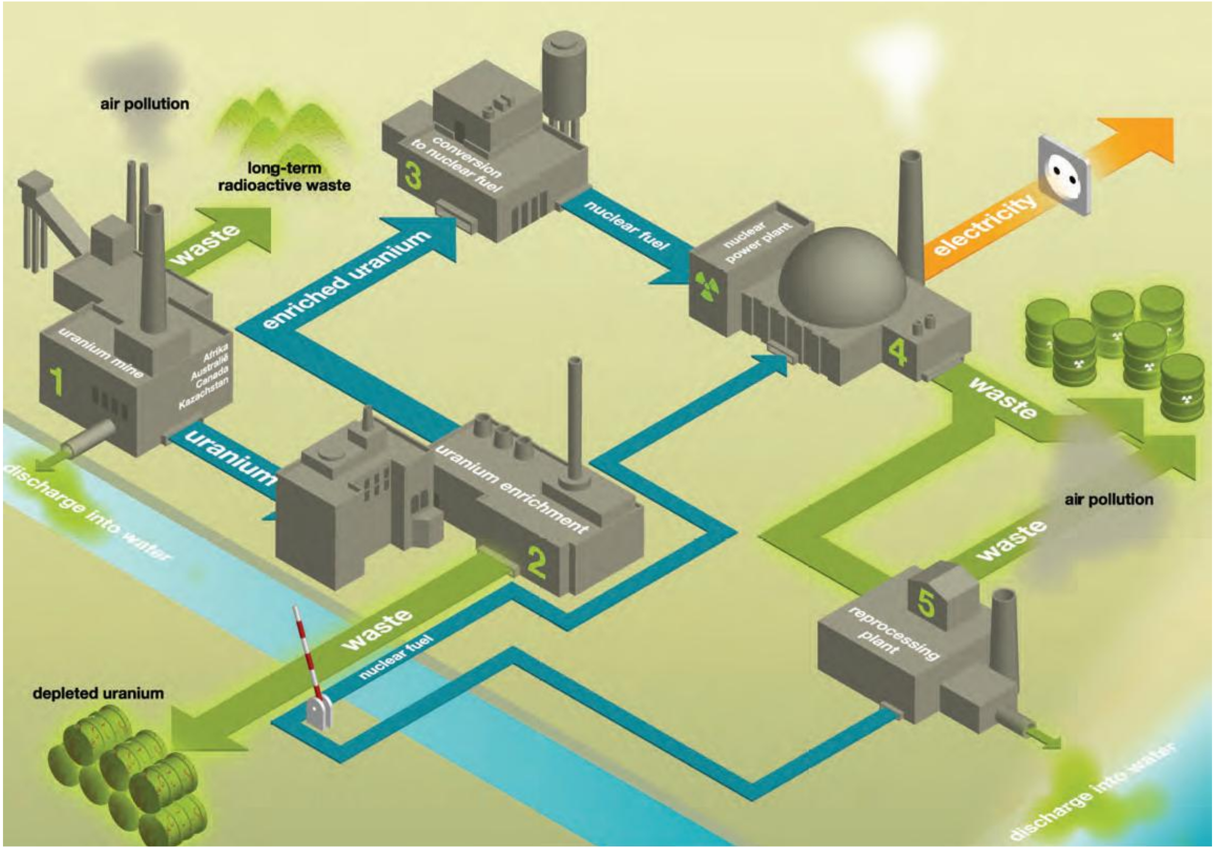


Fig. 9. Possible ways of environmental contamination. [4]

Typical uranium ore contains about 0.1% of uranium. Therefore there are a majority of dangerous materials (radioactive and toxic) that are extracted during the uranium ore mining. One of the most important is emission of radon gas (Ra-222) which is being created in a radioactive decay what can be dangerous for the miners (if underground mining is performed). In 2008 in a French state-owned company Areva's uranium mine in Niger analyses showed a contamination of water, air and soil and workers were not informed about the health risks by the company. Also in Poland in the mid 50's uranium mines existed. One of the examples is a secret Soviet mine near village of Kletno, Lower Silesia. The workers were usually prisoners, soldiers, and very few well-paid *real* miners. Working conditions were hard and many of people were poisoned by the radiation causing radiation sickness. In the village of Miedzanka, also Lower Silesia, wasteful exploration of the uranium mine forced displacement of the people who had been living there before because of the poisoning the environment. Another problem connected with the mines is cleaning them up after the closing down. In the USA hundreds of the uranium mines have not been cleaned up and some environmental and health risks in some communities exist.

After uranium has been extracted from the earth usually it should be enriched to be used by the reactors. Most of the reactors need uranium U-235 which represents only 0.7% of natural uranium. The enrichment process produces a significant volume of waste: especially depleted uranium (DE). It is primarily composed of the uranium U-238. The radiation dose of DU is about 60% of the same mass of natural uranium ore. It is also found in a reprocessed spent nuclear reactor fuel (but here also U-236 is present). Nowadays more than 1.2 million tones are stored without any foreseen future use. The USA and the Great Britain used it in ammunition and as armor for tanks. Many soldiers suffer now health problems due to long exposure to the radiation but despite that fact DU continuous to be used in arms.

After uranium has been enriched it is put into the fuel rods and transported to the nuclear power plant where it is used for the electricity generation. As a result also amounts of waste are produced which can be categorized as a Low Level Waste (LLW), Intermediate Level Waste (ILW) and High Level Waste (HLW) which remains radioactive from the period of minutes to thousands of years. Waste (especially HLW) should be stored during this time and safety of them should be guaranteed (which potentially spans many Ice Ages for example). In the Fig. 8. below there is a comparison between plutonium storage period to become safe and ages of mankind culture development.

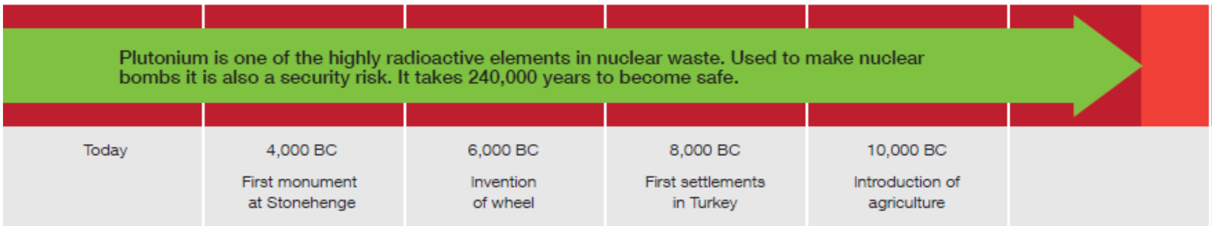


Fig. 10. Comparison of plutonium storage time period and development of mankind culture. [4]

Some of the spent nuclear fuel is reprocessed (plutonium and unused uranium are separated out from the waste to reuse in nuclear power plants). Only few countries in the World conduct reprocessing on a commercial scale (i.e. France, the United Kingdom and Russia). Therefore, dangerous nuclear waste and separated uranium and plutonium are transported across borders, through cities, towns and villages. Studies show increase of leukaemia among under 25-year olds living within 10 km of La Hague reprocessing plant (northwest France) (*Journal of Epidemiol Community Health* 2001;55:469-474 (July)). Also studies made in the UK show twice as much plutonium in the teeth of people living close to the Sheffield reprocessing plant than in the teeth of living further away (*Sci Tot Environ*, 201, 235–43). On the other hand, in the USSR the government built such facilities in so-called *closed cities* (i.e. the city of Ozyorsk, Chelyabinsk Oblast). In September 1957 the cooling system in one of the banks containing about 80 tons of radioactive waste failed and caused an explosion. The explosion released 740 PBq of radioactivity into the environment. In the next 10 hours radioactive cloud reached 350 km northwest from the accident. The fallout of the cloud caused a long-term contamination of an area more than 800 km^2. 10 000 people were evacuated from the affected area and 470 000 people were exposed to the radiation. At least 200 people died of radiation sickness. Accident is categorized as level of 6 (Chernobyl - 7) on the 0-7 International Nuclear Events Scale.

Next problem is storing of nuclear waste in deep underground repositories. It is not easy to find a suitable location for such installation which safety would be guaranteed for ages. In example we can focus on the Yucca Mountain waste site in Nevada, USA, which construction began in 1982 but for now it has not been completed and start date is postponed beyond 2020. The US government found that there is a possibility for the future movements of underground water to transport contamination into the environment. Similar problems were encountered while building Olkiluoto-3 nuclear power plant in Finland.

Natural disasters are also very important issues. In 2003 after the torrential rainfall along the lower Rhone River threatened to flood two nuclear reactors at the Cruas-Meysse nuclear power plant in France. In 2007 an earthquake in Japan caused a fire at the Kashiwazaki-Kariwa nuclear power plant. The reactors were shut down releasing cobalt Co-60 and chromium Cr-51 into the atmosphere and leading to 1200 liters of contaminated water into the see. A year later reactors were still not operable.

Nuclear facilities and especially radioactive waste transportation which crosses regularly borders are potential targets for terrorists. A study written by John Large for the Greenpeace (an expert from Large and Associates Consulting Engineers) which shows scenarios involving terrorist attack or the crash of a plutonium shipment from La Hague reprocessing plant to the Marcoule nuclear power plant. The report estimates that 11 000 people would die from the effects of radiation exposure. Similar study was done in the USA by Dr. Edwin Lyman (Union of Concerned Scientists) which shows

that potential terrorist attack on the Indian Point nuclear power plant could lead to 518 000 long-term deaths from cancer and 44 000 near-term deaths from radiation poisoning.
There are other studies in the Greenpeace report showing for example the economic reasons against nuclear energy, but since we are physicists, not economists, they are not discussed by us in this paper.

6. Conclusions

The development of the World, and the development of Poland on a local scale, causes the increase of the energy demands for the global consumption. The energy from the fossil fuels will be more and more expensive, not only by the limited amounts of resources, such as coal, oil, natural gas, etc., but many other reasons. It actually does not matter if they will last for the next 50, 150 or 250 years. They should be used not for the energy production but for other, scientific for instance, purposes. Coal is not accidentally named *the black gold* – it is our treasure which has been given us by the God or Mother Nature and should be used with caution. Therefore, we (the whole World) should switch from the energy production based on fossil fuels to other sources.
Recently we have heard about the leak to the Internet of the e-mails which were sent between some scientists in the United Kingdom (scientists from Climatic Research Unit and the University of East Anglia, Norwich) concerning climate change issues. Some of them say that climate change is natural, not caused by us, and happens periodically, and term *global warming* is only a manipulation. This leak has been named *the Climategate scandal* and will have probably significant influence on a UN climate change conference which is now being held in Copenhagen, Denmark. But, in our opinion, it also does not matter whether the global warming is true or not. The Earth is our home and if we can pollute it less, by reducing the emission of greenhouse gases and other harmful substances, we should.
Today it is not possible to produce all the energy from the wind, sun, water and other natural sources. Therefore, our goal should be a sustainable energy production, based as much as we can on renewable sources mentioned before, and, on the other hand, on others that produce the lowest amounts of CO_2 and other pollutions as possible – like nuclear energy. It is the most environmentally friendly way of producing electricity on a large scale.
Some people (so-called *ecologists*) used to say, that nuclear energy is dangerous. In this paper we tried to explain the Reader that they are actually wrong. The technology nowadays is completely different than in 1986 when the infamous Chernobyl accident occurred. Due to the law restrictions we can say that it is the most controlled and, therefore, the safest source of energy. Moreover, one can compare the number of accidents that happen in nuclear industry to the accidents that happen in coal mines for instance. Every year we hear about miners which have been killed underground.
On the other hand the nuclear energy is not ideal and should be still developed. Some of the arguments of the critics make sense. Uranium mining, use of depleted uranium, transportation and repository safety and possible of terrorist attack are important problems. Also some politically unstable countries like Iran, North Korea and others may try to use the nuclear technology not only for the energy production but for the military purposes.
The government, the scientists, media and we, the students connected somehow with the nuclear science, should also inform the society about the nuclear energy. We should give them the possibility to learn in easy way how the electricity is produced and why we need nuclear power.

In Poland we are obliged now by the European Union to reduce CO_2 emission. But today more than 90% of electricity is produced from coal. We do not have strong winds (like Denmark), it is very capricious in Poland, do not have large tides on the Baltic See (like in Portugal) and we are not very sunny country. Therefore, for the energy production on a large scale which will be both cheap and environmentally friendly in Poland the only solution is the nuclear energy and we should hopefully wait when the first nuclear power plant in Poland will start to operate.

But of course we should try to diversify the sources of energy and in the locations, where it is possible, build facilities for the electricity production from the natural, renewable sources. But surely we should not spend our national treasure, *black gold*, for the energy production.

In the end we want to say and emphasize, that **everybody (each of us) can and SHOULD take care of our Planet by trying to save energy!** Some simple efforts, for example **like switching off the TV and turning off the lights** while we are in the other room, **stopping leakages from the taps**, **using bicycles or public transportation** in the cities where it is possible instead of private cars, which can be made by a single person, can really give significant results on a large scale!

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